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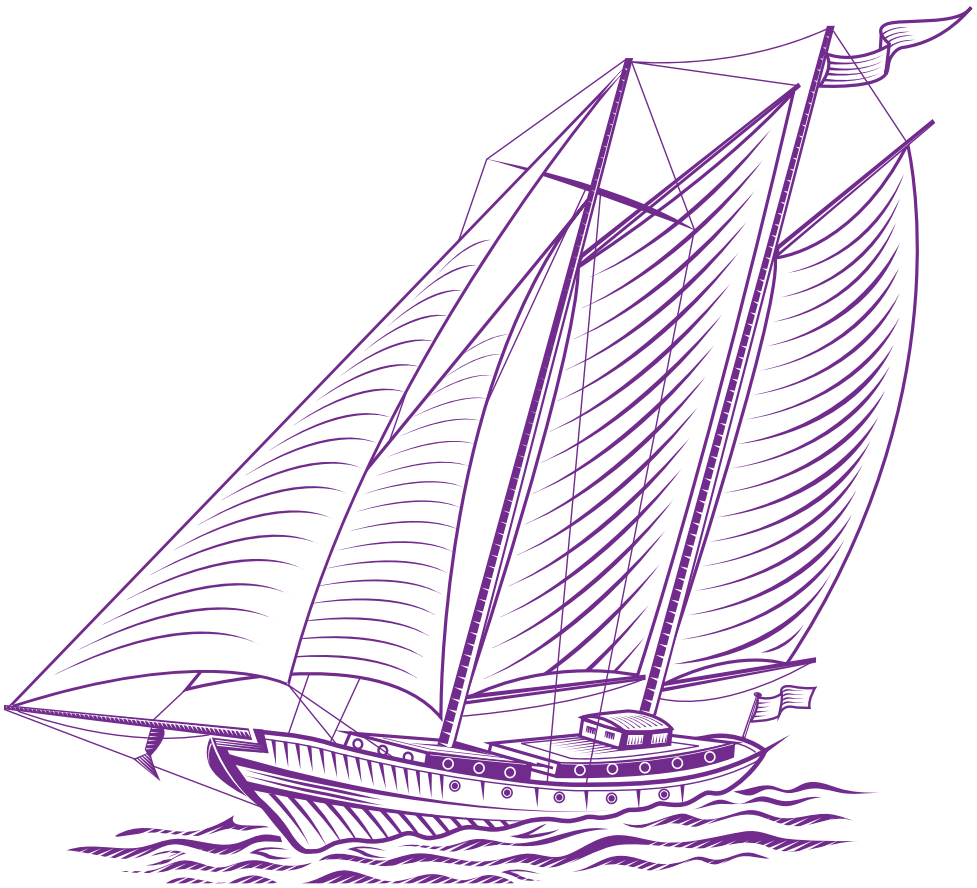

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BIG DATA ANALYTICS AND ITS INFLUENCE ON MANAGEMENT ACCOUNTING: EVIDENCE FROM SOUTHERN AFRICA

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ABSTRACT. This paper explores the influence of big data and big data analytics on management accounting practices and decision making in southern Africa. We collected qualitative data from 24 management accountants in three countries using an online questionnaire with open-ended questions. The results indicate that big data analytics have changed management accounting practices, leading to better decision making. There has been a shift away from manual processing of information to automation, ensuring heightened accuracy and timely decision making. It was found that big data supported organisational strategy through improved customer service, targeted marketing and cost management. The need for management accountants to gain expertise in data analytics was identified. The results offer unique insight from a southern African perspective of the change in management accounting practices and how big data influences decision making. The findings contribute by reporting how big data can impact corporate strategy and its use in decision making.

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Introduction

Operational change in the business environment is a significant determinant of evolving management accounting practices (Talha *et al*., 2010; Tiron-Tudor & Deliu, 2021; Zainuddin & Sulaimana, 2016). However, this is not new; Kaplan (1984) called for a re-examination of management accounting practices four decades ago. Kaplan's call was prompted by technological developments and a shift in competitive forces at the time (Johnson & Kaplan, 1987; Kaplan, 1984). The current 4th Industrial Revolution (perhaps even the 5th Industrial Revolution) accelerated technological change, as illustrated by the increased use of digital technologies such as sophisticated robotics, blockchain, and artificial intelligence (Oesterreich *et al*., 2019; Rachinger *et al*., 2019), as well as the associated big data phenomenon (Raguseo, 2018). Such digitalisation has profoundly affected the contemporary functioning of business enterprises (Bhimani, 2020), which in turn requires management accounting practice to adapt to current circumstances (Bhimani, 2015; Oesterreich *et al*., 2019; Talha *et al*., 2010; Zainuddin & Sulaimana, 2016).

The application of management accounting techniques revolves around the sourcing, analysis and communication of decision-relevant, financial and business information (CIMA, 2018). It is therefore fair to assume that management accountants should have some foundational business acumen and appropriate specialist skills. However, since big data comprises complicated and extensive data sets which require particular abilities to deal with (Janvrin & Watson, 2017; Power, 2014; Phillips-Wren & Hoskisson, 2015; Raguseo, 2018), it may be that management accountants today could lack the necessary specialist skills (Rikhardsson & Yigitbasioglu, 2018; WEF, 2023).

Research on the impact of big data on the role of the management accountant includes conceptual papers (e.g. Appelbaum *et al*., 2017; Bhimani & Willcocks, 2014), literature reviews (e.g. Nielsen, 2018; Rikhardsson & Yigitbasioglu, 2018), and empirical studies that consider management accounting automation (e.g. Korhonen *et al*., 2021), business analytics competencies in context (e.g.

Oesterreich & Teuteberg, 2019), the impact of data analytics on the tasks of management accountants (e.g. Spraakman *et al*., 2021). Abdelhalim (2024) investigated the integration of management accounting practices with big data analytics by focusing on the impact on corporate sustainability performance management in a Saudi Arabian manufacturing company.

As the need to change management accounting practices in the era of big data is recognised, there are current calls for empirical research on the impact of big data on management accounting to understand better the effect of digitalisation on the finance function (Gartner & Hiebl, 2018; Möller *et al*., 2020). Furthermore, Saleh *et al*. (2023) emphasised that more research is needed on the implications of big data analytics for the accounting profession. These calls build on the assertion of Kaplan (1984) that management accounting practice must adapt to its current environment. As big data can be regionally specific and its role in southern African management accounting practices is not well known, this study investigates its influence in selective aspects of business support in the subcontinent.

This paper therefore reports a preliminary insight from industry practitioners into how such practices have changed and affected decision-making in business, corporate strategy and the role of the management accountant in three southern African countries – South Africa, Zimbabwe and Uganda. In a South African context, demand for management accountants has been acknowledged by its addition to the local critical skills list (South African Government, 2020). Furthermore, many southern African countries report an imbalance in access to technology known as the "*digital divide*" – a disparity between available skills and those required in the industry (Durodolu & Mojapelo, 2020; Janse van Rensburg *et al*., 2019; Maisiri *et al*., 2019; Ongbali *et al*., 2019). Against this backdrop, the question arises whether big data-related developments have resulted in any noteworthy changes in management accounting practices in the subcontinent.

Literature Review

Big data versus big data analytics

Big data results from the contemporary business and social environments' digitisation (Gartner & Hiebl, 2018; Inoubli *et al*., 2018) and the interlinking of machinery, computers, mobile phones, and social media (Raguseo, 2018). According to Appelbaum *et al*. (2017), Grover *et al*. (2018) and Inoubli *et al*. (2018), the main pertinent dimensions of big data are data-related concepts such as high *volume*, high *velocity*, and wide *variety* set in a complex *veracity* structure (also known as the "4Vs"). According to Grover *et al*. (2018), big data can help defend against the competition by allowing entry barriers and market enhancement.

Some authors use the concepts of *big data* and *big data analytics* interchangeably (Moll & Yigitbasioglu, 2019; Nielsen, 2018), yet there are conceptual differences (Oesterreich & Teuteberg, 2019; Raguseo, 2018). The concept of big data in itself refers to the large volumes of unstructured data that are difficult to process with conventional technology (Power, 2014). Big data analytics, in turn, refers to the use of software in the processing and analysis of the vast volumes of data in a big data environment (Raguseo, 2018). Data analytics encompasses a variety of techniques such as data search and mining, textual and statistical analysis, and visualisation (Duan & Xiong, 2015; Tiron-Tudor & Deliu, 2021). Data analytics, therefore, seeks to answer questions such as, what may happen if this trend continues, or what is the best option (Nielsen, 2018)? According to Joshi & Marthandan (2020), the workplace is transformed by data analytics. As such, big data analytics is part of the new digital technologies that impact the core management accounting practices.

Evolution of management accounting practices

External and internal institutional pressures have long influenced management accounting practice (Alsharari *et al*., 2015; Appelbaum *et al*., 2017, Ter Bogt & Scapens, 2019). Kaplan (1984) and Kristandl *et al*. (2014) explain that the three significant historical drivers of change in management accounting have been: 1) improved production methods, 2) new technology, and 3) increased globalisation.

As mentioned earlier, the practice of management accountancy is to collect, analyse, and communicate information for supporting internal decision-making (CIMA, 2018; Van der Stede, 2017). Big data can be seen as a powerful technological development, the emergence of which has disrupted the modern finance function (Tiron-Tudor & Deliu, 2021). For example, Quattrone (2016) highlights that the *discussion process* of conventional decision-making has evolved with the current digital revolution. However, this decision discussion process is often eliminated when management reports are merely tabled as pre-packaged data sets from which *managerial judgment calls* are to be made. Charles & Gherman (2013) support this line of thinking when expressing their concern of not knowing whether the source of the pertinent information is reliable and accurate. They also identified a need to consider the broader context of the information presented.

A case study investigation by Abdelhalim (2024) at a Saudi Arabian manufacturer revealed that the investment in big data analytics facilitated and improved organisational management accounting practices, consequently enabling sustainable development. Appelbaum *et al*. (2017) and Rikhardsson & Yigitbasioglu (2018) emphasises the evolving role of management accounting in the context of

emerging technologies, while Schmidt *et al*. (2020) also consider factors causing resistance in adopting emerging data analytics technology. Using an interventionist case study, Korhonen *et al*. (2021) explored the automation of management accounting, resulting in their cautioning against premature automation of management accounting tasks without the practitioners understanding its ramifications. Other commentators have reported that big data analytics could enhance marketing-related decision making (Gartner & Hiebl, 2018; Raguseo, 2018) and generate enhanced customer insights at lower costs than the traditional market survey and analysis approaches (Kitchens *et al*., 2018). The cost of investing in such technologies versus their effective application has been highlighted by Charles & Gherman (2013), Clayton & Clopton (2019), and Wamba *et al*. (2017).

In light of the above, it may be argued that organisations able to harness big data's potential have a distinct advantage over those that do not. Abdelhalim (2024) argues that management accounting practices and big data assist businesses in quickly adapting to internal and external changes. However, Rikhardsson & Yigitbasioglu (2018) observed that although management accountants may have (perceived) business acumen, they could also be lagging in the expertise needed to exploit the latest data handling practices. Oesterreich & Teuteberg (2019) illustrated this when they found a skills gap in the competence profiles of management accountants in Germany.

Materials and Method

To answer the research question, we collected qualitative data from professional management accountants in South Africa, Zimbabwe and one in Uganda. Such an approach allows for an in-depth examination of how the (management) accounting function operates and develops (De Villiers *et al*., 2019). As an exploratory study, our approach may also be considered *a valid means of asking open-ended questions to build knowledge about the topic* (Saunders *et al*., 2016).

Even though our initial targeted population was industry-based management accountants, we acknowledge that not all individuals fulfilling a management accounting role are registered with a professional accounting body. Nevertheless, in context, we thought it prudent to start our data collection by targeting *professional registered* management accountants. In the subcontinent, the primary professional accounting bodies represented include the Association of Chartered Certified Accountants (ACCA), the South African Institute of Chartered Accountants (SAICA), and the Chartered Institute of Management Accountants (CIMA) (Short, 2021), with the CIMA primarily focused on management accounting. Hence, we purposively selected five CIMA-registered management accountants

as our starting point. This number was increased using chain-referral (or snowball) sampling in line with the research practices of Etikan *et al*. (2016) and Heckathorn (2011).

A questionnaire with open-ended questions (Appendix 1) was used, which allowed the participants to respond as they saw fit and not be constrained by predetermined alternatives (Ghauri & Grønhaug, 2005). Since the focus of the study is on the changes in management accounting practices, no participant-specific demographic information was collected. The questionnaire comprised five sections, with the first section focusing on general big data topics and the remainder on four key themes identified in the literature, namely:

1) Management accounting change due to technological development;
2) the impact of big data on corporate strategies;
3) the impact of big data on the management accountant; and
4) the skills required by management accountants.

The questionnaire was compiled and then distributed online using the QuestionPro survey tool. This approach was used by Molinari and De Villiers (2021), due to the restrictions imposed on face-to-face human interaction and work-from-home protocols due to COVID-19. A link was sent via e-mail to the first five participants, who forwarded it further. Initially, only 16 responses were received between June and November 2020; in an attempt to increase the responses, the link was reopened between May and June 2021. Figure 1 illustrates the process of reaching the final sample.

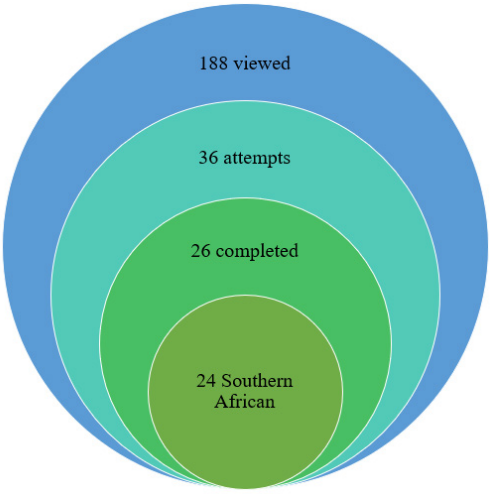

Figure 1. Sample selection
(Source: Authors' compilation)

A total of 188 targets viewed the survey. There were 36 attempts to complete the questionnaire, with ten dropping out before completion, resulting in 26 completed surveys. Sixteen participants were in South Africa, seven in Zimbabwe, one in Uganda, and two in Europe. Since the focus is on southern Africa, we excluded the European responses. Therefore, 24 responses were analysed which is comparable with the Betti & Sarens (2020) study. The completed questionnaires provided much detail, allowing an in-depth analysis of the responses. The average time taken to complete the questionnaire was 32 minutes.

The raw data from QuestionPro was downloaded into Microsoft Excel, filtered, and incomplete responses removed. Initially, structural coding was used to identify and label common words and phrases and categorise the data, with each question analysed manually (Saldana, 2015). The data was also uploaded to Atlas.ti 8.0, coded, and analysed by an external consultant, categorising it into the appropriate themes. The manually coded data and the Atlas.ti reports provided comparable results.

Results and Discussions

The results are categorised and presented via the following four themes.

Understanding the big data phenomenon

A total of 18 participants (75%) contextualised the concept in terms of large volumes of data. Although the remaining six (25%) did not specifically refer to the volume of data, they agreed that it related to a wide variety of unstructured data collected by businesses, as outlined by Participant 3, as the:

> *"… collection and storage of seemingly mediocre bits of information of just about everything to be mined, analysed, and used to profile people, machines, processes, and businesses."*

Most participants stressed that the data make sense only after further analysis or processing (i.e., generating information) using various software applications, as explained by Participant 11, that it is:

> *"…not possible for a human to look at the data and make sense of it or be able to identify patterns in it. It needs to be processed by super-computers."*

In line with a general understanding of big data, all participants described the phenomenon as large, massive, or exponential growth in business data and information. The majority of participants highlighted that, if appropriately

analysed, big data should aid in decision-making. Specific benefits of big data analytics noted by participants include "… *improved decision making*", "… *can be used very strategically*", "… *determine behaviour and patterns for decision making*", and "… *make strategic decisions*". Participant 4 specifically highlighted big data's role in gaining a competitive advantage:

> *"Companies have started using all of this data to ensure they gain a competitive advantage."*

Overall, the participants' general understanding of the big data phenomenon relates to large volumes of data that can aid organisational decision-making, identify patterns, and provide a competitive advantage.

Management accounting changes due to technological development

First, the participants were asked to reflect on the change in management accounting practice. The majority of participants (22; 92%) acknowledged that management accounting practice has changed. The responses demonstrate examples of changes. Eight participants (33%) mentioned improved ability to analyse data, resulting in enhanced trends and pattern analysis, cost behaviour information, and profiling. Five participants (21%) emphasised that being big data-enabled can assist with understanding of costs and better decision-making, as stated by Participant 9:

> *"… using applications such as Power BI, big data is being investigated to help make better decisions and assumptions of cost and revenue trends."*

Three participants (13%) reported time savings due to quicker data interrogation, whereas four (17%) mentioned benefits of moving away from manual entry to automated data capture. Participant 1 noted:

> *"… less manual work to do which means less human error. The use of big data saves a lot of time for management accountants and allows them to be more efficient."*

Other changes mentioned include the capability of improved planning and forecasting. Participant 3, in particular, described the ability to enhance marketing efforts as follows:

> *"You have different levels of big data. Accounting and management accounting used to look at simple metrics in the books to provide analysis. Now systems provide detailed information about the*

behaviour of individual customers, which assists with profiling customers which in turn assists with marketing efforts to retain business and bring loyalty amongst customers."

Furthermore, 14 participants (58%) supported the view that the big data phenomenon creates organisational challenges:

"The company needs systems to process all the big data. Our current system is slow and can't handle the amount of data involved." [Participant 1]

"Having the correct systems in place to facilitate and cope with data…" [Participant 22]

However, Participant 5 mentioned that although top management bought into the idea of big data, there is "*a lot of push back from the finance team and lack of confidence that it will work*."

Another potential obstacle is a lack of accurate, quality data, as raised by Participant 9: "The data that is being gathered is not always of a high quality, which may lead to misleading conclusions."

The next two questions sought the participants" opinion on whether management accounting techniques are becoming irrelevant in their setting and if they noticed new techniques developed. Overall, six participants (25%) believed very few (if any) management accounting techniques were becoming irrelevant, three (13%) noted that standard costing is either evolving or becoming irrelevant. Seven participants (29%) reported that the role of management accountants has changed. Participant 9 opined:

"I don't think that management accounting techniques are becoming irrelevant. I do think that some of the techniques are being automated and done by programs such as Power BI, making the accountant free to only focus on analysing the results retrieved from the techniques performed."

Further, 14 participants (58%) noticed that the role of data in decision-making has changed, leading to changes in skills required. Participant 22 reasoned:

"Not necessarily new techniques but more a shift in the skill set required and the focus of your attention. Instead of spending most of your time doing data preparation, manipulation and formatting, more time is spent on what the data actually means and how it affects your organisation."

All the participants believed that management accountants needed skills development in the various areas of data analysis. For instance, three respondents (13%) mentioned the ability to perform data queries using Structured Query Language (SQL) skills, while others mentioned software programming, advanced Excel skills, and communication skills. Participant 3 claimed that, depending on the level of experience of the management accountant, there is a need for either:

> *"… technical skills to produce information, or … interpretation skills as a manager to give the technical specialist direction in terms of what needs to be mined and how it should be analysed. The skill I therefore need is the latter, including getting a full understanding of what is available and what can be done with the data."*

Therefore, some dynamism in management accounting practices can be observed, but any developments are gradual and largely linked to how technological tools are used in data analysis, not in management accounting as a discipline.

The impact of big data on corporate strategies

Next, we outline whether the participants perceived that big data impacted organisational strategies. Even though four participants (17%) indicated that their organisations" big data capabilities and infrastructure are now not sufficiently developed, twenty participants (83%) confirmed that big data is currently used to support organisational strategies. Examples include three participants (13%) reporting that big data analysis enabled more effective cost management, a further three reporting improved customer service and marketing, and two emphasising better-informed decision-making. The positive impact of big data was noted by Participant 13:

> *"We have developed several models that help us in cost reduction, improving sales, debt collection. We developed the shortest path model for our logistics team to reduce costs of delivery per trip. We have also developed a consumption prediction model for our commercial consumers, enabling us to plan our stock holding positions and when to sell to the customers."*

Participant 23 highlighted how the use of big data supports risk strategies:

> *"The way the company is using big data to aid corporate strategy is using the data available to better forecast and model the changing environment and to be able to understand the high/medium and low risk strategies and what are the things that will drive the different outcomes."*

In terms of how big data contributes to a competitive advantage in business, nine participants (38%) mentioned a focus on customers, including "*… buying patterns from clients*", "*… market analysis and responding to potential customer needs*", "*… forecasting demand and development of new products*", and "*… understand customer trends*". Participant 3 noted that:

> *"Using big data, the group can determine what products are doing better than others and more focus is placed on those. Areas, complimentary spend patterns, and its reaction to it from customers are all used to provide a competitive edge, which leads to that ultimate vision of creating lasting memories for customers."*

It was noted that the results of big data analytics might serve as an early warning signal to enable the timeliness of generated information in timely action. Information becomes more readily available through trend analysis, and big data models produce projections in sales, expenses, and inventory levels, including:

> *"… decreases turnaround time and helping the company to serve [the] client quicker." [Participant 10].*
>
> *"… market benchmarking and market penetration analysis." [Participant 6].*

From the above responses we can observe that big data and big data analysis in the developing economy context of southern Africa contribute to organisational strategies on various levels, including more effective (internal) management as well as enhanced (external) market and customer analysis.

The impact of big data on the management accountant

Aiming to explore how big data impacts management accountants, participants were asked whether they have an influence in implementing technologies enabled by big data. Notably, nineteen (79%) confirmed such influence, with one participant specifically mentioning the successful recommendation to implement Microsoft Power BI, a business analytics tool. Other interviewees shared their influential role in providing information for decision-making. For example, Participant 22 mentioned:

> *"As management accountants we are in the best position to drive technologies, not only in finance but also in strategic and operational areas. We also have a very good understanding about what is required and if the company can afford it (cost / benefit)."*

Participant 18 emphasised the overarching view that management accountants" strategic role is valued within organisations:

> *"As a management accountant, I have a holistic view of the entire organisation and my recommendations and advice are considered highly and respectfully. Therefore, by putting a strong argument showing how the benefits of big data outweigh the cost, I think I am in a position to influence that. The only constraint may be the financial resources."*

Regarding the practical application of big data-enabled software, 14 participants (58%) confirmed the use of software applications, such as Microsoft Power BI, Azure, Abaca, Python, and SAP BI. Some of the drawbacks reported included expensive software that sometimes did not meet organisational requirements. Three participants indicated a shortage of specialised IT skills by the management accountants to adequately use the software applications.

Even though robust reporting capabilities were noted, suggestions for enhancing these software applications include better user-friendliness, flexibility, and adaptability, as recommended by Participant 9:

> *"… handle large sets of data, be highly adaptable to different types of data, give the user the ability to make calculations with the data, should use machine learning to self-adapt and learn to better manage the data."*

Based on the feedback, big data-enabled management accountancy technology should be cloud-based, with a dashboard format, and capable of collecting both internally and externally sourced data. Participant 3 formulated this requirement as follows:

> *"Data collection sources should be semi-automated and possibly strengthened by A[rtificial] I[ntelligence] technologies. Reporting tools should be flexible and be able to easily export information to analysis software to be used by lower-level resources such as Excel etc. for additional reporting purposes. Cross compatibility is a must."*

Therefore, big data impacts southern African management accounting practice, especially in its technological aspect.

Our research indicated that the study population's understanding of the big data concept as large volumes of data (and its analysis) aligns with the definitions of Gartner & Hiebl (2018) and Power (2014). Kristandl (2014) believes that, given the historical adaptation of the profession to changes in the business environment, management accounting will continue to evolve in a big data environment. Additionally, our participants emphasised that big data analytics helps their respective organisations to gain a competitive advantage.

We found, firstly, that big data developments in management accounting practice should lead to better decision-making due to:

- an enhanced ability to analyse the data and identify trends and cost behaviour characteristics, leading to improved managerial planning and forecasting,
- quicker availability of analysed data enabling a faster response to identified trends and customer behaviour, and
- employees spending more time on interpreting analysed data than on performing calculations, resulting in accurate reporting.

Even though these findings support those of Raguseo (2018), who documented 1) *transactional* benefits of big data analysis as employee productivity growth and reducing operating costs, 2) *informational* benefits such as improved data accuracy and management data, and 3) *strategic* benefits in the provision of better services and products, and enabling a quicker response to change, our participants also underlined the resistance by the finance function for using big data.

Second, our results revealed that traditional management accounting techniques were not considered irrelevant or outdated due to big data, but instead, have evolved or become automated. Some of the tasks that will become automated were listed by Rikhardsson & Yigitbasioglu (2018) as inventory valuation, depreciation calculations, and asset valuation. However, Saleh *et al*. (2023) found that although some of the operational tasks performed by accountants will become automated, the need for accountants will not be entirely replaced by big data analytical tools.

Third, besides extant literature positing that big data motivates firms to reconsider their business models and strategy (Bhimani, 2015; Oesterreich *et al*., 2019; Rachinger *et al*., 2019), we found that it positively supports corporate strategy internally and externally.

Fourth, our research shows that the participants reported reservations when the big data-related challenges were linked to technological systems:

- Inadequacy of the software applications: The participants reported that some data analytics software does not meet all organisational needs, which builds on the findings of Patrizio (2018) that there is no universal packaged software to serve all potential customers.
- Lack of the requisite skills: We found a need for management accountants in the southern African region to develop new data analytical skills, which complements the management accountants' skills gap identified by Oesterreich & Teuteberg (2019), and Möller *et al*. (2020).

Our study demonstrates the practitioners' view on the importance of developing these skills. Additionally, the participants highlighted the influential role that management accountants play in implementing big data technologies. With their holistic business view, management accountants may provide positive contributions to the organisation's strategic directions, including selecting and applying the appropriate big data technologies.

Conclusions

This paper explored the influence of big data and big data analytics on management accounting practices and decision making in southern Africa. We reported unique insights about the change brought by the big data phenomenon as offered by 24 management accountants in practice in South Africa, Zimbabwe, and Uganda. Our study responds to calls for empirical research on the impact of big data on management accounting (Gartner & Hiebl, 2018; Möller *et al*., 2020).

Our findings contribute to the literature by revealing that management accounting practitioners appear optimistic about the influence of big data and big data analytics and that it leads to better decision-making in southern Africa. Their perceptions are that it enhances competitive advantage through quicker response times to customer needs as trends and patterns of customer behaviour are identified faster. They reported that traditional management accounting techniques have evolved but are not irrelevant. The participants feel that more time can be spent interpreting information than manually analysing data. The negative effects are relative resistance by the finance team or management to incorporating big data due to a perceived lack of 1) confidence and 2) quality data. Our results show that using big data and big data analytics assists organisations in achieving corporate strategies through a better understanding of internal and external trends. The participants felt that they influenced the choice and implementation of big data technologies, and their opinions and contributions were valued.

The potential limitations of the paper include a relatively small sample size that can be considered as minor, the scale of big data and big data analytics use in the participants' companies is lacking, and the benefits of using big data technologies in their respective companies are not quantified. The areas for future research include expanding this study to other African countries and extending this study to address the identified limitations.

The practical implications of our findings are that management accountants are encouraged to become skilled in using big data technologies. It provides quicker, more accurate, and informed decision-making, enabling organisations to reach strategic goals and gain competitive advantage.

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Appendix 1

This Appendix is based on the dissertation of Masuke (2021).

General questions relating to the topic

- What is your understanding of the big data phenomenon?
- What is your definition of big data?

Management accounting change due to technology/ change in business environment

- Based on your opinion, has management accounting practice changed in your organisation due to the big data phenomenon?
- If yes, please explain how it has changed.
- Are you facing challenges in your organisation in the practice of management accountancy due to the big data phenomenon?
- If yes, please explain the challenges you face.
- What management accounting techniques, in your opinion, are becoming irrelevant in your organisation due to the big data phenomenon?
- In your opinion, are there new management accounting techniques developing in your organisation due to the big data phenomenon?
- If yes, please explain.

Impact of big data on corporate strategy

- What strategy, in your opinion, does your organisation follow? Differentiation, Cost leadership, Focus.
- How is your organisation using big data to aid corporate strategy?
- How is your organisation using big data to gain competitive advantage?

Impact on the management accountant

- Do you think you have influence as a management accountant in your organisation to implement a big data driven technology for management accountancy practice?
- If yes, please explain how
- Are you using big data driven software in your organisation in the practice of management accountancy? If yes, please give details of the software used.
- If your answer to the above question was yes, please answer this question:
- What shortfalls do the big data analytics applications / you use or available in the market, have in meeting the requirements and functions of management accountancy?
- What features and capabilities should a big data driven management accountancy technology have?
- How can the traditional management accounting practices, such as target costing, budgeting, break-even analysis, product profitability analysis and performance evaluation be incorporated into a big data driven analytic system?
- Do you think we can incorporate social media data into a big data driven management accountancy system? If so, please explain how.

Skills of a management accountant

- What skills do you need to develop as a management accountant in order to effectively utilise the big data opportunities?

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THE KEY FACTORS FOR A SUSTAINABLE SMART CITY – A CASE STUDY OF 22 INTERNATIONAL SMART MUNICIPALITIES

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ABSTRACT. This article examines the core components and global initiatives driving smart city development, focusing on sustainability and safety & health. Drawing insights from literature and case studies of 22 international smart cities, the main objective of the research is to identify key projects shaping Smart Environment/ Sustainability and Smart Living/ Safety & Health. Notable examples include Tel Aviv-Yafo's solar roof and Dubai's Smart Healthcare Model. The findings emphasize a global commitment to citizen-centric, environmentally conscious urban environments, showcasing diverse approaches and technological innovations. The article offers actionable insights for aspiring smart cities, emphasizing a phased, collaborative approach and technological integration. Key observations include the global movement towards sustainability, diverse smart city initiatives, and the importance of cross-sector collaboration. The presented model serves as a blueprint for cities, addressing specific steps like assessment, goal setting, and learning from global best practices. Beyond current practices, the article suggests future research directions, including assessing long-term impacts, addressing privacy concerns, and exploring

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governance models. The article advocates ongoing research to guide policymakers in the dynamic landscape of smart cities, promoting sustainability and innovation.

Keywords: smart city, digitalization, sustainability, sustainable development.

JEL classification: O38, H11, I18, Q58

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Introduction and review of literature

In the rapidly evolving landscape of urban development, the concept of smart cities (SC) has emerged as a transformative force, integrating technology to enhance sustainability, efficiency, and the overall quality of life for citizens. This article delves into the theoretical underpinnings of smart cities by conducting an extensive analysis of published literature, with a focus on keywords such as "SC," "sustainability," and "digitalization". Our exploration unveils key components integral to SC frameworks, including Smart Government, Smart People, Smart Economy, Smart Environment, Smart Infrastructure, and Smart Living.

The utilization of cutting-edge technologies to revamp urban infrastructure and enhance the overall well-being of citizens is unquestionably a prevailing contemporary practice. This trend is substantiated by numerous initiatives undertaken by research teams, businesses, and municipal governments at local, national, and global scales. The idea of smart cities and innovative technologies offers a multitude of benefits. Key enhancements encompass improved quality of life, reduced energy consumption, swifter and safer transportation, increased green spaces in densely populated urban areas, intelligent infrastructure solutions, rapid communication with authorities, resolution of urban challenges, an eco-friendly environment, and the creation of living spaces for future generations (Kumar et al., 2016; Důbravová & Bureš, 2023).

Smart Cities leverage Information and Communication Technologies (ICT) to improve the quality of life for their residents. The concept of SCs has undergone significant development over the past two decades. Various definitions for SC can be found in the research literature. For instance, as defined by Bakıcı et al. (2013, p. 139), a SC is a highly technologically advanced

urban center that employs new technologies to connect people, information, and city infrastructure, with the aim of creating a sustainable, environmentally friendly city, fostering competitive and innovative business, and improving the overall quality of life (Anthopoulos, 2015; Herscovici et al., 2022).

A SC is characterized by a sophisticated framework that embodies a new level of intelligence achieved through the interconnected utilization of resources. This intelligence is harnessed for analytical, modelling, optimization, and visualization services. Moreover, it involves the capacity of individuals to acquire, advance, and implement cutting edge technologies. It is important to note that a SC not only relies on traditional and modern media infrastructure, such as transportation and communications technology, but also thrives on a foundation of social capital (Hollands, 2008; Giffinger & Gudrun, 2010; Harrison et al., 2010; Schaffers et al., 2011; Chourabi et al., 2012; Schaffers et al., 2012; Mocholí, 2016; Sarmiento, 2017; Sikora-Fernández, 2017; Valderrama, 2017; European Commission, 2020; Caragliu et al., 2021; Mejia et al., 2022).

A city is deemed "smart" when it combines conventional infrastructure and investment in human resources to foster sustainable economic growth and a high standard of living, all underpinned by integrated control technology (ICT). In this context, a SC can unite its physical surroundings, which encompass its natural assets, with its community, businesses, and human capital to enhance services and infrastructure, ensuring ongoing sustainability (Win & Tonyali, 2021; Demertzi et al., 2023).

Climate change requires European cities to improve their quality of life while lowering their costs. They require innovative and successful digital initiatives. Climate change has been acknowledged as a significant public health (PH) issue. Evidence-based PH practices should guide urban planning. Current determinants of environmental health and climate risk pose a serious threat to public health (Lapão et al., 2023). The essence of the SC is sustainability, and its main condition is a functional PH. The strategic plan is to integrate public health into the SC concept to help mitigate PH crises such as the COVID-19 pandemic (Lapão et al., 2023).

Consumer healthcare technologies have grown rapidly in recent years, driven primarily by the widespread use of mobile devices and the Internet. The development of Smart Consumer Healthcare Technologies (SCHT) has raised awareness of health and wellness management has changed, empowering people to track and compare. One of the key advantages of SCHT is its ability to democratize health care, making it more accessible and affordable. This allows consumers to monitor their health from the comfort of their own homes, reducing their reliance on costly doctor visits and hospital stays. SCHT also increases the accuracy of health information by enabling consumers to collect

and track health information over time, which can be shared with health care providers. Consequently, this helps health professionals make informed decisions about treatment options. Another notable advantage of SCHT is its ability to support chronic disease management (Herencsar, 2023).

The "Smart City" expression was initially coined by (Drohojowska, 1995) in 1991. While researchers are progressively gaining awareness of smart cities, the first notable surge of interest in this topic can be traced back to around 2011. The authors also developed a graph based on the research encompassed by Web of Science, which clearly underlines their statement.

Information security holds a critical role in smart cities, ensuring higher levels of confidentiality, availability, and integrity. It is also instrumental in maintaining the stability required by national services and organizations to sustain viable and livable intelligent urban environments. While smart cities aim to enhance productivity and efficiency, the neglect of cybersecurity could pose significant risks to both residents and authorities (Demertzi et al., 2023).

For instance, the rapid growth of the Internet of Things (IoT) introduces new vulnerabilities that malicious actors can exploit. With billions of interconnected "things" deployed in smart cities worldwide, numerous potential weaknesses and techniques come into play (Valaskova et al., 2020).

In summary, according to (Ganguly et al., 2019), the most substantial security challenges in SC environments include:

A vast and intricate attack surface: As cities become smarter, they incorporate more systems and "systems of systems," which increases the risk and impact of potential attacks. This necessitates more stringent control and visibility. Additionally, integrating solutions from various vendors amplifies the complexity, especially during rapid technological transitions. Inadequate oversight and organization: Complex systems require more robust management and governance capabilities. Keeping leadership well-informed about intricate occurrences will demand additional resources and capabilities (Ganguly et al., 2019; Demertzi et al., 2023).

The so-called digital revolution has ushered in numerous scientific breakthroughs, enhancing the efficiency and functionalities of conventional technology. One prominent outcome of this progress is represented by the development of SC infrastructure (SCI). Smart municipalities, in particular, have expanded the horizons of traditional municipal infrastructure by integrating cyber-physical systems (CPS). These systems have the potential to enhance sustainable initiatives on the long term, the overall performance as well as growth. As both legacy and novel systems are adapted to embrace technological modernization, the introduction of CPS highlights the increasing importance of analyzing the potential attack surfaces of these devices (Wright et al., 2022).

The structure of the article and is presented below:

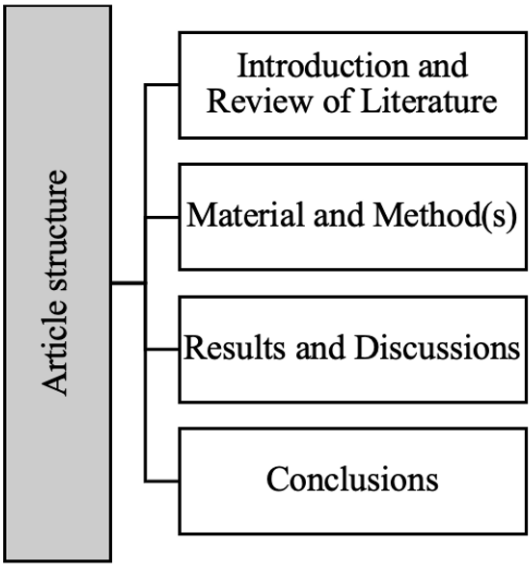

Figure 1. The structure of the article

The research aim of this study is to distill valuable lessons and create a model that can guide other municipalities aspiring to embrace the smart city paradigm. Through this research, we not only showcase exemplary projects but also identify key observations and propose future research directions to contribute to the continued evolution of smart cities worldwide.

To provide practical insights, we present a comprehensive study based on published literature, official websites, reports and news about 22 international smart cities, analyzing their projects and initiatives in the realms of Smart Environment/ Sustainability and Smart Living/ Safety & Health.

Material and Method(s)

In the process of researching the theoretical aspects, we have consulted the published literature using keywords such as "SC", "sustainability", and "digitalization". From the researched literature, we have identified the key components of a smart city, and these are: Smart Government, Smart People, Smart Economy, Smart Environment, Smart infrastructure and Smart Living. The entire process of identifying these components has been published elsewhere (Stegerean et al., 2022; Trincă, 2023).

As shown by Figure 2, the number of publications regarding the smart city topic increased significantly in the last ten years underlining the importance for further researching this topic from various angles. The overview of publications and citations on the topic of smart cities was initially developed by (Blazek et al., 2022), yet it only contained information up until 2022. We updated it, considering data from the Web of Science Core Collection, ending the data gathering at the end of July 2024.

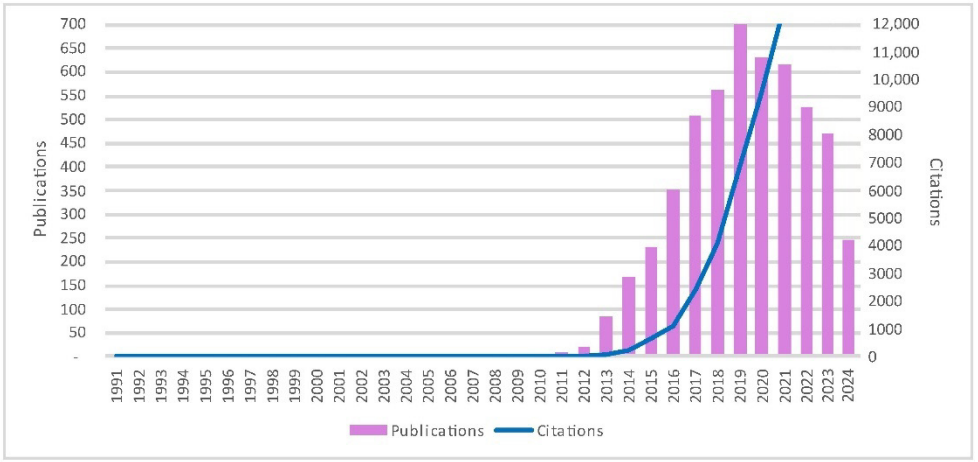

Figure 2. An overview of publications and citations on the topic of smart cities
Source: authors' work, updated from (Blazek et al., 2022, p.2)

In order to underline the most important terms and the connections between them, we developed a bibliometric analysis of the co-occurrence network of terms in the highly cited articles from the Web of Science Core Collection on the topic of smart cities, published in the last decade. The VOSviewer software solution was used as it was proven to be a reliable tool for creating cluster maps (van Eck & Waltman, 2010).

As it can be seen in the figure above, there are four major clusters, with the one associated with the smart city term being the predominant one. Another cluster is associated with the term technology, while the other two are associated with the terms application and system. These terms are the most frequent ones in the publications regarding smart cities and play a pivotal role in any digital economy.

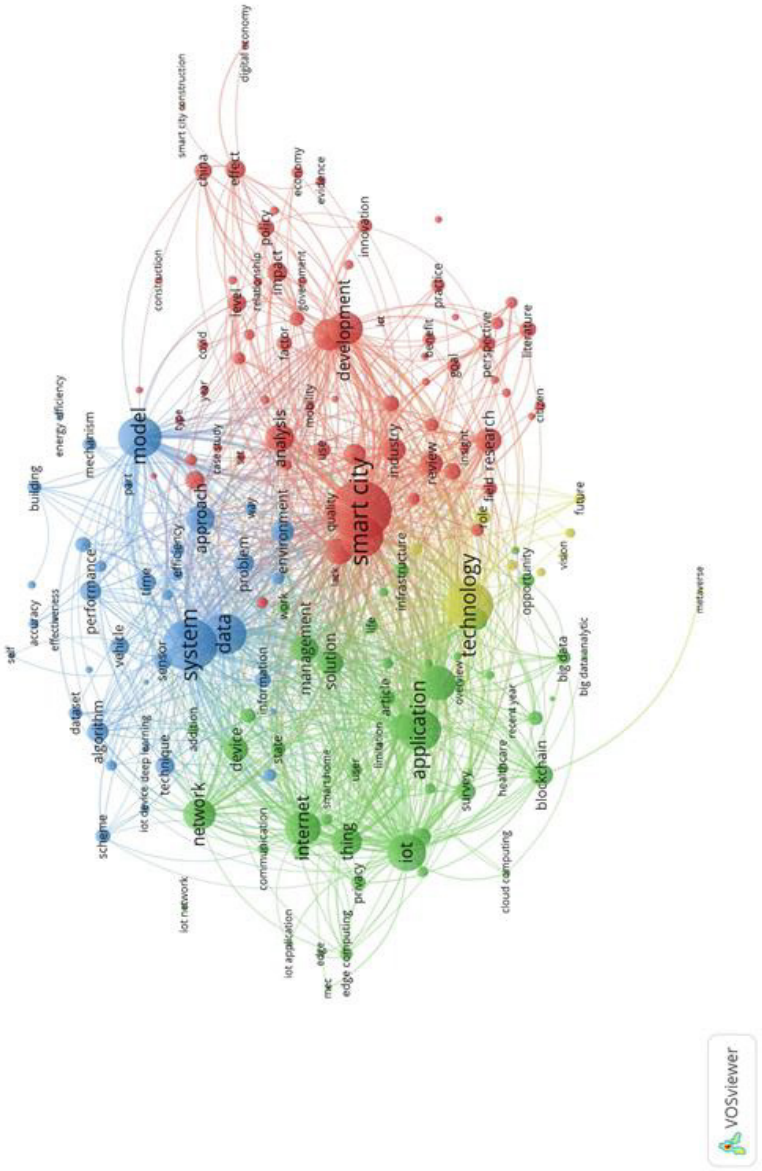

Figure 3. A bibliometric analysis of the co-occurrence network of terms in the highly cited articles from the Web of Science Core Collection on the topic of smart cities, published from 2014 onwards
Source: authors' work, using the VOSviewer software

These cities that were selected for the analysis emerged from articles published on the smart city topic, and these particular municipalities were chosen as they encompassed all six components of the SC framework. The common elements that are shared by these cities are the integrated approach of implementing the smart city framework, their intensive use of digital technologies and the visible results the municipalities have from the framework's adoption.

By studying the relevant literature, data was gathered a sample of 22 smart cities that are dispersed around the world, to develop a model that could be applied by other municipalities. The information regarding the smart initiatives implemented by these cities was easy to access, as the digitalization process increased the transparency and the popularization of each municipality's projects. When elaborating the sample, we took into account elements such as notoriety, frequency and impact, as well as the aspect mentioned before, the presence of the key elements of any smart city within their development strategy.

The cities that are part of this study are located across five continents as follows: Asia (Dubai, UAE (Ok & Yoo, 2017); Gyenggi province, South Korea (Ok & Yoo, 2017); Hong Kong, China (Anthopoulos, 2017); Seoul, South Korea (Anthopoulos, 2017; Ok & Yoo, 2017); Tel Aviv-Yafo, Israel (Herscovici et al., 2022)), Australia (Melbourne, Australia (Anthopoulos, 2017; Sancino & Hudson, 2020)), Europe (Amsterdam, The Netherlands (Schuurman et al., 2012; Ok & Yoo, 2017; Sancino & Hudson, 2020); Barcelona, Spain (Ok & Yoo, 2017; Bibri & Krogstie, 2020); Bristol, UK (Sancino & Hudson, 2020); Brno, Czech Republic (Fialová, et al., 2021); Geneva, Switzerland (Anthopoulos, 2017); Guimarães, Portugal (Fonseca et al., 2022); London, UK (Anthopoulos, 2017; Ok & Yoo, 2017; Bibri & Krogstie, 2020); Milton Keynes, UK (Sancino & Hudson, 2020); Nice, France (Ok & Yoo, 2017); Rotterdam, The Netherlands (van Zoonen, 2016); Tampere, Finland (Anthopoulos, 2017); Vienna, Austria (Anthopoulos, 2017)), North America (Chicago, USA (Sancino & Hudson, 2020); New York City, USA (Schuurman et al., 2012; Anthopoulos, 2017; Shah et al., 2019); Washington DC, USA (Anthopoulos, 2017)) and South America (Curitiba, Brazil (Sancino & Hudson, 2020)).

The fact that the municipalities are located across the planet shows that we are facing a global issue regarding smart cities and there are some common approaches that can be underlined.

Results and Discussions

As the topic of smart cities is vast and many authors have approached it from many angles in recent years, we decided to focus our attention towards two of the most important smart city components: Smart Environment/ Sustainability and Smart Living/ Safety & Health. The first component is in the spotlight nowadays

as the globe is tackling global warming and the majority of countries have already set up targets and measures for a carbon neutral future. On the other hand, the quality of life of citizens that live in cities around the world is a constant challenge and goal to achieve for municipalities.

In our quest to develop a model that will serve as a guide of implementing good practices for every aspiring smart city, we focused on the list of international smart cities that were found in the researched literature.

When taking into account the Smart Living/ Safety & Health component, we discovered common aspects like the adoption of smart surveillance systems and apps for quality of life. The similar projects implemented by the studied municipalities from an environmental/sustainable point of view consisted of smart waste systems and environmental projects, along with smart energy management approaches.

Two tables were developed, encompassing the most relevant examples of projects implemented by the municipalities, regarding the Environment/ Sustainability and Smart Living/ Safety & Health smart city components. In the research process that proceeded the development of the tables, we considered three main sources of information: published articles, official governmental websites and newspapers or blogs.

Table 1 presents the most relevant examples of sustainable smart city projects that were implemented, most of them focusing on the environmental issues. As previously mentioned, the sources were placed in three categories. From this point of view, 91.67% of the sources were from the official governmental websites and 8.33% from newspapers or blogs.

The sample represented by the 22 cities is presented in the table below in an alphabetical order, as they do not have a different degree of importance, and all of the initiatives are to be considered.

When analyzing the data gathered and presented in the table below, we can underline that some approaches towards sustainable projects are similar, while others are particularized on the specific needs and requirements of that community. One of the main goals of the cities is represented by a direction towards environmentally friendly development, that responsibly manages resources, minimizes waste and encourages the recycle and reuse of certain goods. Specific references are made to the concept of circular economy that encourages the reuse of materials and product, by keeping them in circulation for as long as possible. This economic model helps cities tackle the climate challenges and is present in the strategies of Rotterdam, Amsterdam, Geneva, and Vienna. Smart waste management projects were implemented by the cities that were previously mentioned, along with Brno, Chicago, Melbourne, Tampere and Hong Kong. Rotterdam and Brno also have specific projects dedicated to sustainable water initiatives.

Table 1. Examples of the Environment/ Sustainability component in the international smart cities

No.	City, Country	Examples of Projects	Source
1	Amsterdam, The Netherlands	The concept of a Circular City is centered around minimizing waste and pollution through a strategic focus on reducing, recycling, and reusing resources. This approach aims to create a sustainable urban environment by implementing circular economy principles that contribute to a more efficient and environmentally conscious city.	(Amsterdam Smart City, 2022)
2	Barcelona, Spain	The establishment of a low emissions traffic zone aligns with the sustainable development goals outlined in Agenda 2030. Initiatives like Energia Barcelona underscore our commitment to energy conservation. Additionally, the implementation of an air quality monitoring system ensures a proactive approach to environmental stewardship, further contributing to our sustainable development objectives.	(Barcelona City Hall, 2022)
3	Bristol, UK	Reducing carbon emissions, enhancing building efficiency with insulation, implementing smart energy management systems, and integrating renewable electricity sources are key goals for environmental sustainability.	(Tuppen, 2011)
4	Brno, Czech Republic	Leveraging smart resources is crucial for creating a more sustainable city. This involves integrating technologies and data-driven solutions to optimize resource use in areas like energy, water, transportation, and waste management.	(Intelligent Cities Challange, 2022)
5	Chicago, USA	The Chicago Climate Action Plan outlines strategies for addressing climate challenges, including a waste strategy aimed at sustainable waste management practices. The plan also emphasizes initiatives to reduce carbon emissions and increase the use of renewable energy sources, contributing to the city's commitment to environmental sustainability.	(City of Chicago, 2022)
6	Curitiba, Brazil	Implementing low-carbon solutions, like renewable energy sources, energy-efficient technologies, green infrastructure, sustainable urban planning.	(Smart Cpts in Curitiba, 2022)
7	Dubai, UAE	The Dubai Plan 2021 is a visionary initiative with the goal of transforming Dubai into a smart and sustainable city. This comprehensive plan includes optimizing energy resources as a key focus area. Additionally, the implementation of the Sustainable City within DubaiLand exemplifies concrete steps taken to realize these ambitions, fostering a more sustainable and environmentally conscious urban environment.	(United Arab Emirates' Government, 2022)

No.	City, Country	Examples of Projects	Source
8	Geneva, Switzerland	Collecting used smartphones contributes to sustainable practices by promoting the recycling and reuse of electronic devices, reducing electronic waste. "My Solar Square Meter" is an innovative concept that allows individuals to subscribe to a solar share in one of the township's participatory power plants. This initiative enables community members to collectively invest in and benefit from solar energy generation, fostering a more sustainable and renewable energy future.	(République et canton de Genève, 2022)
9	Guimarães, Portugal	Aligning with the Sustainable Development Goals, the city is dedicated to designing projects that transcend city boundaries, encompassing a broader regional scope. This approach ensures a comprehensive and inclusive impact on sustainable development across the entire region.	(Intelligent Cities Challange, 2021)
10	Gyenggi province, South Korea	The 2022 Gyeonggi Environment Safety Forum serves as a platform for discussions and exchanges on environmental safety matters in the Gyeonggi region. It provides an opportunity for stakeholders to share insights, innovations, and strategies aimed at enhancing environmental safety and sustainability.	(Gyeonggi-do Provincial Office, 2022)
11	Hong Kong, China	The commitment to reduce carbon emissions by 20% and recover 1.5 million tons of waste underscores a proactive approach to environmental sustainability. The Climate Action Plan 2050 likely outlines a comprehensive strategy for addressing climate challenges and achieving long-term sustainability goals. Additionally, the focus on green buildings suggests an emphasis on constructing and maintaining environmentally friendly structures to further contribute to a more sustainable future.	(Innovation and Technology Bureau of Hong Kong, 2020)
12	London, UK	Efforts toward reduced energy usage, emissions, and investment in low-carbon infrastructure. Other initiatives include: Cleantech work (environmental technologies), Green Finance and Social Value projects.	(Greater London Authority, 2022a; Jackson-Obot, 2022)
13	Melbourne, Australia	The concept of an "Urban Forest Visual" refers to an initiative or project that aims to visualize and promote urban forests, emphasizing the importance of green spaces and tree coverage in urban environments. "Smart litter bins" typically refer to technologically advanced waste bins equipped with sensors and technology to optimize waste collection processes.	(City of Melbourne, 2022)
14	Milton Keynes, UK	The Community Action Platform for Energy (CAPE): community-driven projects, education, and efforts to enhance energy awareness and conservation at the local level.	(Daga, 2022)

No.	City, Country	Examples of Projects	Source
15	New York City, USA	The Office for Climate and Environmental Justice was created, that entirely focuses on sustainability projects.	(Mayor's Office of New York City, 2022)
16	Nice, France	The Climate Air Energy Territorial Plan (PCAET) is a strategic framework designed to address climate, air quality, and energy challenges within a specific territorial area. This comprehensive plan typically outlines specific objectives, actions, and policies aimed at mitigating climate change, improving air quality, and promoting sustainable energy practices at the local or regional level.	(Cities for Digital Rights, 2022)
17	Rotterdam, The Netherlands	Projects like the Floating Farm and Recycled Park/Clean Rivers projects, with a dedicated focus on the concept of Circular Economy.	(Rotterdam Innovation City, 2022b; Rotterdam Partners, 2022)
18	Seoul, South Korea	The "Roads Recharging Vehicles During the Drive" project is an innovative initiative where roads are equipped to recharge vehicles while in motion, contributing to sustainable and eco-friendly transportation. The "Seoul-type Sustainable Development Implementation System" refers to a system implemented in Seoul that focuses on incorporating sustainable development practices across various aspects of urban planning and governance. This system likely involves strategies and policies to promote environmental sustainability, economic development, and social well-being in Seoul.	(Morningstar, 2021)
19	Tampere, Finland	Enhancing the energy efficiency of existing building stock is a crucial strategy to mitigate emissions resulting from energy consumption. This involves implementing measures and upgrades to reduce energy waste, optimize systems, and introduce sustainable technologies, contributing to a more environmentally friendly and energy-efficient built environment.	(City of Tampere, 2022)
20	Tel Aviv-Yafo, Israel	Engaging in a solar roof project, implementing a Green Label for Businesses to promote eco-friendliness, and fostering sustainable communities through initiatives like Community Gardens are integral components of the commitment to environmental responsibility and sustainable neighborhoods.	(Tel Aviv City Hall, 2022)
21	Vienna, Austria	"Repair not replace" emphasizes the importance of repairing items rather than discarding them. The expansion of solar energy involves increasing the use of solar power as a renewable energy source.	(UIV Urban Innovation Vienna, 2022b)

No.	City, Country	Examples of Projects	Source
		Creating green fuel from residual waste involves converting waste materials into environmentally friendly fuel sources, providing an alternative to traditional fossil fuels and promoting sustainability through the reduction of waste, electric powered waste collection, green streets and neighborhood oasis.	
22	Washington DC, USA	The Sustainable DC 2.0 Plan is a comprehensive strategy aimed at fostering sustainability and resilience in Washington, D.C. This plan outlines ambitious goals, including a targeted reduction of emissions by 31%, a significant increase in the use of renewable energy, and a plan to cover 37% of the city with trees. These initiatives collectively contribute to a more environmentally friendly, resilient, and sustainable urban environment.	(Department of Energy & Environment, 2021)

Source: authors' work

The most encountered topic among the sustainable initiatives of the 22 cities, was the one of energy. As energy costs constantly increase, along with the demand, the need of other energy sources is an important one. Renewable energy projects like solar panels are mentioned, along with projects associated with reduced energy consumption trough efficient and green buildings. In the case of 73% of the 22 studied municipalities energy related projects and initiatives are mentioned, thus supporting the fact that this was the most encountered topic.

The second most encountered projects were the ones associated with air quality and the reduced level of emissions, in more than a third of the cities. In this case, a remark should be made, the one that the emissions and air quality issues are also tackled in projects associated with the Smart Infrastructure/ Mobility/ Transport component of the smart city concept. From an efficient transportation system, with electric and hydrogen-powered vehicles, ridesharing initiatives and dedicated lanes, significant improvements are made in terms of air quality and emissions reduction.

The topic of green urban spaces and gardens, or even urban forests is specifically mentioned in the plans of almost a third of the studied cities. Projects that increase the number of trees planted, the spaces dedicated to citizens, like community gardens, green streets and even floating farms are ideal for offering better air quality and a more pleasant space to live in.

Offices dedicated to climate and the environment, forums, plans, and systems that are associated with sustainable development were established by municipalities like New York City, Gyeonggi Province, Nice, Rotterdam, Dubai, Seoul, Washington DC, Hong Kong, Milton Keynes and Chicago. With these cities

being located in different continents across the globe, we can emphasize that sustainability and climate-related issues are issues that concern all regions of the world.

These projects collectively represent a global movement towards creating more sustainable, resilient, and environmentally conscious cities, incorporating diverse strategies, technologies, and community-driven efforts to address the complex challenges of our time.

Table 2 systemized the data collected for the Smart Living / Safety & Health component. 65.52% of the sources were from official government websites, 31.03% from newspapers or blogs, and 3.45% from published articles.

Table 2. Examples of the Living / Safety & Health component in the international smart cities

No.	City, Country	Examples of Projects	Source
1	Amsterdam, The Netherlands	Smart Health Amsterdam serves as the network for fostering innovation in the Life Sciences & Health sector through data and AI-based technologies.	(Amsterdam Economic Board, 2022)
2	Barcelona, Spain	Establishing the European Medicines Agency (EMA) in Barcelona could significantly enhance the environment for health startups. Furthermore, a Smart Intensive Care Unit with innovative features such as smart beds and lighting is in place.	(CatalanNews, 2018; Novoseltseva, 2020)
3	Brno, Czech Republic	Honeywell collaborates with prominent health providers to enhance digitalization in healthcare. In the initial phase with the University Hospital Brno, the focus is on skin patches for real-time monitoring of patient vitals, seamlessly uploading data to a mobile app. Ongoing efforts will extend this collaboration to the Department of Internal Cardiology, integrating automated call systems and innovative smart voice technology.	(Scott, 2022)
4	Bristol, UK	Establishing a platform for collaboration among key health and care leaders, fostering integrated health and social initiatives.	(Health and Wellbeing Board, 2022, 2023)
5	Chicago, USA	Chicago has inaugurated its inaugural smart medical district, pioneering a digital infrastructure and service ecosystem dedicated to health innovation.	(SmartCitiesWorld news team, 2019)
6	Curitiba, Brazil	Establishing a city communication infrastructure tailored for health center units.	(Silveira, 2014)
7	Dubai, UAE	Introduced in 2013, the Dubai Smart Healthcare Model revolutionized patient interactions by enabling self-check-ins through a touchscreen	(KPMG, 2015; The First Group, 2022)

No.	City, Country	Examples of Projects	Source
		system using identity cards. This innovative approach also incorporates consolidated digital health records, telemedicine services, healthcare analytics, and overall smart healthcare solutions, enhancing the efficiency and accessibility of healthcare services in Dubai.	
8	Geneva, Switzerland	GDHub endeavors to transform guidelines and policies into actionable insights, fostering effective coordination, governance, collaboration, and, ultimately, measurable impact.	(Geneva Digital Health Hub, 2022)
9	Guimarães, Portugal	Guimares has two public medical facilities, one private hospital, and numerous clinics to meet all of the requirements for healthcare.	(International Living, 2022)
10	Gyenggi province, South Korea	A smart app service is available to display convenience facilities catering to individuals with mobility impairments. Additionally, there is a data-driven system for monitoring infant health.	(Gyeonggi-do Provincial Office, 2021; Korean Ministry of Land, Infrastructure, and Transport, 2022)
11	Hong Kong, China	The Electronic Health Record Sharing System has been implemented, facilitating seamless sharing of health records. Additionally, a Big Data Analytics Platform has been launched to support healthcare-related research endeavors. The integration of telehealth, videoconferencing, and remote consultation services further enhances the accessibility and efficiency of healthcare delivery.	(Innovation and Technology Bureau of Hong Kong, 2020)
12	London, UK	myhealth.london.nhs.uk - website for finding healthcare services; Championing healthcare innovation is a key focus, highlighted by the Mayor's London Health Board. Additionally, a new initiative, the London Digital Partnership Board for health, is actively promoting advancements in digital healthcare solutions.	(Greater London Authority, 2022b; Smart London, no date)
13	Melbourne, Australia	Cortical Labs in Melbourne is pioneering the development of "DishBrain Intelligence," a groundbreaking initiative that converges soft tissue and silicon. Leveraging stem cells, they are creating a neural network equivalent that resides on a laboratory slide, aptly named the "DishBrain." This innovative approach represents a unique intersection of biological and artificial intelligence technologies.	(Vogles, 2023)
14	Milton Keynes, UK	Milton Keynes University Hospital (MKUH) has partnered with digital innovator Haltian to trial the Empathic Building Smart Hospital solution. This cutting-edge platform is crafted to enhance productivity and efficiency by leveraging data-driven insights.	(Milton Keynes University Hospital, 2022)

No.	City, Country	Examples of Projects	Source
15	New York City, USA	The NYS Scanner app is designed for scanning Covid vaccination cards, including Excelsior Passes Plus and SMART Health Cards. Additionally, it integrates an Enhanced 911 System that precisely determines the caller's location through the GPS functionality on their smartphone.	(Smart City Solutions, 2021; New York State, 2023)
16	Nice, France	Recognition was granted to initiatives related to connected health and aging well at the Lisbon Web Summit in November 2017.	(Office de Tourisme Métropolitain Nice Côte d'Azur, 2022)
17	Rotterdam, The Netherlands	LSH010 is a Rotterdam municipality initiative. With LSH010, the municipality brings together businesses, organizations, and institutions in Rotterdam's economically booming Life Sciences & Health sector. This is accomplished by the municipality doing the following: • Offering a (international) platform to Rotterdam-based businesses • Bringing together many parties, whether online and offline • Sharing information and working cooperatively on significant problems and innovations • Providing assistance to new and expanding businesses	(Rotterdam Innovation City, 2022a)
18	Seoul, South Korea	"On Seoul Health On" project focuses on empowering individuals for self-health management. Through this initiative, individuals take charge of their well-being by actively engaging in health management practices.	(Korean Ministry of Land, Infrastructure, and Transport, 2021)
19	Tampere, Finland	The Tays RDI-Center at Tampere University Hospital is spearheading the vision for everyone in the city to predominantly utilize digital services by 2025. This forward-looking initiative includes the development of new digital well-being services aimed at enhancing the overall health and welfare of the community.	(Business development, HealthHUB and Hospital District of Tampere Region, 2022)
20	Tel Aviv-Yafo, Israel	Volunteering and Social assistance; Emergency Buddy - medical assistance and preventing homebound loneliness Municipal Employment Centre - for at-risk children and youth who have endured mental, emotional, or social trauma	(Tel Aviv City Hall, 2022)
21	Vienna, Austria	E-Health encompasses both the treatment process and patient management, utilizing information and communication technologies (ICT) for enhanced healthcare services.	(UIV Urban Innovation Vienna, 2022a)

No.	City, Country	Examples of Projects	Source
22	Washington DC, USA	The mission of the DC Health Benefit Exchange Authority is to execute a healthcare exchange program in the District of Columbia in alignment with the Affordable Care Act (ACA). This mission aims to guarantee access to quality and affordable healthcare for all DC residents. The online platform (dcgealth.dc.gov) serves as a comprehensive resource, providing all necessary information to residents. Additionally, the Digital Vaccine Record (DVR) is a part of this initiative, contributing to streamlined and efficient healthcare record keeping.	(DC Health, 2023; DC Health Link, 2023)

Source: authors' work

The smart cities studied in the research have a constant focus on innovative initiatives regarding the health aspect. From a general perspective that is present in the case of Nice and Guimarães to more specific projects that will be detailed below.

More than 40% of the studied municipalities have developed applications dedicated to medical assistance, vaccine and health cards evidence, enhanced emergency calling locating services, aiding citizens with mobility impairments, infant health monitoring, digital health records, telemedicine, self-check-ins and self-health management, just to name a few. These cities include Tel Aviv-Yafo, New York City, Gyeonggi province, London, Dubai, Seoul, Geneva, Washington DC and Hong Kong.

Smart platforms that serve as a network for all institutions, businesses and organizations that are related to both health and life sciences in order to collaborate and encourage innovative projects, while tackling with the inevitable challenges that come with the adoption of digital technologies in the health sector. The fact that multiple actors can be brought together using both online and offline approaches will result in more targeted projects that suit the needs of the entire community. Among the cities that fostered these initiatives, we can recognise the Dutch municipalities of Amsterdam and Rotterdam, together with the British cities of London and Bristol.

Smart hospitals are an important aspect that is present within communities that adopt the smart city framework. A specific example can be outlined in Barcelona, with the Intensive Care Unit (ICU) that incorporates various digital innovations, such as smart beds that are aimed at facilitating the patient's status and that is linked to a smart display that aides hospital personnel constantly monitor the progress. Smart lightning that is able to resemble the day-night cycle is also an important feature of the smart ICU. In Brazil, the municipality of Curitiba

developed and implemented a complex infrastructure for communication that is aimed to help the various health institutions across the city, with dedicated solutions according to their specific needs. The Tays RDI-Center at Tampere University Hospital is another relevant example for digital technologies adoption and their objective to predominantly use them by the year of 2025. An innovative initiative is developed in Melbourne, and it involves the creation of a neural network equivalent, using stem cells and combining silicon with soft tissue in a special combination of technology and biology. Data-driven approaches are being implemented at the University Hospital located in Milton Keynes, in a fruitful collaboration between the private sector and the health provider. The platform that was developed by the hospital and a private organization specialised in digital technology innovation is able to increase productivity and efficiency levels with the use of data processed by the software in an approach to better serve the needs of patients and use resources responsibly. Another University Hospital that is constantly collaborating with the business sector for integrating innovative technologies in the treatment process of patients is the one located in the Czech city of Brno. In this case, the constant monitoring of the patient status and vital signs is performed with the use of digitally enabled patches that are applied directly on the skin of the patient. Moreover, these patches are able to transmit data in real-time to a mobile application that can be monitored by medical personnel. As heart-related conditions are a constant challenge for medical professionals, the hospital considers the use of digital innovations in another department of the institution, the one of internal cardiology. With the seamless integration of automated systems for calls and the use of smart voice enabled technologies within the operations of this department, significant benefits would be brought for patients, employees and the medical institution. The city of Chicago made a bigger step in terms of smart health, by developing an entire medical district, dedicated to the integration of novel technologies and innovations dedicated to cater to the treatment of patients in an improved way. By designing an entire area dedicated to healthcare institutions, universities and innovators, the so-called Illinois Medical District encourages a faster pace in the development and adoption of various health initiatives.

The above table illustrates a global landscape of innovative healthcare and technology initiatives implemented in various cities and countries. These projects reflect a commitment to leveraging technology, data-driven solutions, and collaborative efforts to enhance healthcare services, foster community well-being, and address emerging challenges. The diversity of approaches, from smart city initiatives and digital healthcare platforms to ground-breaking medical research and community-focused projects, underscores the multifaceted nature of efforts to improve healthcare delivery and promote well-being. These

innovations collectively contribute to the global pursuit of more efficient, accessible, and patient-cantered healthcare systems, emphasizing the importance of technological innovation and cross-sector collaboration in shaping the future of healthcare.

To achieve the results observed in the studied smart cities, the local government of an aspiring city can undertake a strategic and phased approach, considering the following key steps in Figure 4:

1. Assess and plan ahead	• Clearly establish the challenges that may be faced along with the top priorities for the municipality. • In order to establish a clear image of the road ahead, various stakeholders should be consulted, from academics, entrepreneurs to citizens.
2. Establish clear goals	• Setting the main goals and objectives that the municipality has in order to become smart should be a constant priority.
3. Take the example of other cities	• Various notable examples of successful municipalities that implemented the framework exist, such as the ones presented in the study. The ones that are the most appropriate should be studied, from cities comparable to the municipality.
4. Develop a clear strategy	• A smart city strategy should be elaborated, taking into account the six smart city components. • The projects should follow a phased implementation, based on the needs and priorities of the municipality.
5. Integrate solutions based on digital technologies	• Constant investments in different technologies are required in order to be able to keep up with the rapid changes and innovations. • Dedicated hubs that gather universities, the private and public sectors, along with start-ups should be established, in order to foster innovation.
6. Collaborate with other institutions and establish partnerships	• PPPs, or Public-Private Partnerships constitute an important aspect, as many times private companies can have both more expertise and funding for a certain domain. • Partnerships with municipalities from around the world should be encouraged in order to develop relevant projects and learn from best practices.
7. Engage the citizens	• The members of the community should be both informed about the smart city projects, as well as consulted and engaged. • Taking into account the feedback from the citizens is important, thus implementing a solution dedicated to receiving suggestions and complaints is to be considered.
8. Invest in sustainable projects	• In order to reduce both costs and the carbon footprint for the municipality, renewable energy projects such as solar panels should be integrated on public buildings. • Waste collection and management is a top priority for any smart city, thus an intelligent waste management system that encourages citizens to take into account the reduction of the environmental impact is to be implemented.

9. Allocate funds for both healthcare and safety of residents	• Telemedicine solutions and other smart health projects are to be financed in order to increase the variety of health services provided to the community. • The safety and wellbeing of residents can be improved trough the integration of sensors and smart security systems that are aimed both at protecting the citizens along with increasing their quality of life.
10. Update the smart projects based on constant monitorization	• A software that integrates data analytics about the smart city projects should be considered for a comprehensive monitoring and evaluation of the initiatives. • As technology evolves in a rapid pace, along with the dynamics of the municipality, a smart city is expected to adapt and make adjustments of the projects constantly.
11. Elaborating dedicated policies and regulations	• Both privacy and security concerns, along with the ethical ones should be taken into account in the process of elaborating policies and regulations dedicated to the smart framework.
12. Secure the necessary funding and investments	• Technological breakthroughs, along with complex smart city infrastructure require multiple sources of funding as the costs are notably high. Such sources include both public and private funds, various grants offered by local, regional or global institutions, along with revenue that is generated by the smart initiatives, such as solar panels.
13. Train and develop the skills of the city's workforce	• Constant training initiatives should be encouraged, in order to provide the municipality's workforce with the necessary resources for developing skills aimed at both supporting as well as maintaining the smart projects.

Figure 4. The key steps an aspiring city has to approach to integrate smart city solutions
Source: authors' work

By combining these elements into a well-structured and adaptable SC strategy, an aspiring city can work towards achieving the positive outcomes observed in the studied smart cities. It is crucial to tailor the approach to the city's unique characteristics, challenges, and goals, fostering a sustainable, innovative, and citizen-centric urban environment.

In the present research, the landscape of smart cities worldwide was explored, focusing on two critical components: *Smart Environment/Sustainability* as well as the *Smart Living/ Safety & Health*. This is the first study to develop a comprehensive model based on successful practices in these areas that could serve as a guide for other municipalities aspiring to become smart municipalities.

The selected 22 smart communities displayed a variety of innovative projects, reflecting a global commitment to addressing *environmental challenges*, enhancing *sustainability*, and improving the *quality of life* for the inhabitants. The findings were organised into two tables, highlighting exemplary projects in each component.

For the *Smart Environment/ Sustainability Component* we can underline the most innovative approaches that the cities adopted. The elaboration of a green label that is dedicated to environmentally friendly private organisations constitutes an important milestone for Tel Aviv-Yafo and stands as an example for other cities as it determines businesses adopt sustainable approaches and it offers citizens valuable information about what type of approach has that organisation taken.

Another notable project is the one of the world's first floating farm that operates in Rotterdam since 2019. This project contributes towards lowering emissions generated by transportation as the farm is close to the customers. It also contributes to the circular economy as the livestock of the farm can be fed with grass from the city's sport fields. By being developed on water, the farm is not affected by the amounts of precipitation and by how much the sea level fluctuates.

An initiative that can engage the entire community to contribute towards renewable energy is the one introduced by the municipality of Geneva. By giving the possibility to all citizens to invest in collective solar power plants and benefit from the outcomes of the energy generated, the city made the entire process more accessible especially for the residents that do not have the space or resources to integrate solar panels at their household. This type of project can be replicated by other cities as it would give more confidence to citizens to invest in a project that is developed by the local government.

The *Smart Living/ Safety & Health Component* there are several notable projects that can be highlighted in terms of how innovative they are. To begin with, the integrated approach of the city of Chicago that established a smart medical district dedicated to healthcare institutions, academia, start-ups and businesses that operate in the health sector, to encourage innovation. With the appropriate support and infrastructure, projects like the "DishBrain Intelligence", that combines biology and digital technologies to create a neural network equivalent using stem cells, are possible. This initiative that was developed in laboratories located in the city of Melbourne constitutes a relevant example of how new discoveries in health and technology can be made in a city that focuses on this component of the smart city framework.

A consistent *health infrastructure* that integrates the health records of the patients in a digital format, innovative telemedicine approaches, stores and processes the data collected by medical devices, streamlines the treatment process and operations of the medical organizations, facilitates the work of health personnel and offers more appropriate forms of treatment for the residents of the smart municipality. In this specific case, the project that begun in 2013 in the United Arab Emirates has to be highlighted. Dubai was an early adopter of the SC approach, as in the year of 2013 there was not such a

significant popularity of the subject as it is encountered today. The Dubai Healthcare Model is centred upon offering to citizens a more accessible way to medical services with the utilization of various digital technologies, while also focusing on making the services more efficient from an operational perspective.

Emergency healthcare services are vital for any community. As digital transformation and novel technologies were introduced in the medical field, hospitals that integrated them improved their operations and increased the quality of treatment offered to patients. A notable example for this aspect is the one of the Smart Intensive Care Unit from the Hospital Vall d'Hebron that is located in the Spanish city of Barcelona. The unit was opened in 2018 and it revolutionised the way in which medical decisions are made as the innovative equipment that was integrated enabled medical professionals to have access to real-time data of the patients.

Similar approaches of integrating innovative equipment in hospitals were also encountered in the case of two other countries Czech Republic and the United Kingdom, specifically in cities of Brno and Milton Keynes. In the case of Brno, the collaboration between the University Hospital and a company focused on technology made the integration of real-time patients' data access possible through the use of connected skin patches with sensors and a dedicated mobile application, thus offering similar conditions to the ones from the Hospital Vall d'Hebron in Barcelona. Milton Keynes University Hospital also collaborated with a technology provider that enabled the adoption of an integrated system that optimises the operations of the medical institution in terms of patient flow, efficient use and management of the available equipment and facilities.

After reviewing the innovative projects that were implemented by the 22 studied cities, some key observations can be made. To begin with, a global movement that focuses on the development of municipalities that are more sustainable, resilient, as well as environmentally friendly through the utilization of innovative digital technologies can be recognised. More municipalities from across the globe are adopting smart city solutions in an approach to respond to the current challenges and to better address the inhabitants' needs.

Even though the core concepts of the SC framework are similar across the cities, different approaches are encountered when a more detailed analysis is performed. This idea suggests that in order to achieve the benefits brought by innovative technologies, local governments should take into account the particularities of the community, the region and the economic context when developing smart projects.

A common element that binds together all smart city initiatives is the one of technological breakthroughs that are part of any project. Municipalities have understood that through the utilization of innovative digital technologies

within any operation or service they can be integrated in, significant positive results can be achieved, especially in terms of sustainability, efficient resource management and an optimised way of providing public services to the community members.

To successfully execute SC projects, it is essential to employ a cohesive approach that integrates new technologies and tools while engaging a variety of stakeholders. This process unites the endeavors and initiatives of different parties within a collaborative decision-making framework. It is through the interaction among these stakeholders that deployment models for Smart Cities take shape, defining the roles of each participant and the necessary equilibrium between them to attain the city's goals (Zona-Ortiz et al, 2020; Mejia et al., 2022).

To successfully execute SC projects, it is important to employ a cohesive approach that integrates new technologies and tools while engaging a variety of stakeholders. This process unites the endeavors and initiatives of different parties within a collaborative framework that is aimed at facilitating the process of taking decision. Through the constant interaction among these various stakeholders the viable so-called deployment models for smart municipalities take shape, defining the roles of each participant and the necessary equilibrium between them to attain the city's goals (Zona-Ortiz et al., 2020; Mejia et al., 2022).

Thus, the primary purpose of local government in facilitating smart development involves fostering innovative solutions which leverage ICT to encourage collaborative efforts in creating urban services and products. The main purpose of SC management dedicated to enhance and integrate various city management processes, harnessing human as well as social capital for better outcomes that ultimately lead to an improved life quality level for inhabitants.
Some key elements in the elaboration of smart city solutions can be condensed as follows:

- Formulating a comprehensive strategy for the long-term, that is founded on a though analysis of the municipality's strategic vision, its unique challenges and opportunities, and urban dynamics.
- Embracing openness, accessibility, and information sharing within and outside the organization to promote cooperation, integration, and transparency.
- Establishing inclusive processes that engage various stakeholders, including private individuals, in the processes of initiation, production, as well as in delivering both public services and goods through SC solutions.
- Combining both "new" online interventions and "traditional" offline methods, for instance, to rectify and mitigate potential disparities in the use of ICT in the education sector as well as to enhance the acceptance rate of intelligent initiatives within projects of urban development that integrate a sustainable component (Butnariu & Gusul, 2021).

The fruitful collaboration between the municipality, academia and private organisations is vital for the effective development of SC approaches, especially when referring to sustainable projects or projects targeting the community's health and life quality levels. From a policy elaboration approach that involves also the community members and companies, to projects in which the expertise and experience of the private sector are combined with the administrative capability of the local government, the partnerships between the public sector and the private one have demonstrated to contribute towards successful, sustainable and resilient projects that are appreciated by the citizens, local businesses and ultimately, the local administration.

Conclusions

The findings from this particular study offer some valuable insights for municipalities aiming to embark on the smart city journey. The objective of the study has been achieved, as the development model presents successful projects that were implemented worldwide as well as valuable insights dedicated to aspiring communities.

By studying successful projects that were implemented worldwide, cities can adapt, develop and implement innovative solutions that are tailored to their particular situation in terms of long-term goals and challenges faced. The recent innovations in digital technologies and the medical field combined with the global movement towards sustainable goals provide the ideal blueprint for creating smarter communities and urban settings, that are resilient to challenges and include approaches centred upon the residents.

The current research in the field of smart cities may advance through diverse approaches. To begin with, there is a constant interest for a comprehensive assessment that examines the long-term impacts of SC approaches, especially focusing on *environmentally centred projects, healthcare* initiatives, and the *quality of life* level of inhabitants of the smart communities. By taking a detailed look on how these projects influence the *citizen engagement* level and *social equity* municipalities can develop more tailored social projects that directly address the specific needs that the residents may have.

When referring to *environmentally* or *sustainability* centred initiatives, there are some successful examples to be outlined, such as the implementation of the concept of circular economy in the municipalities of Rotterdam, Amsterdam, Geneva, and Vienna. Smart waste management solutions were encountered in the previously mentioned cities, along with Brno, Chicago, Melbourne, Tampere and Hong Kong. Rotterdam and Brno additionally have adopted specific

projects related to sustainable water initiatives. Offices targeting climate and the environmental issues, forums, plans, and systems that are connected to sustainable development were established by local administrations such as New York City, Gyeonggi Province, Nice, Rotterdam, Dubai, Seoul, Washington DC, Hong Kong, Milton Keynes and Chicago.

SC technologies that are being considered and implemented today, are based especially on data-driven solutions. With this aspect, *data privacy and security* concerns emerge. Further studies on how effective *cybersecurity* measures can be implemented by local governments can constitute a direction for further research. As data security challenges can affect the entire digital infrastructure of the city, a dedicated focus towards solutions that address these challenges should be at the top of the priority agenda for any municipality.

Governance models dedicated to smart cities should also be explored further, focusing on the effective collaboration between the local administration and the private sector especially when there exists a need for special expertise in complex projects, experience and founding.

When *smart health solutions* are considered, the attention paid on the patients' needs, feedback and wellbeing should be the primary focus, while the technological advances are to be integrated in order to increase efficiency, better manage resources, streamline operations and better serve the treatment needs of the beneficiaries, while helping medical professionals take informed decisions based on real-time data. Notable examples include the "DishBrain Intelligence" project from Melbourne, the Dubai Healthcare Model that was implemented from 2013 onwards, the first Smart Intensive Care Unit from the Hospital Vall d'Hebron in Barcelona. Similar approaches were also encountered in Brno and Milton Keynes.

By performing additional comparative studies across smart communities around the globe, specific patterns and models of best practices can be outlined, while taking into account both cultural and economic factors. The main role of communities as well as *citizen engagement* within the development process of smart communities should be further investigated, along with the effects brought by the integration of digital and innovative technologies in education and within the development of the workforce.

The evaluation of how effective both *communication and collaboration* are between the local administration, businesses, universities, and members of the community is crucial for a successful adoption of smart city approaches. Better understanding of how cities manage knowledge transfer, effective policy and regulation elaboration trough networks that facilitate collaborations between municipalities constitute another significant research opportunity.

In terms of *funding* the smart projects, as resources of local communities are limited and not that high, the research of innovative financing models such as Public-Private Partnerships (PPPs) is beneficial in order for many investments for the city to be finalised in a shorter timeframe. Moreover, researching how novel digital technologies can improve the response to a local crisis and enhance the properness of the community is essential for ensuring a resilient city.

This study also has some limitations that are to be addressed. To begin with, the list of international cities that constitute the basis for the analysis includes only 22 entries. This number can be seen as being not that high and a more comprehensive future research that includes a larger number of cities should be taken into account. The information regarding the analysis came from published literature, official websites and newspapers or blogs, so this research did not directly evaluate the perception of the residents towards the smart city initiatives. It would constitute a great research challenge to conduct such a study as the cities are dispersed around the globe, yet the current research can serve as a starting point for other authors that focus on this subject. Ongoing exploration in these areas will not only contribute valuable insights but also guide policymakers and support evidence-based processes of taking decisions in the dynamic landscape of smart cities.

Future research perspectives include a study that focuses on the implementation of Smart City/ Smart Village approaches within a specific country, Romania being the one that is being taken into account.

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OH-MY-GOD, HOW IS THIS? OR WHAT MAKES A SONG POPULAR?

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ABSTRACT. The role of music in the history of mankind is indisputable, not only as a means of communication, but also as an added value that cannot be reproduced, because music, by its very nature, defines the present moment in an addictive way, depending on the events experienced. The diversity of musical styles and their chameleonic nature is also a major factor in the fragmentation of the consumption of musical products. However, in the music industry, there has recently been a growing trend towards intergenerational collaborations in order to reach a larger segment. One only has to think of the remix of Elton John and Dua Lipa's song *Cold heart*, which has achieved outstanding results worldwide[3]. The present study is based on the ValMar ft. Szikora Robi's song *Úristen* [Oh-My-God], in order to identify the criteria that determine the opinion of the target segment and consequently their expectations of a given song.

Keywords: music, consumer behaviour, attitude, positive aspects

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[3] Daw (2021), https://www.billboard.com/culture/pride/elton-john-lockdown-sessions-album-announcement-9623292/

Introduction and review of literature

Music, despite its diverse forms, is one of humanity's most universal means of expression and communication (Longfellow 1835, in Mehr et al., 2019). The universe of music is infinitely complex and can evoke an unlimited range of emotions, including complex emotions such as "wonder, transcendence, or nostalgia (among others)" (Vuilleumier & Trost, 2015, p. 219). Studies have also shown that music can have a positive effect not only on the quality of mental performance (Lesiuk, 2005, p. 188)[4], but also on physical performance (Terry et al., 2020), and may also help to treat certain illnesses more effectively (White, 2001). Moreover, music has a well-defined role in business, because:

(1) for fine dining restaurants, the role of music is significant in terms of brand personality and perception of décor (Magnini & Thelen, 2008),
(2) in an ambiance that includes classical music, customers tend to buy more expensive wines (Areni & Kim, 1993),
(3) "the music tempo variations can significantly affect the pace of in-store traffic flow and dollar sales volume" (Milliman, 1982, p. 86). In any case, it should be noted that music has the greatest impact on consumer spending when there is a high degree of congruency between the background music and the environment (Jacob, 2006)[5],
(4) music can be identified in commercials as a stimulating component (Hecker, 1984), as a significant background feature (Morris & Boone, 1998), as a peripheral persuasion cue (Park & Joung, 1986). Nevertheless, the choice of background music should take into account not only the product category of the advertisement (Allan, 2008), but also what the brand represents (Lavack et al., 2008). Moreover, the potential of music, as far as advertising is concerned, varies in terms of its intensity (Szabo, 2017) but also in terms of style and genre (Craton & Lantos, 2011; Graakjaer, 2014). For example, the inclusion of classical music in television commercials does not add value, "even for individuals whose sociodemographic backgrounds would indicate an increased preference for this music" (Kupfer, 2017, p. 44). However, it is certain that a well-chosen musical background has a significant effect on purchase intention (Ferreira, 2021), increasing the effectiveness of the company's marketing communication activities (Szabó, 2016).

[4] In cases where employees can decide whether or not to listen to music.
[5] According to congruence theory, consumers will spend more if they perceive that the type of music is in line with the business environment.

Material and Method(s)

The main pillar of this study is the analysis of the song *Úristen*[6] [Oh-My-God], as the authors of the song:

(a) Peti Marics and Milán Valkusz are the most successful and most sought-after young performers in Hungary (Tények Plusz, 2022; Dandó, 2022). Their success has not diminished over time (Tények Plusz, 2024), and they are also appearing in more and more shows (e.g. in addition, they have been featured in numerous TV programs (e.g. Asia Express 2022/contestants; Sztárban Sztár 2022/Marics Peti contestant; 2023/Marics Peti jury member, Milan Valkusz contestant; Zsákbamacska 2024/Marics Peti presenter; Megasztár 2024/Marics Peti jury member),

(b) and Róbert Szikóra is the creator of a very distinctive style of music, i.e. the Hungarian *csiki-dam*.

In order to draw a well-defined picture of the musical product *Úristen* [Oh-My-God], the first step was to carry out a content analysis of the song and the video clip according to the following criteria:

(1) use of color,
(2) outfit of the performers,
(3) physical evidence,
(4) message of the song,
(5) word choice.

The second phase was to analyze the reviews published on the song.

1. The research involved the analysis of all relevant comments[7] received between 02 April 2022 and 09 November 2022 in the comment section of the song or video clip. A total of 6,203 comments were written on the music product analyzed, of which 5,990 comments were analyzed, as the communication between the people who expressed their opinions was not analyzed, as it did not contain any relevant information with regard to the research questions raised.
2. In order to facilitate transparency, the categorization of comments was more than necessary. The opinions are grouped according to a particular concept shown in the presentation of results section (directly) below Table 2.

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[6] The song *Úristen* [Oh-My-God] is the final product of the collaboration between ValMar (Peti Marics and Milán Valkusz) and Róbert Szikora. The music video of the song was released on April 2nd, 2022.

[7] https://www.youtube.com/watch?v=HOF3PYjKxm0

3. The definition of the criteria that determined the analysis of the opinions is the result of a long preliminary work, as they were formulated and finalized after reading the comments. Consequently, the analysis of the opinions was carried out according to the following variables:
   (a) emotions evoked by the song,
   (b) positive and negative aspects of the song,
   (c) attitude patterns,
   (d) consumption of the song,
   (e) image of the performers.

This present research aims to answer the following research questions:

Q_1: What is the final product of the song *Úristen* [Oh-My-God]?
Q_2: What are the positive aspects of this musical product?
Q_3: What constitutes the negative aspects of the song?
Q_4: Which forms of attitude can be distinguished in the comments?
Q_5: How often is the song consumed?
Q_6: Which adjectives do viewers use to describe the performers?

Results and Discussions

Content analysis of the lyrics and video clip of the song Úristen [Oh-My-God]

Content analysis was based on the criteria that play a significant role in the reception of a given musical production.

1. The color scheme of the clip is retro, with brown, orange, beige, green, dominating the whole clip. Again, the blurred film frames reinforce the retro feel.
2. The characters in the video clip are representatives of the rockabilly style: the ladies' outfits are defined by the make-up, the polka-dot, narrow-waisted and flared skirts, use of belts and high heels. Men wear black leather jackets and sunglasses as accessories.
3. Physical evidence: the location of the video clip is a contemporary bistro. The furnishings imitate a retro atmosphere, with iconic elements such as: a disco ball, a telephone booth, a jukebox. The display of the Cadillac in the video clip was also intended to reinforce nostalgia.
4. Enjoying and embracing life is at the heart of the production's message.
5. The vocabulary of the song includes both slang used by young people (yeah, baby, baby, Oh-My-God) and concepts associated with retro feelings, such as the use of cologne.

The content analysis of the song and the video clip (including the storyline) suggests that the song promotes (1) the enjoyment of life, (2) the search for adventure, and (3) the feeling of being 'forever young'. If the message of the video clip is interpreted in the context of consumer behavior, it can be concluded that the music industry (also) plays a significant role in the phenomena that shape society at a given time, since trends such as hedonism, the pursuit of experiences and the desire for 'eternal youth' can be identified in the production.

Analysis of consumer feedback on the music product Úristen [Oh-My-God]

Consumers' behavior varies according to the crucial event that occurs in one's life (Keller & Kotler, 2006). However, in the music industry, such generalizations - regarding the relationship between the consumption of a particular musical work and a certain crucial event - cannot be made, as there are musical works that individuals can claim regardless of whether they are about birth or death (Kulcsár and Crenganeș, 2019). The best example of this in Romania is Gheorghe Zamfir's song *The Lonely Shepherd*, which can be associated with both weddings and passing away (Szabó, 2021): i.e. with joy and sorrow. In fact, the final product of a musical creation is primarily the emotions and feelings that a given song evokes (Kulcsár and Crenganeș, 2019). In the following (Table 1), the end products of the song *Úristen* [Oh-My-God] are categorized:

Table 1. The end products of the song *Úristen* [Oh-My-God]

High spirits	Nostalgia	Joy	Cheering up	Happiness
6[8]	9	9	6	4
Addiction	Joy of life	Tranquility	Love	Youth
3	3	1	1	2
Energy	Serenity	Brings people together	Sets the mood	
1	1	1	1	

Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PyjKxm0

The song included in the analysis mainly evokes joy or nostalgia in the listeners. The results suggest that the song is popular not only among young people, but also among the older generation, since Róbert Szikora's presence, his participation and the way he appears reminds them of their youth: in fact, it

[8] Frequency of occurrence in comments.

brings generations together, bringing back those 'good old times'. Overall, the conclusion can be drawn that the end products of the song are positive and represent added value for the consumer, because it makes them to cheer up; provides happiness; encourages us to enjoy life; motivates to be more relaxed; gives love, energy, serenity, joy, high spirit and a positive basic mood. The categorization of the end products of the song based on emotions is presented in the following figure (Figure 1).

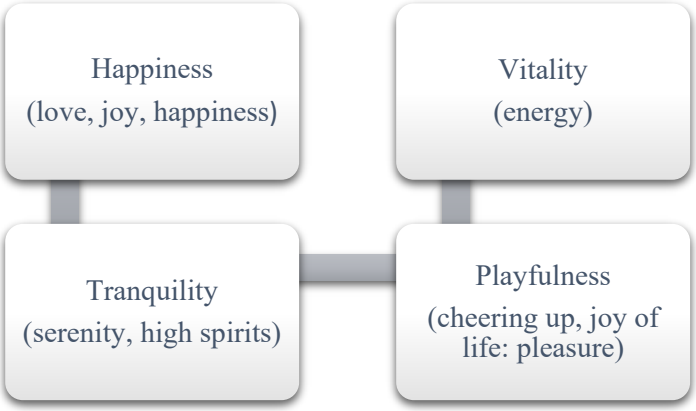

Figure 1. The end products of the song *Úristen* [Oh-My-God]
Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PyjKxm0

As illustrated in the figure above (Figure 1) ValMar ft. Robi Szikora's song can be structured in terms of emotion into the following four groups: happiness (14), tranquility (7), playfulness (9), and vitality (1). However, the end products of a given song can be differentiated depending on what the consumer is experiencing. Whatever the interpretative and experiential mechanism, the elicitation of emotions can be understood as a basic requirement for a song, apart from the fact that the intensity and nature of emotions can vary greatly from one individual to another. The question arises, what makes a song popular? There are several factors that directly influence which songs will be popular. Consumer expectations are, in fact, a factor of the success of a particular piece of music. The following table (Table 2) shows the positive aspects of the song, grouped into different categories:

Table 2. The positive aspects of the song *Úristen* [Oh-My-God]

Catchy character[1]	Rhythm[2]	Atmosphere[3]	Voice of the performers [4]	Video clip itself[5]
46	6	6	18	12
Directing the clip[6]	Choreography[7]	Insatiability[8]	Style[9]	Freshness
2	2	2	2	1
Orchestration[10]	Lyrics[11]	Retro style[12]	Harmony [13]	Humor[14]
1	6	14	3	1

Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PyjKxm0

[1]very catchy, so catchy, crazy catchy [2]has good rhythm, very good rhythm [3]very good atmosphere, good atmosphere, fantastic atmosphere [4]good voice, brutal voice, fantastic voice, beautiful voice, unique voice, hoarse voice [5]super video clip, top video clip, cool video clip, brilliant video clip, good video clip [6]good directing [7]love choreography, good choreography [8]impossible to get bored with [9]like its style, old style, cool style, good style [10]excellent orchestration [11]super cool lyrics [12]good retro [13]performers are in harmony with each other [14]funny

According to consumers, the main positive aspect of the song is its catchy melody. It is this characteristic that helps to transform the consumer from being a mere consumer into a regular customer, especially in case of songs of this type. The second most important positive aspect is the voice of the performers. The particular tone of voice of the artist(s) can also play a significant role in the 'recognition' of a song, as it can be interpreted as a differentiator from the consumer's point of view. The retro character of the song is the third most frequently identified positive aspect: this feature adds value not only for older generations but also for younger people, as retro is a very popular genre nowadays.

The quality of the music video, and the nature of the song itself, can play an important role in the reception of a piece of music. Consequently, it is worth examining separately what consumers perceive as positive aspects of these two components. The positive characteristics and parameters of the song and the video clip (Table 3), as expressed in the comments, were the following:

Table 3. Categorization of the positive aspects of the song and video clip *Úristen* [Oh-My-God]

The song	The video clip
○ catchy characteristic, ○ rhythm, ○ atmosphere, ○ the voice of the performers, ○ insatiability, ○ lyrics, ○ retro style, ○ humor, ○ orchestration.	○ atmosphere, ○ directing, ○ choreography, ○ style, ○ retro style, ○ harmony, ○ humor.

Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PYjKxm0

The positive aspects that apply to both the song and the video clip are: atmosphere, retro character, humor. The consumer's attitude towards a particular service product typically influences his/her evaluation of it, his/her consumption of it, since attitude is a cognitive representation that (in a broad sense) summarizes the individual's evaluation of a person, group, item or possibly an action, i.e. it is a permanent attitude that includes appreciative behavior (Domokosi, 2007). The majority of the respondents expressing their opinion adore the analyzed song, as 115 comments contained the term 'adore', which is the primary evidence of an enthusiastic attitude (Table 4).

Table 4. The categorization of the attitudes towards the song *Úristen* [Oh-My-God]: positive domain

Adores	Likes	Loves	Favorite	Respects
115	7	7	14	1
Categorization				
Enthusiastic (115)	Positive (29)			

Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PYjKxm0

In services, including the music industry, how consumers perceive the service product as a whole is very important. In the table below (Table 5), we have categorized the positive attributes that can be interpreted as specific to the analyzed song.

Table 5. The evaluation of the song *Úristen* [Oh-My-God]

Brutal (1)	Good (20)	Super (11)	Hit of the year (20)	Unbelievable (4)
Best (32)	Summer hit (12)	So good (12)	Best song of the world (16)	Wonderful (3)
Cute (1)	Brutal good (9)	Amazing (4)	Very good (121)	Stunning (1)
Fantastic (8)	Bull's eye (1)	Favorite (2)	Phenomenal (1)	Powerful song (2)
So great (2)	Huge (10)	Rules (9)	Excellent (1)	Insatiable (3)
Cool (5)	Got great (8)	Great (3)	Premium (2)	Sensational (1)
Beautiful (2)	Genius (6)	Fresh (1)	Unforgettable (1)	

Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PYjKxm0

The respondents used a total of 34 different (positive) adjectives to rate the song: most of them rated the song as 'very good'. However, due to our human nature, there is no single product or service that can be uniformly liked by every single consumer. At the same time, stereotypes can play a significant role in the consumer's attitude towards something, since in this case the consumer tends to be a justifier of them (Kovács, 2004). The song being analyzed was described by the respondents as having the following negative connotations (Table 6):

Table 6. The categorization of the attitudes towards the song *Úristen* [Oh-My-God]: negative domain

Negative aspects	**Attitude**			
Amateur	Negative (49)		Hostile (22)	
1				
Too simple lyrics	Bad	Cringe	Irritating	Infernal
8	42	1	8	1
Mass production	Not good	Poor	Annoying	Dreadful
1	2	1	6	1
Not good voice	Not the best		Terrible	Unworthy
5	2		3	1
Not good videoclip	Lousy		Nasty	Disgraceful
1	1		1	1

Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PYjKxm0

The simplicity of the song's lyrics has left some consumers feeling inadequate. At the same time, the music industry is not immune to the direct impact of all the changes that society has to confront in a given period of time. Consequently, changes in the macro-environment also shape the expectations and needs of a song. For example, in May 2022, the popular program *Csináljuk a fesztivált!* [Let's make a festival!] on *Duna* TV channel was won by the song *Lady M* performed by Peter Šrámek[9], because the pandemic, the Ukraine-Russia war, has made people want to hear cheerful songs, not deeply sad ones. Of course, none of this detracts from the vocal qualities of the performer or the 'raison d'être' of songs of this kind. In all, 49 people expressed negative and 22 hostile attitudes towards the song.

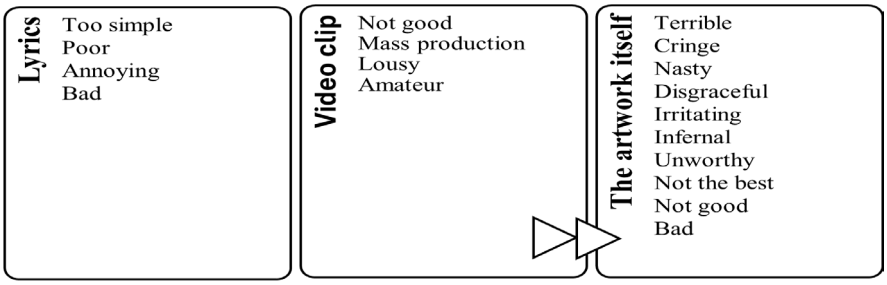

Figure 2. Categorization of negative aspects of the song *Úristen* [Oh-My-God]
Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PYjKxm0

[9] https://www.youtube.com/watch?v=z8Ebka02TWY

In order to get a more detailed picture, the negative comments were grouped according to whether they referred to the lyrics themselves, the video clip or to the artwork as a whole.

As the literature points out, the success of any business depends on satisfied customers, i.e. loyal consumers. The frequency with which a song is consumed depends on many factors, e.g. the age of the consumer, as young people tend to create their own playlists, while the older generation mostly listens to songs played by radio stations (*Tények Plusz*, 2024). It is important to note that the aggressive presence of a particular piece of music in everyday life (played on several media) also has a negative dimension, since this is when the 'it is all over the news' phenomenon occurs. Figure 3 illustrates the frequency of consumption of the song analyzed.

Figure 3. Consumption frequency of the song *Úristen* [Oh-My-God]
Source: Authors' compilation based on the comments made https://www.youtube.com/watch?v=HOF3PYjKxm0

The image that consumers have of the performers can also play a big role in the reception of a song. The table below (Table 7) categorizes consumer feedback on the image of Róbert Szikora and ValMar.

Table 7. The image of Róbert Szikora and ValMar

Róbert Szikora	ValMar
Humble (1)	'Cuties' (1)
Good (2)	'Big' (1)
So good (2)	The best (6)
Very good (11)	Super (2)
The best (2)	Very good (10)
'Cherry on cake' (1)	'Huge' (1)
Icon (1)	Geniuses (3)
Fits the music (2)	The most talented (4)
God (2)	Excellent (1)
Top (1)	'Sweet' (1)
Rules (2)	Rules (2)
Legend (5)	Smart (4)
Still: Good (2), 'Big' (1) Unbeatable (1)	They cannot deliver anything bad (3)

Róbert Szikora	ValMar
'Retro face' (1)	
Amazing (1)	
'Huge' (1)	
Forever young (1), Young (1)	
Professional (1)	

Source: own, based on the comments made
https://www.youtube.com/watch?v=HOF3PYjKxm0

The information presented in the table above, suggests that:

(1) over the years, Róbert Szikora has managed to maintain all the personal characteristics that define him as a performer (humble, authentic, youthful). In fact, these personal characteristics, in addition to his talent, have enabled him to gain the recognition of both the profession and the public[10].

(2) ValMar, before the song *Úristen* [Oh-My-God], managed to create an identity that caught the attention of the younger generation, but their popularity grew after the release of the analyzed song. As Róbert Szikora noted, ValMar "let in some fresh air into the world of Hungarian Rock'n Roll" (Lendvai, 2022).

Conclusion

The success of the song *Úristen* [Oh-My-God], according to the consumers' opinions, is due to:

- ✓ the use of multidimensional segmentation,
- ✓ generating end products that add value for consumers by triggering positive emotions,
- ✓ paying attention to trends,
- ✓ the harmony between the performers and the identity of the performers also ensures the authenticity of the musical production.

[10] Popmeccs - Vocalist of the Year (1985), Popmeccs - Composer of the Year (1986, 1987), Popmeccs - Lyricist of the Year (1986), EMeRTon Award (1988), Börze Award - Lifetime Achievement Award (2003), Knight's Cross of the Hungarian Order of Merit (2013), Jimmy Zámbó Award (2016), Budapest Prize (2019), Péter Máthé Award (2023).

Overall, it should be taken as a fact that (1) the problems that society is facing, (2) the trends that are emerging internationally are shaping consumer expectations of music products, and (3) the image of the artist can be an important factor in the reception of a song. At the same time, the consumer is a critical element in the music industry, since not only changes in the macro-environment can influence consumer expectations, but also events in the micro-environment can shape consumer tastes, i.e. when, what kind of songs and what content they listen to. Consequently, music itself is a very complex service for which there will always be a demand from society, despite the fact that there are periods when there are demand troughs for some music and peaks for others.

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THE ROLE OF TRANSFER PRICING LEGISLATION IN MITIGATING BASE EROSION AND PROFIT SHIFTING IN DEVELOPING COUNTRIES WITH A SPECIFIC FOCUS ON ZIMBABWE

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ABSTRACT. In today's interconnected global economy, transfer pricing has emerged as a critical issue for governments worldwide. Tax authorities are particularly concerned about its potential for profit shifting to low-tax jurisdictions, which can significantly reduce overall tax liabilities. This study investigates the role of transfer pricing regulations in mitigating base erosion and profit shifting in Zimbabwe. Utilizing a qualitative systematic review method, the research provides insights into the current state of transfer pricing regulations in Zimbabwe and offers recommendations to enhance their effectiveness. The study also addresses the challenges faced by tax authorities in enforcing these regulations and proposes policy recommendations to improve compliance and effectiveness. The findings indicate that robust transfer pricing regulations can significantly reduce base erosion and profit shifting. The study recommends the implementation of Advanced Pricing Arrangements (APAs), safe harbors, materiality thresholds, and training programs for Zimbabwe Revenue Authority (ZIMRA) G3 Officials to strengthen the effectiveness of transfer pricing regulations in Zimbabwe.

Keywords: Base Erosion, Profit Shifting, Transfer Pricing, Regulations, Zimbabwe

JEL classification: G3, H2, H3

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Introduction and review of literature

Given the increasing globalisation of businesses, there is a rising concern that multinational enterprises (MNEs) frequently use transfer pricing to shift profits from high-tax to low-tax jurisdictions, thereby maintaining a semblance of legality (Sebele-Mpofu et al., 2021a,b). Bhat (2009) also notes that transfer pricing can facilitate profit manipulation across different jurisdictions. Similarly, Teles et al. (2024) assert that profit shifting by multinationals is a significant challenge for low- and middle-income countries (LMICs). Although many nations have introduced anti-profit shifting regulations to combat this form of tax avoidance, the effectiveness of these measures remains largely uncertain. This suggests that transfer pricing could be used as a method for Base Erosion and Profit Shifting (BEPS), thereby affecting corporate tax revenue mobilisation in developing countries (Sebele et al., 2022). Consequently, it is crucial for countries to implement strategies to mitigate tax-motivated transfer pricing in today's interconnected business environment.

Developing countries need to strengthen their policies to protect tax bases and minimize revenue losses (Oguttu, 2018). Transfer pricing, if not properly regulated, can lead to tax avoidance, evasion, and illicit financial flows, causing significant losses. Recognized as a complex issue in international taxation (United Nations Conference on Trade and Development / UNCTAD, 1999), transfer pricing remains a critical challenge for MNEs and tax administrations (Mortished, 2006). This study explores the effectiveness of transfer pricing regulations in preventing profit shifting and enhancing tax revenue collection. Governments must ensure that MNEs report taxable profits accurately, reflecting their economic activities (OECD, 2022). With the evolving tax landscape and OECD's influence, transfer pricing is a priority for tax administrations and taxpayers (KPMG, 2019). MNEs often shift profits from high-tax to low-tax jurisdictions through transfer pricing (Kalra & Afzal, 2023). Research by Crivelli et al. (2016) highlights the impact of profit shifting on developing countries' tax income, economic growth, and equitable taxation. This paper examines the role of transfer pricing legislation in mitigating BEPS in Zimbabwe, a developing country. It explores OECD guidelines, frameworks, and Zimbabwe-specific laws, assessing their effectiveness in curbing BEPS and identifying barriers and opportunities for successful implementation. The insights aim to help policymakers, tax authorities, and businesses make informed decisions to create fair tax policies and improve transfer pricing laws.

Defining key terms

Transfer Pricing and the arm's length principle

Transfer pricing is legal in nearly all countries (OECD, 2022; Beebeejaun, 2018). Without it, MNEs could shift profits to low/no-tax jurisdictions, inconsistent

with their economic substance. The OECD (2010) defines transfer pricing as setting prices for goods, services, and intangible assets exchanged between related entities, whether in the same or different countries. Eden & Huxham (2016) notes that transfer pricing determines each party's income, crucial for allocating profits and tax liabilities across jurisdictions. However, it has led to increased BEPS (Ngorima, 2016), raising concerns among policymakers and regulatory bodies. MNEs exploit transfer pricing complexities to minimize tax liabilities. This necessitates a review and reform of transfer pricing guidelines to ensure fair taxation. The 'arm's length principle' (ALP) is vital for setting appropriate prices and avoiding double taxation (McNair et al., 2010; OECD, 2022). It is noteworthy that the ALP mandates pricing as if transactions occurred between independent parties, making it an international norm. Further, many double-tax treaties contain provisions for resolving transfer pricing disputes based on the ALP. Beebeejaun (2018), and Dharmapala (2014) assert that the ALP is central to the OECD guidelines for transfer pricing, and this is in line with the above discussion. However, researchers have debated its adequacy and suitability in regulating transactions among related parties. The ALP faces additional challenges in developing countries where economic conditions differ from those of developed nations (Oguttu, 2016, 2018; Mashiri, 2018). These include limited comparability data, evolving business landscapes, and complexities in pricing transactions. Some scholars argue that applying the ALP in developing countries, such as Zambia, Malawi, and Kenya, presents conceptual and practical difficulties (Mashiri, 2018). Increased disputes, tax administration complexities, and compliance burdens also arise from enforcing the principle. Corruption and weak institutional environments complicate transfer pricing regulation in these contexts (McNair et al., 2010).

Profit Shifting

Profit shifting refers to multinational corporations transferring profits from high-tax nations to low-tax jurisdictions or tax havens to minimise tax liability (Oguttu, 2018). This practice involves underreporting profits in countries where the company operates, resulting in reduced or no tax payments in those nations. Hines (2014) asserts that MNEs employ various strategies to minimise their tax liabilities, with profit shifting emerging as a significant concern in the contemporary global business landscape. Even though transfer pricing regulations can help manage tax liabilities, they also carry the risk of being exploited for profit manipulation. Base erosion is mainly caused by MNEs adopting profit-shifting methods, according to KPMG (2019).

It can be deduced that MNEs manipulate transfer pricing by setting prices for goods and services exchanged between subsidiaries to shift profits to low-tax jurisdictions (such as tax havens) while minimising tax liabilities in high-tax countries. Accordingly, tax havens often impose minimal or no corporate taxes and have limited information-sharing requirements to facilitate this tax avoidance. Tax havens encourage aggressive transfer pricing practices by reallocating taxable profits to low-tax countries and reducing local taxes on foreign income (OECD, 2013). In addition, there is an issue of thin capitalisation. This capitalisation is when a company has a high level of borrowing relative to its equity base (PWC, 2015). Sebele-Mpofu et al. (2021a) submit that thin capitalisation is applied when high debt levels are derived from related companies. MNEs often use strategies such as artificially inflating interest payments to affiliated entities in low-tax jurisdictions, leading to excessive interest deductions and reduced taxable profits in developing countries (Dharmapala & Riedel, 2013).

Status of Transfer Pricing Regulations in Zimbabwe

According to Ngorima (2016), in Zimbabwe, transfer pricing regulations are designed to control the pricing of transactions between related parties. These regulations ensure that business dealings occur at arm's length, preventing unfair transfer pricing practices. By doing so, they safeguard the tax system's integrity and address BEPS by multinational businesses (MNEs) (Mashiri, 2018; Sebele-Mpofu et al., 2021b). According to Mashiri (2018) Zimbabwe Revenue Authority (ZIMRA) enforces strict restrictions and monitors compliance to reduce the likelihood of MNEs transferring profits from high-tax to low-tax jurisdictions. As a result, the goal is to adjust prices to reflect what would have been applied under standard commercial conditions between independent entities.

In Zimbabwe, transfer pricing regulations align primarily with guidelines from the OECD (2013; 2022). These regulations were incorporated into Zimbabwean law in 2016 through amendments to the Income Tax Act 23 of 2016 (hereinafter referred to as the ITA). The concept of the arm's length principle has long been part of sections 23, 24, and 98 of the Zimbabwean. Section 24 applies to business or financial dealings involving local and international parties. Section 23(1) explicitly addresses property sales at prices below fair market value, including immovable property. Section 98 deals with tax avoidance schemes related to non-arms-length transactions. Enforcing Section 98 can be challenging for ZIMRA, as they must demonstrate that a transaction was undertaken primarily or solely to evade or delay tax payments. However, guidance on determining whether transactions align with the arm's length principle was introduced by the Zimbabwean Commissioner General on 1 January 2016 (KPMG, 2019).

The regulations by the Zimbabwean Commissioner General mandate that taxpayers prepare documentation for their annual statutory returns. This documentation should cover an overview of the business operations, organisational chart, group structure, and group operational structure. Taxpayers must justify their transfer pricing method and explain why it's the best choice for a specific transaction. The ITA outlines five methods, each suitable for different types of transactions. Commonly recommended methods include cost-plus, resale, and comparable unit prices (OECD, 2022). However, they can be used if other approaches better fit the situation. While the Comparable Uncontrolled Price (CUP) method is straightforward, it may not suit complex transactions. Having documentation prepared by someone well-versed in the nuances of these methods is advantageous for taxpayers.

In addition, the Zimbabwean regulations also necessitate adjustments to ensure compliance (Mashiri, 2018). These compliance adjustments account for jurisdiction-specific characteristics. For instance, a location adjustment may be made if the taxpayer benefits from region-specific advantages (such as savings) or faces political or economic risks that could impact pricing. Consequently, the charged price may vary based on these considerations. Conclusively, the transfer pricing legislation governs the buying and selling of goods, components, or raw materials; provision of services; financial transactions including guarantees; transactions involving intangible assets such as acquisition, sale, or licensing; share transactions including internal restructuring, transactions involving in-kind exchanges such as capital contributions or dividends, and dealings with administrators and shareholders such as salaries.

International Standards and Guidelines

OECD (2013) developed guidelines to combat profit shifting and promote equitable transfer pricing practices. These guidelines establish the arm's length principle, ensuring that transfer prices align with those negotiated between unrelated parties (OECD, 2022). By adhering to these guidelines, nations can mitigate profit shifting and ensure fair market value transactions. The OECD's Transfer Pricing Guidelines (2010) provide detailed instructions for multinational enterprises and tax authorities on applying the arm's length principle across borders. Meanwhile, the UN (2013) focus on transfer pricing concerns, especially for developing nations. Both emphasise documentation, but the UN offers simplified requirements tailored for countries with limited capabilities. These guidelines foster international cooperation and data exchange among tax authorities, addressing challenges posed by the global operations of multinational enterprises.

The OECD's transfer pricing regulations have drawn both praise and criticism. However, critics like Durst (2019) argue that the OECD guidelines are unrealistic for developing nations. The arm's length principle, central to these guidelines, can be challenging due to transactions between affiliated companies that don't mirror those between independent entities. Durst (2019) further critiques the "comparable" price requirement, especially for global companies with integrated operations. On the other hand, Oguttu (2018) defends the arm's length principle, emphasising its positive outcomes and the risks of rejecting it. The OECD faces criticism for its interactions with tax havens and its focus on wealthy nations (Oguttu, 2016). The UN also created guidelines based on the OECD's recommendations for developing economies (UN, 2013). These discussions highlight ongoing debates and the evolving landscape of transfer pricing regulations.

Challenges in implementing transfer pricing regulations

There are many challenges in implementing transfer pricing regulations in developing countries, including capacity and expertise. Eden (2009) asserts that tax authorities in developing nations often lack the necessary knowledge and resources to effectively monitor and enforce transfer pricing rules. This implies a shortage of skilled tax professionals and limited technological infrastructure can hinder their efforts. In addition, there is an issue of data limitations. Access to comparable data is crucial for applying the arm's length principle. PWC (2015) cites that developing countries face difficulties due to limited resources and a lack of local comparables. Without robust data, determining fair market value becomes challenging, and countries like Zimbabwe operate in unique economic environments, which introduces additional complexities. Political pressure from MNEs significantly contributes to the local economy and can impact transfer pricing enforcement. A further challenge is the alignment with the international standards. Picciotto (2017) concludes that harmonising local transfer pricing regulations with international standards (such as those set by the OECD) can be tricky. This is because differing economic priorities and contexts may require tailored approaches.

Referring to Table 1, Zimbabwe, emphasise the arm's length principle. With an amendment to the ITA, Zimbabwe established transfer pricing regulations in 2016. These clauses are based on the ITA's sections 19, 24, and 98 and the Fourth and Fifth Schedules. Extra guidance on evaluating arm's length consideration in cross-border related party transactions is given in Practice Note 7. From the table, Zimbabwe does not have any specific transfer pricing methods outlined in its legislation.

Table 1. Comparison of Zimbabwean Transfer Pricing Regulations with International Guidelines

CATEGORY	INTERNATIONAL GUIDELINES		ZIMBABWE
	OECD	UN	
Documentation	A three-tier structure is outlined in Chapter V of the OECD guidelines: (i) a master file with standardised information pertinent to all MNE group members; (ii) a local file that specifically mentions significant transactions made by the local taxpayer; and (iii) a Country-by-Country (CbC) report with specific information about the worldwide distribution of the MNE's income and taxes paid. According to the standards, a thorough functional analysis and a complete comparability study must be the foundation for the transfer price analysis. Nevertheless, only MNEs with at least €750 million in revenue should be obliged to file the CbC report, as per the OECD/G20 Final Documentation Report. This code complied with BEPS Action 13, which focuses on reevaluating documentation related to transfer pricing (Ernst and Young, 2021).	While adhering to the OECD documentation guidelines, the UN suggests that guidelines for the content of the local file incorporate materiality thresholds that take the size and characteristics of the MNE into account. It recommends that the materiality levels be tailored to the local laws as revenue/cost thresholds or a set amount. It also promotes SMEs to be exempt from thresholds based on transaction volume or freed from maintaining documentation (C2.4.4).	Documentation should be contemporaneous and filed with the annual tax returns.
Deadline	The OECD leaves the prescription of deadlines to domestic law.	The UN leaves the prescription of deadlines to domestic law.	The necessary documentation needs to be in place when the income tax return is filed, and it needs to be turned in to the Commissioner-General within 30 days of the Commissioner-General sending out a written request.
Advanced Pricing Agreements (APAs)	The Mutual Agreement Procedure (MAP) Advance Pricing Agreement (APA) is an initiative by the OECD to support agreement banks. The primary goal of the MAP APA process is to eliminate any possibility of double taxation. According to the OECD, governments often favour bilateral or multilateral agreements.	The UN acknowledges that both bilateral and multilateral APAs need a lot of resources, but it nonetheless supports them (C.4.4.2.2).	The Income Tax Act allows taxpayers to enter into APAs with ZIMRA.
Dispute resolution	Effective conflict resolution systems are encouraged by BEPS Action 14 for nations (Ernst and Young, 2021).	The UN supports having an independent judicial system that treats tax cases with impartiality, which can enhance investor confidence.	All tax complaints, even those involving transfer pricing, appear to fall under the usual dispute resolution processes.
Penalties	The OECD recommends that tax authorities implement penalty regimes for transfer pricing that encourage the timely and accurate preparation of transfer pricing documents to foster compliance. To ensure the effectiveness of these documentation requirements and deter non-compliance, the OECD endorses sanctions specific to the documentation (D7 para. 5.40).	The UN indicates penalties for non-compliance with documentation requirements or refusal to pay taxes. Requirements (C.2.4.3).	Non-compliance with the transfer pricing regulations may result in penalties, including transfer pricing adjustments, interest charges on unpaid tax, and potential penalties for inaccuracies or omissions in the documentation.
Databases/ Comparable data	Paragraph A4.3 prohibits tax authorities from employing transfer pricing methods using information not disclosed to taxpayers. However, it permits the usage of external databases if internal databases are unavailable.	According to the UN, failing to meet filing requirements or not paying taxes can lead to penalties (C.2.4.3). Furthermore, the UN encourages using internal databases as a first step before turning to external ones (C5.6.4).	The ITA acknowledges that the internal databases may be unavailable, so other sources are permissible. Reliability thereof is considered on a case-by-case basis.
Transfer pricing methods	The OECD outlines five transfer pricing methods, which can be generally classified into two categories: profit-based methods and traditional methods.	It borrows five transfer pricing methods from the OECD.	Zimbabwe does not have specific transfer pricing methods outlined in its legislation.

Source: Own compilation based on Ngorima (2016); the OECD Transfer pricing guide (2010), UN Manual on Transfer Pricing (UN, 2013)
Note: It is noteworthy that the international guidelines' sections/categories, that is both OECD and UN are indexed in letters A-D, which represent specific sections within these guidelines.

Materials and Methods

This paper used a qualitative systematic review method inspired by Tay et al. (2022) study, following Mpofu's (2021) definition of systematic reviews. These reviews involve systematically searching, identifying, extracting, analyzing, and synthesizing information based on pre-established guidelines. The outcomes can be qualitative or quantitative (Snyder, 2019). This approach ensures replicability and standardization, enhancing trustworthiness and credibility (Paré & Kitsiou, 2017; Mpofu, 2021). Tay et al. (2022) focused on two areas: the establishment and adoption of transfer pricing legislation across countries, and how such regulations in developing countries like Zimbabwe address BEPS. They explored the role of transfer pricing legislation in promoting revenue growth and its implications for stakeholders.

The researchers conducted a comprehensive literature search across databases like Elsevier, Springer, Emerald, Science Direct, ProQuest, and Scopus, using terms related to transfer pricing, BEPS, and compliance strategies. They included peer-reviewed articles, working papers, and reports from organizations like the OECD and UN. Qualitative data analysis continued until saturation, defined as the point where no new codes or themes emerged (Mpofu, 2021). Thematic analysis was used, following Attride-Stirling's (2001) framework and Braun & Clarke's (2006, 2019) process.

Results and Discussion

This part of the paper discusses the established results about the role of transfer pricing legislation in mitigating BEPS. The discussion of the results is organised as follows: (1) features and objectives of transfer pricing legislation, (2) the adequacy of the existing legislation, (3) effectiveness and sufficiency of regulations, (4) possible challenges in implementing the legislation, and (5) recommendations.

Objectives of transfer pricing regulations

This paper established that the transfer pricing legislation seeks to foster tax compliance and documentation, act as an oversight and regulation of the transfer pricing practices of MNEs operating across countries, cover domestic related party transactions and prevent BEPS. These objectives are individually discussed in detail below:

Tax compliance and documentation requirements

The ITA's transfer pricing provisions and regulations (Statutory Instrument [SI] 109-2019) aim to promote tax compliance and prevent profit shifting for fair taxation and revenue generation. Based on the reporting by KPMG (2019), Zimbabwe has implemented robust transfer pricing methods to tax profits where economic activities and value creation occur. Hence, taxpayers must maintain comprehensive documentation, including functional and comparability analyses, detailed business descriptions, and evidence supporting chosen transfer pricing methods (OECD, 2022).

As per the discussion earlier, five different pricing methods can be used to set prices following the arm's length principle. The names of the methods that can be used are the comparable uncontrolled price method, the resale price method, the cost-plus method, the transactional net margin method, and the transactional profit split method (OECD, 2022). Taxpayers must choose the most appropriate method based on the nature of the transaction and available data (OECD, 2022). Documentation should be prepared contemporaneously with transactions and be accessible for ZIMRA to review. This transparency enhances compliance and better assesses reported transfer prices. Consequences for non-compliance encourage voluntary adherence to the regulations, and it is noteworthy that tax compliance regulations should be context-based.

Multinational enterprises oversight

Mashiri (2018) asserts that transfer pricing regulations aim to oversee and regulate the practices of MNEs. These regulations ensure that transactions between related entities occur at arm's length, preventing artificial profit shifting and safeguarding the countries' tax base. The Zimbabwean transfer pricing regulations require related-party transactions, such as those between subsidiaries and parent companies, to be conducted at arm's length prices). MNEs in these countries must maintain comprehensive transfer pricing documentation, including transaction details, pricing methodologies, and supporting analyses. Annual transfer pricing disclosure forms are mandatory, providing information on related-party transactions and resulting profit allocations. Non-compliance can lead to penalties, encouraging adherence to the regulations.

Prevention of base erosion and profit shifting

The systematic review highlights that SI 109/2019 aims to prevent profit shifting by accurately allocating taxable income based on Zimbabwe's economic activities. This safeguards the country's tax base against manipulative transfer pricing practices. According to Ngorima (2016) the regulations ensure that MNEs operating in Zimbabwe allocate profits appropriately, preventing

BEPS. By enforcing the arm's length principle, the regulations create a fair tax environment, curbing profit shifting to low-tax jurisdictions. These regulations promote fair pricing in related-party transactions, enhance transparency, and encourage compliance. However, some scholars argue that these regulations alone are insufficient to comprehensively address profit-shifting issues, as transfer pricing regulations in Zimbabwe are still a work in progress and continue evolving (Sebele-Mpofu et al., 2021b).

Effectiveness and Sufficiency of the Transfer Pricing Regulations

Significant changes in business operations or pricing strategies remain scarce despite improvements in documentation and reporting. This suggests that many corporations comply superficially, adhering to existing transfer pricing policies that may not fully align with arm's length principles. In this section, we explore the effectiveness of Zimbabwe's existing transfer pricing regulations in curbing profit shifting and ensuring equitable taxation.

Adequacy of current regulations

According to Wealth et al. (2022), Zimbabwe's current transfer pricing regulations may not fully address domestic transfer pricing complexities. KPMG (2019) suggests that safe harbours and Advance Pricing Agreements (APAs) could simplify processes and enhance clarity for tax authorities and taxpayers. On the other hand, the existing measures, such as transfer pricing regulations, thin capitalisation rules, and documentation requirements, partially mitigate profit shifting. In conclusion, as Zimbabwe's regulatory framework matures, ZIMRA's expertise in handling transfer pricing issues is expected to improve as individuals receive education and training on transfer pricing issues.

Cases and Awareness of Profit Shifting

Sebele-Mpofu et al. (2021a) assert that ZIMRA authorities and taxpayers are familiar with the concept of transfer pricing, and their definitions of it are influenced by their epistemological perspectives, which are shaped by their experiences and professional backgrounds. However, despite the familiarity with transfer pricing regulations, direct encounters with profit shifting are uncommon. Scholars are not aware of profit-shifting strategies, such as charging high management fees or manipulating interest rates, but direct evidence of such activities is limited, and this is in line with Dharmapala (2014) findings. It can be concluded that while MNEs and tax authorities are aware of profit-shifting conceptually, the literature indicates indirect encounters rather than concrete cases. This suggests that profit shifting may be subtle or underreported in Zimbabwe.

Compliance efforts by multinational corporations

According to Ngorima (2016) transfer pricing regulations have prompted increased compliance efforts among taxpayers. In support, several researchers have highlighted the benefits of adopting transfer pricing regulations, including protecting the tax base, stabilising the investment climate, and attracting foreign direct investment (Mashiri, 2018). This means they must now maintain detailed documentation and justify their transfer pricing policies. Some MNEs have adjusted their practices to align with the arm's length principle, although changes in underlying business operations remain limited (Sebele-Mpofu et al., 2021a). This implies that some companies have restructured their operations by operating divisions within a single entity rather than as separate legal entities to simplify compliance. This shift reflects the impact of transfer pricing regulations in Zimbabwe.

Enforcement, Monitoring and Penalties

The ZIMRA enforces SI 109/2019, conducting tax audits and reviewing taxpayer documentation to ensure compliance with the arm's length principle. ZIMRA has the authority to adjust taxable income if transfer prices reported by taxpayers deviate from arm's length conditions. Penalties for non-compliance include fines and adjustments based on ZIMRA's assessment. These penalties act as a deterrent, encouraging voluntary compliance and accurate tax assessment.

Operational challenges in implementing transfer pricing regulations in Zimbabwe

This section of the chapter explores the operational challenges that hamper the implementation of transfer pricing regulations in Zimbabwe.

Administrative and Compliance Burden

Compliance with the regulations imposes a significant administrative burden on businesses, particularly smaller enterprises that may lack the resources to maintain extensive documentation. According to Mashiri (2018), compliant taxpayers and the ZIMRA authorities face significant administrative burdens. The complexity of complying with transfer pricing regulations is a notable challenge, often leading to frustration among taxpayers. Oguttu (2016) argues that while revenue authorities aim to combat profit shifting, the regulations are burdensome for compliant taxpayers. From the ALP perspective, the ALP imposes extensive documentation, information, and professional resource requirements that the need for diverse documentation makes the ALP application costly and time-consuming. Information asymmetry and lack of

resources often favour MNEs over tax authorities (Sebele-Mpofu et al., 2021b). This complexity burdens developing countries' tax systems and benefits tax consultants (Picciotto, 2017). The ALP increases administrative and compliance burdens, creating opportunities for tax planning and avoidance.

Zimbabwe is considered to have high taxes, and the high cost of compliance feels punitive (Mpofu & Wealth, 2022; Sebele-Mpofu et al., 2021b). This is because every transaction, regardless of its magnitude, must be disclosed, making compliance costly. This points out that annual updates to transfer pricing documents are expensive. It can be inferred that the regulations, though well-intended, impose significant costs on taxpayers.

Hence, the enforcement of transfer pricing regulations by ZIMRA is hampered by administrative burdens and limited capacity. Mashiri (2018) cites that ZIMRA's skills are still developing, and they lack the leverage of consulting firms. As a result, there is a need for capacity building within ZIMRA, noting a skills gap and insufficient enforcement since the regulations were introduced in 2016.

The learning curve for transfer pricing legislation

The learning curve for transfer pricing in Zimbabwe is steep for taxpayers and authorities. Sebele-Mpofu et al. (2021b) found that the current transfer legislation is a learning curve and a foundation to build on. They further established that implementing transfer pricing legislation is essential but emphasised that challenges on the effectiveness of transfer pricing legislation must be addressed. The challenges include the lack of skills, expertise and financial resources, unavailability of comparable data and databases, corruption and many other issues that need to be dealt with urgently to make the current legislation more fruitful. In affirmation, Ngorima (2016) asserts that since the regulations were introduced in 2016, there has been a lack of clarity and understanding. As a result, taxpayer training and digital platforms are needed to provide compliance guidance. Overcoming these challenges will require time and effort from both sides.

Benchmarking and data access issues

Accessing relevant data and benchmarking tools is a significant challenge, including the issue of comparable data. Wealth et al. (2022) aver that while data for leasing transactions is easily accessible from real estate companies and financial transaction data is regulated by the Reserve Bank of Zimbabwe obtaining data for other transactions is challenging. The data is crucial for MNEs to apply transfer pricing methods like the Comparable Uncontrolled Price as required by Zimbabwean transfer pricing legislation. This limitation adds to the

already high compliance costs, such as, producing transfer pricing documentation. It can be inferred that the lack of local comparables and the high cost of international databases hinder taxpayers and ZIMRA from accurately establishing arm's length prices. Ngorima (2016) highlighted Zimbabwe's unique economic conditions, such as hyperinflation, which complicate the use of international benchmarks and submits that authorities also lack access to these databases, affecting their ability to interpret results. Addressing these issues requires collaborating to develop a robust, accessible, and reliable database.

Recommendations for Strategic Improvement

Introduction of Advanced pricing Arrangements and establishing safe harbours

The analysis shows a consensus on the need for advanced mechanisms like safe harbours and APAs to simplify compliance. Mpofu & Wealth (2022) adduce that APAs could provide certainty and reduce disputes by allowing taxpayers and ZIMRA to agree on transfer pricing methods in advance. In affirmation, Wealth et al. (2022) state that simplified mechanisms, such as safe harbours for low-risk transactions, could reduce administrative burdens and let ZIMRA focus on high-risk areas. This would ensure that APAs and safe harbours help establish predetermined prices, prevent disputes, and enhance business certainty.

Enhancing training and capacity building

The researchers concluded that enhancing ZIMRA officials' capacity and expertise through targeted training is crucial for effective enforcement. In support, Sebele-Mpofu et al. (2021a), and Wealth et al. (2022) affirm the need for more education and training to enhance competencies on issues related to transfer pricing and adoption of the regulations in place.

Introduction of materiality threshold

Introducing revenue-based thresholds for transfer pricing regulations could reduce unnecessary burdens on smaller entities, such as the Small-Medium Enterprises (SMEs). Researchers suggest that every transaction, regardless of size, must be disclosed without a threshold, which is costly for taxpayers. A threshold would alleviate this burden by requiring disclosure only for transactions above a certain amount, allowing taxpayers to focus on more significant transactions and reducing administrative costs.

Conclusions

In conclusion, the paper's findings indicate that transfer pricing regulations in Zimbabwe have made significant progress in curbing profit shifting. By enforcing the arm's length principle and rigorous documentation requirements, these regulations ensure closer scrutiny of intercompany transactions, thus reducing profit- shifting opportunities. However, their effectiveness relies heavily on robust enforcement and access to reliable benchmarking data. While these regulations adhere to international standards such as OECD, UNCTAD and promote fair tax practices, challenges such as administrative burdens, limited data access, and capacity constraints within ZIMRA hinder their effectiveness. To address these challenges, capacity building, simplified compliance mechanisms, and improved data accessibility are crucial.

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