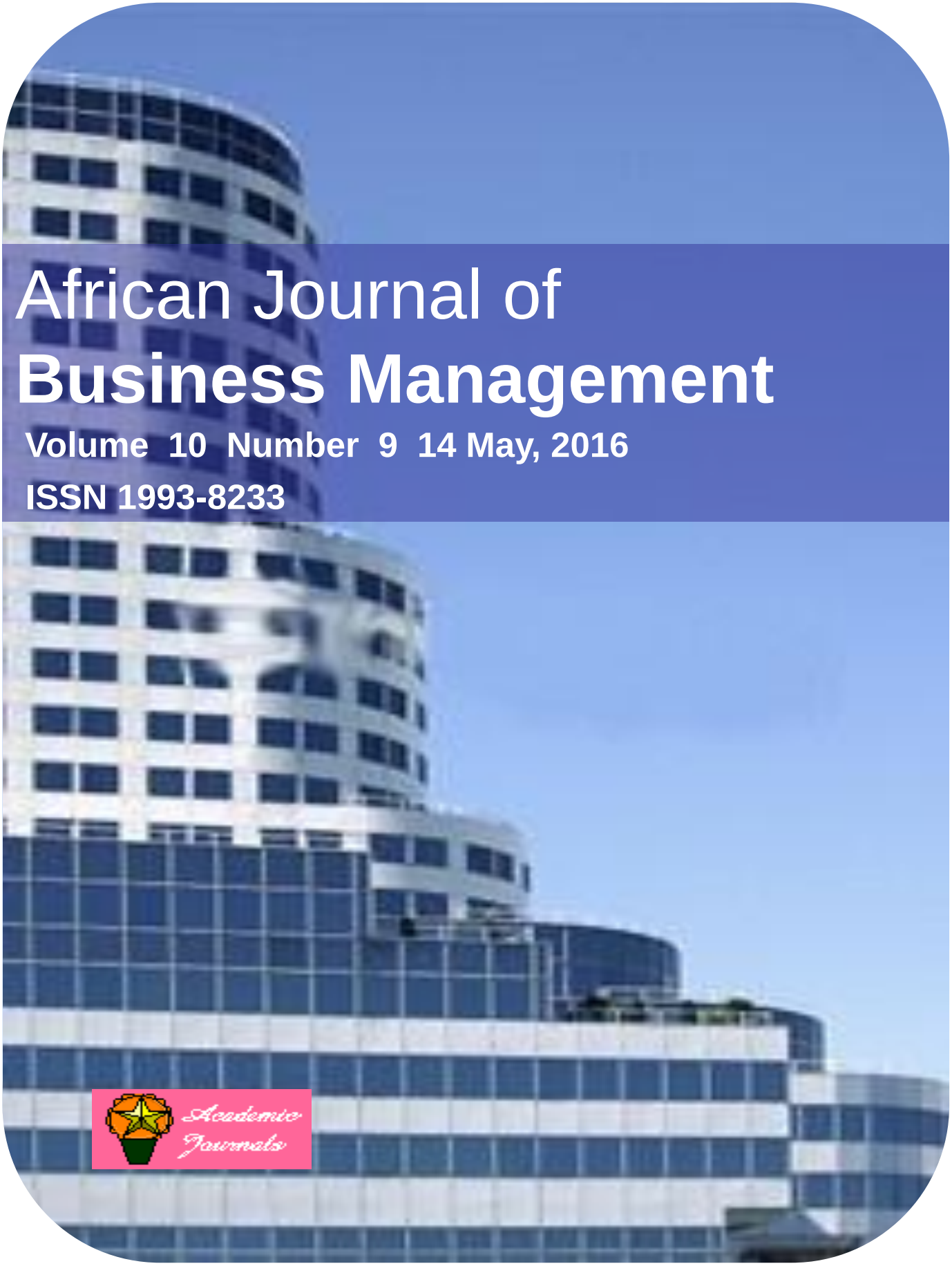

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Table of Contents: Volume 10 Number 9 14 May, 2016

ARTICLES

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Full Length Research Paper

Early adopters of integrated reporting: The case of the mining industry in South Africa

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This study aims to investigate the structure and the content of Integrated Reporting, a new corporate reporting model that seeks to link financial and non-financial information disclosed by companies. This paper assesses the nature and extent of non-financial disclosures in corporate reports of the mining companies listed on the Johannesburg Stock Exchange. The methodological approach is Content Analysis with the aim of carrying out an automated lexical/textual analysis on the content of non-financial information using software for collecting a *Corpus* of data from the analysed corporate reports. The results do not highlight good practices of non-financial disclosure: the overall analysis does not detect homogeneous behaviour among companies. Nevertheless, the higher incidence of issues on Key Performance Indicators (KPI) targets and governance structures could be due to their relationship to certain listing requirements. The analysed period is restricted to one year, and it could be interesting to perform a longitudinal analysis. There is also a lack of a comparative analysis by means of the assessment of other industries in South Africa. Integrated Reporting is still in its early stages; consequently, findings from the first adopters may provide an insightful overview about its threats and weaknesses and practical suggestions for its preparers and users. The research may contribute to studies on the mining industry in the first country that has required the adoption of Integrated Reporting. The present study focuses on the first adoption of a new reporting tool that may be able to improve corporate communication to a wide range of stakeholders.

Key words: Integrated reporting, textual analysis, disclosure index, non-financial information, mining industry, South Africa.

INTRODUCTION

This study focuses on an analysis of the first adoption of Integrated Reporting (IIRC, 2013a), a new model of business reporting that combines financial and non-financial information, with a particular focus on the environmental, social and corporate governance items (Eccles and Krzus, 2010, 2014; Adams et al., 2011;

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Eccles and Armbrester, 2011; Tilley, 2011; Busco et al., 2013; King and Roberts, 2013). Consequently, Integrated Reporting (IR) aims to disclose information about the company's strategy, corporate governance and financial performance; to reflect the financial, social and environmental context within which companies operate; and to disclose a detailed description of companies' value creation in the medium-long term (IIRC, 2013b; Eccles and Krzus, 2010, 2014; Churet and Eccles, 2014; PWC 2010). Although a standardized structure has not yet been defined and there are no detailed guidelines (Rossouw, 2010: Busco et al., 2013; Abeysekera, 2013), IR has already been adopted (CorporateRegister.com, 2013) by an increasing number of companies[1].

The purpose of this paper is to contribute to the empirical understanding of early Integrated Reporting practices among the South African listed companies. This is achieved by analysing the IR disclosures within a wide range of corporate reports[2] in the first stage of IR adoption (fiscal year 2011). The research objectives are the following:

RO1: to identify the main items of non-financial information that should to be included in Integrated Reporting to highlight the major features of the IR content and structure;
RO2: to assess both the amount (how much) and themes (what) of non-financial information disclosed in corporate reports drawn up by 20 South African mining companies listed on the Johannesburg Stock Exchange (JSE).

The selection of South African companies is justified by several reasons; for example, there are interesting disclosure requirements issued by King Code of Governance Principles for South Africa (King III, 2009). In addition, the companies listed on the JSE are required to adopt Integrated Reporting for all financial years ending on or after March 1st 2010. There is also a strong propensity for developing countries to disclose items in the three categories of intellectual capital (Goh and Lim, 2004; Abeysekera, 2008) and social and environmental issues (de Villiers and van Staden, 2006).

The mining sector was chosen because of its significant role in the South African economy and its high risk with regard to ethical, social (Davis et al., 2012) and environmental issues (Firk, 2002; de Villiers and van Staden, 2006; Lodhia and Hess, 2014). The mining industry also includes companies with the highest environmental impacts, for example, high CO_2 emissions (National Treasury, 2010; Hindley and Buys, 2012); it needs its operations to be legitimized by means of environmental disclosures and practices (de Villiers and Barnard, 2000).

Reflecting the growing importance of non-financial disclosures in the success and reputation of many companies, there has been a dramatic increase in the academic attention paid to various aspects of these items, but IR adoption is still in its early stage and only few studies have made an in-depth investigation of the first reports drawn up by South African companies at the outset of IR implementation (Hindley and Buys, 2012; Carels et al., 2013; Setia et al., 2015).

KING CODE III (THE KING REPORT ON GOVERNANCE FOR SOUTH AFRICA 2009)

Companies listed on the JSE are required to implement integrated sustainability performance and integrated reporting[3] (all companies must issue an "integrated report" for financial years starting on or after March 1, 2010 m or explain why they are not doing so). The new requirements stem from the Institute of Directors, South Africa (IODSA)'s King Code of Governance Principles (King III). New JSE listing requirements put the Code into effect on 1 March 2010 for financial years ending 28 February 2011 and beyond. Although the King III enables companies to draw up separate reports for financial and non-financial information, the revolution brought about by the adoption of IR is represented by the deep cohesion among the different types of information: rather than being developed separately, financial, environmental, social and governance reports are produced in close connection with each other and made available simultaneously on the websites of listed companies.

King III recommends that entities adopt IR to enable stakeholders to make a more informed assessment of a company, based on a combination of its financial and social value, rather than its book value alone. In the words of Mervyn King, "Sustainability is the primary moral and economic imperative for the 21st century". The term "integrated report" is used throughout the Code and is explained in chapter 9: "The integrated report should … have sufficient information to record how the company has both positively and negatively impacted on the economic life of the community in which it operated during the year under review, often categorized as environmental, social and governance issues (ESG). Further, it should report how the board believes that in the coming year it can improve the positive aspects and eradicate and ameliorate the negative aspects" (King Code of Governance Principles for South Africa 2009: 9). King III's key principles are the following: Leadership, Sustainability and Corporate Citizenship. In particular King III identifies certain principles of IR and disclosure (King III, Chapter 9) that should inform the process of IR.

1 In addition, IIRC launched a *Pilot Programme* (2011) that provided a platform for companies to begin applying the principles of Integrated Reporting. This initiative ended in October 2014 (www.theiirc.org).

2 In the early stage of the IR mandatory adoption, the listed mining companies chose to prepare several report models, an integrated report and an annual report plus stand-alone reports. See Appendix 1.

3 Integrated reporting means "a holistic and integrated representation of the company's performance in terms of both its finance and its sustainability." IoDSA, King Code of Governance for South Africa 2009, p. 55.

Integrated reporting and disclosure requirements

The board should ensure that appropriate systems and processes are put in place to produce a report to stakeholders that provides a complete picture of a company's financial and non-financial profiles such that the report is holistic and reliable. To comply with the recommendations of the Code, "reporting should be integrated across all areas of performance, reflecting the choices made in the strategic decisions adopted by the board, and should include reporting in the triple context of economic, social and environmental issues. The board should be able to report forward-looking information that will enable stakeholders to make a more informed assessment of the economic value of the company as opposed to its book value." King III recommends companies adopt IR to show the following key elements of business:

1. Effective ethical leadership and corporate citizenship;
2. Governance of risk;
3. Governance of information technology;
4. Compliance with law, codes, rules and standards;
5. Their relationship with governing stakeholders.

More specifically: 1. Company decision-makers (the board of directors) should ensure the proper conduct of their firm in terms of their positive impact on the triple bottom line to qualify the company itself as a "good corporate citizen". 2. King III defines the roles and responsibilities for a risk management approach involving all types of business operations. 3. In addition, King III attaches great importance to the governance and management of information technology resources for the achievement of high specific skills. 4. Companies are required not only to comply with the rules established by law but also to follow those non-binding rules that can improve corporate governance. 5. A final aspect introduces an interesting new concept called "Alternative Dispute Resolution" (ADR), reported as Principle 8.10 in Chapter 8, "Managing stakeholder relationships", whereby King III places particular emphasis on stakeholders with the aim of providing adequate solutions to disputes that may arise in business relationships. To this end, it should be noted that the Code requires the Board to provide forecast information and ensure its quality and reliability, as this aspect represents a priority request by stakeholders.

The lack of a standard reporting framework may represent a serious obstacle to the current implementation of King III by all listed companies. For this reason, the role of the Integrated Reporting Committee South Africa (IRC SA) becomes essential, in that it does not reiterate the disclosure principles of King III, but "it sets out a framework within which such disclosures can be reported using the principles of "apply or explain" and of "substance over the form" (IRC SA, 2012: 18). The processing of a report should be carried out thoroughly from the very beginning by implementing the principles in the company's core business strategy to generate undoubted benefits, such as an increase in the legitimacy of the company's transactions and higher confidence among stakeholders.

The IRC and its framework working group will coordinate efforts with the Global Reporting Initiative's (GRI's) new International Integrated Committee (IIRC). The establishment of the IIRC is designed to support one of GRI's goals for 2020, to converge ESG and financial reporting, which was announced at the Amsterdam Global Conference on Sustainability and Transparency in late May 2010 (www.amsterdamgriconference.org/index.php?id=39&item=33). A fundamental support mechanism for the implementation of IR is the Global Reporting Initiative (GRI), a member of the International Integrated Reporting Council (IIRC), together with the International Accounting Standards Board (IASB), the Financial Accounting Standards Board (FASB), the Prince's Accounting for Sustainability Project and the World Business Council for Sustainable Development (WBCSD). The GRI is a globally recognized organization that has *de facto* established the standards for ESG reporting. As is well-known, in addition, the GRI sets the guidelines not only for "what to report" but also for "how to report", as well as laying down the rules for the implementation of reports in accordance with the so-called triple bottom line. The G3 guidelines (G3) were developed in 2006 and represent the third generation of GRI Guidelines for sustainability reporting. The guidelines indicate the general principles, guidelines and communication standards that should be included in sustainability reports. Recently, GRI updated these guidelines and issued a new version, the 2013 G4 Guidelines (GRI, 2013).

LITERATURE AND BACKGROUND OF THE STUDIES

The strong need to change corporate reporting (Beattie, 2000; Singleton-Green, 2010) towards a gradual "managerialization", that is, the adoption an internal perspective in the drawing up of external disclosure (Beattie and Pratt, 2003; Beattie et al., 2004; Zambon, 2011) has been boosted by the unanimous acknowledgement of the lack of information in traditional corporate reporting. The information gaps mainly concern the recognition and measurement of intangibles and intellectual capital (Striukova et al., 2008); more recently, environmental and sustainability items and ESG indicators (Environmental, Social and Governance) have become key information items (Gazdar, 2007; FEE, 2008; KPMG, 2011a, b; Hopwood et al., 2010; Eccles and Krzus, 2010, 2014; Porter and Kramer, 2011; IIRC, 2011, 2013a; ACCA and Eurosif, 2013; Iannou and Serafeim, 2014). Companies are being forced to re-evaluate how they can report financial and non-financial data as transparently as possible to all stakeholders (Rensburg

and Botha, 2014). Non-financial disclosure is especially remarkable because it provides different stakeholders with information that financial reporting alone fails to provide (White, 2005). Stakeholder theory emphasizes the need for an organization to identify powerful stakeholders (Stainbank, 2012) to which it is accountable and to maintain a good relationship with these stakeholders, which could include voluntarily disclosing information (Deegan et al., 2000; Newson and Deegan, 2002; Van Staden, 2003; Gray et al., 2014).

The mining sector shows an exceptional sensitivity to ESG issues (Frik, 2002) and corporate social responsibility (de Villiers and Alexander, 2014). Therefore, stakeholders would give due attention to the industry's environmental, social and governance performance. Jenkins and Yakovleva (2006: 272) state that there is an increased demand for the disclosure of social and environmental information by mining companies as a means of legitimizing their existence and documenting their performance (de Villiers and van Staden, 2006; Pellegrino and Lodhia, 2012; de Villiers and Alexander, 2014). Environmental legitimacy shows a strong relationship with environmental accountability, which involves the public evaluation of corporate environmental performance and reporting. This is also dependent on environmental proactivity, which requires companies to invest in environmental management and accounting systems, as well as stakeholder engagement (Alrazi et al., 2015).

Prior research: The case of South Africa and the mining industry

First, an overview of the existing literature evaluates the previous studies focused on corporate reporting referring to the integration of financial and non-financial information. As a preliminary result, a strong need for the disclosure of non-financial information can be emphasized in several studies (Robb et al., 2001; White, 2005; Bollen, 2004; Palenberg et al., 2006; Gazdar, 2007; Coram et al., 2009). According to Gray et al. (1995), non-financial reporting and especially social and environmental disclosure is country-dependent because independent studies in different countries provide different results. This type of disclosure in developing countries is crucial (Kumah, 2006; Islam and Deegan, 2008, de Klerk and de Villiers, 2012) and particularly necessary given the presence of multinational corporations in developed countries.

In depth-analyses mainly concentrate on the studies carried out in the mining industry, whereas, is well known, non-financial disclosure causes undoubted benefits in terms of transparency (KPMG, 2006). The increase and improvement of disclosure on intangibles, intellectual capital (Firer and Williams, 2003; Yongvanich and Guthrie, 2005), social (Coetzee and van Staden, 2011), sustainability (Borkowski et al., 2012) and environmental (Burritt, 1997; Antonites and de Villiers, 2003; Jenkins and Yakovleva, 2006) items is to be welcomed by mining industry stakeholders (Yakovleva and Vazquez-Brust, 2012). Moreover, it is possible to find several studies focused on Corporate Social Responsibility (CSR) (Warhurst, 1998; Tawiah and Dartey-Baah, 2005; Guenther et al., 2007; Hutchins et al., 2007) and on corporate governance within the mining industry (Abdo and Fisher, 2007; Mangena and Tauringana, 2007).

The previous content analysis studies based on companies' annual reports within the mining industry have mainly focused on environmental and social disclosures (de Villiers and Barnard, 2000; de Villiers and Lubbe, 2001; Jenkins and Yakovleva, 2006; Kemp et al., 2010; Fonseca et al., 2014; Maubane et al., 2014; Lodhia and Martin, 2014; de Villiers et al., 2014), sustainable management practices (Maffini et al., 2015), IC measurements and reporting (April et al., 2003), voluntary disclosures (Stainbank, 2012) and risk disclosures. If we shift from *content analysis studies* based on traditional corporate reporting to *content analysis studies* based on IR, we find that few studies have attempted to explore the disclosures and practices of the first adopters of IR (Wild and van Staden, 2015) in the mining sector (Hindley and Buys, 2012; Carels et al., 2013).

To verify the crucial role of IR in overcoming the information gaps in traditional corporate reporting (Eccles and Krzus, 2010, 2014; Leuner, 2012), we sought to evaluate the content of non-financial information (Chauvey et al., 2013) and the materiality of non-financial Key Performance Indicators (KPIs) by performing a content analysis on IR via a sample of listed mining companies.

METHODOLOGY

Content analysis and text mining

The methodological approach is the content analysis (Krippendorff, 1980; Weber, 1990; Krippendorff and Bock, 2009), which is often adopted in social sciences to measure external disclosures (Beattie et al., 2004; Beattie and Thomson, 2007), which are sometimes supported by a disclosure-scoring system (Robb et al., 2001; Vanstraelen et al., 2003). This analysis may generate data that can take the form of judgments of kind, magnitude and frequency (Hayes and Krippendorff, 2007). In addition, this methodological approach is useful because content analysis as a well-established method in social science and can classify text units into categories (Beattie et al., 2004; Dumay and Cai, 2015). Despite the important contribution of content analysis to analyse the "narrative" portion of companies' reports, many scholars have noted criticisms, for example: difficulties in delivering reliable content analysis (Boyatzis, 1998); difficulties regarding the choice of different units of analysis, such as words, sentences or pages (Gray et al., 1995; Beattie and Thomson, 2007); the need to test the reliability of the coding decision rules (Milne and Adler, 1999; Krippendorff, 2004; Krippendorff and Bock, 2009) and the disclosure rating (that is, by dummies or frequency counts).

The increasing and continuous production and spreading of

digital text data, as well as the evolution of information technology, have enabled the development of methods and algorithms for the acquisition, classification and automatic management of a large amount of unstructured textual databases. In the 1960s and '70s, statistical studies on data expressed in natural language or textual data had already undergone deep changes as a result of the evolution of information technology, later leading to the introduction of automatic text analysis and textual statistics (Lebart and Salem, 1994). Today, the latest solutions are no longer based solely on statistical instruments but are in fact the result of a strict multi-disciplinary approach whereby such instruments are combined with computer and language instruments, particularly in a research area known as text mining (Sullivan, 2001; Zanasi, 2005; Bolasco et al., 2005). In this context, text mining has become essential to draw out knowledge from data (Korczak et al., 2013). The use of automatic techniques for text analysis thus becomes necessary whenever the amount of information is such that it hinders the manual resolution of problems in terms of data classification and clustering.

Given these premises, to limit certain criticisms (the first and third in the list indicated above) of content analysis and reach a great level of reliability avoiding subjectivity, this analysis should be performed by a specific software programme (Beattie and Thomson, 2007; Gumb and Noël, 2009). The use of software shows certain limitations due to the search and count of the unit of analysis; in our case, these limits are overcome due to the sophisticated treatment of the text by the software. It is important to emphasize that automatic content analysis is not able to indicate the location of the items as each company's reports are combined into a single TXT file.

Disclosure index

The main items of IR structure and content used in content analysis in the following tables contain a methodological reference in the following documents:

(i) 'King Report on Governance for South Africa' and 'King Code of Governance Principles' (King III). The Institute of Directors in Southern Africa, 2009;
(ii) Integrated Reporting Committee of South Africa (IRC SA), Discussion Paper, 25 January 2010;
(iii) International Integrated Reporting Council (IIRC), Towards Integrated Reporting - Communicating Value in the 21st Century, Discussion Paper, September 2011;
(iv) Survey conducted by Deloitte (2012) available in the paper "Integrated Reporting: Navigating your way to a truly Integrated Report", February 2012.

We decided to select nine semantic categories correlated to the key contents of IR (Table 1) on the basis of the framework issued by Deloitte (2011). For each category, we selected certain words or groups of words to understand how companies disclosed these issues within IR (Table 2).

Sample selection

The mining sector represents a significant portion of the South African economy (Davies et al., 2002; Maubane et al., 2014). All 20 South African mining companies listed on the JSE in 2012 were included in this study (Appendix 1). Mining companies were selected because the mining industry represents the largest market capitalization on the JSE (ADVFN, 2007). Consequently, the influence of the mining industry on the South African economy is substantial (PWC, 2013).

The 2011 corporate reports drawn up by the mining companies listed on the JSE were downloaded from the websites of these companies and analysed. The results of the content analysis were then tabulated in spreadsheet format using the Excel package. The extent of the quantity (how much) and themes (what) of disclosure and the benchmark assessment of the companies' non-financial disclosures were captured in tables for analysis.

Johannesburg stock exchange SRI index

The JSE SRI was launched in May 2004 as a system to identify those companies listed on the JSE that incorporate the principles of the triple bottom line and good corporate governance into their business operations (JSE and EIRIS, 2010). Some of the companies provided the GRI disclosure index for their non-financial reporting, which made it easy to follow the extent of their non-financial disclosures. Listed South African mining companies are encouraged to adopt GRI as the basis of their sustainability reporting in terms of King III. In other terms, King III recommends that companies produce an integrated report in place of an annual report and a separate sustainability report and that companies create CSR reports according to the GRI Guidelines. This fact provided the impetus for the improvement in these disclosures.

In the following tables, it is possible to notice the companies that have obtained the best results in terms of SRI index: in the first column labelled "high impact", there are eight mining companies that are included in our sample (Table 3). Table 4 shows the companies that obtained the best results in the last five years, 2007-2011 (the so-called "consistent best performers"). Four of the companies in our sample are on this list: Anglo American Plc, Anglogold Ashanti, Gold Fields Limited and Merafe Resources.

Research design and data collection

The empirical research sought to make a benchmarking analysis between the mining companies referring to both the amount and the themes of the information disclosed by the firms (Stainbank, 2012). An assessment of the degree of the companies' compliance with reference to the guidelines required by the above-listed documents will be formulated by means of a disclosure checklist (Table 5). The Research Questions are below:

RQ1: What are the amount (how much) and themes (what) of the items included in nine semantic categories (that is, disclosure checklist, (Table 5) disclosed by the mining companies listed on the JSE?
RQ2: Is it possible to identify homogeneous behaviour within the sample of the companies?
RQ3: What is the degree of compliance with items selected, in spite of the lack of a common framework for creating an integrated report in SA?

The analysed corporate reporting material mainly included the following documents[4]:

(1) Annual financial statements;
(2) Annual integrated reports;
(3) Sustainability reports;
(4) Mineral resource and ore reserve reports.

Annual report disclosures include a single component of an organization's public communication (Aerts and Cormier, 2009). Previous content analysis studies note that only examining the annual report could lead to underestimating the extent of social

[4] In this early stage of IR adoption, the mining companies decided to produce corporate reports in different manners, and it is possible to download various types of reports; only a few companies produced one report (see Table 5).

Table 1. The key issues of integrated reporting.

1)	**Group profile (Corporate context)**
	First few pages of the report to introduce the business
	In which sector does the business operate ?
	What type of business is this ?
	What are the products ?
	What is the structure of the Group and the company ?
	Where does the business operate ?
2)	**Scope and boundary**
	Indicate the reporting period to which the report pertains
	Focus on comparability between different reporting periods
	Focus on comparability between financial and non-financial information
3)	**Key features**
	Illustrate the company's main achievements and key features
	Ensure a balance between financial and non-financial information
	Utilise graphs, illustrations and pictures to deliver a clear message to the reader
4)	**Strategy Vision Values**
	Use this part of the report to inform the reader of the character and values of the business
	Clearly describe the strategic goals and objectives of the business
5)	**Governance structure**
	Set out the governance structure of the group and the company, including the committee structure
	Provide details on directors
	Describe the governance structures to manage risk and sustainability respectively
	Governance report should provide clear feedback on the performance of the Board and each committee
6)	**Stakeholders**
	The Integrated Report is directed at the business' key stakeholders
	Identify the key stakeholders of the business
	Identify the key interests and concerns of the key stakeholders
	Describe the strategy and methodology to ensure effective stakeholder communication
7)	**Material risks and opportunities**
	Identify the risks and opportunities facing the business
	Indicate the mitigation plans in place to mitigate the risks and capitalise on opportunities
	Ensure a balance between financial and other risks and opportunities
8)	**Key performance indicators and targets**
	Identify the key performance indicators as it pertains to the strategy, risks and stakeholder concerns
	Ensure a balance between financial and non-financial indicators
	Identify measurable targets linked to the key performance indicators
	Report back on the progress to achieve these targets
9)	**Remuneration**
	Explain the business' remuneration strategy
	How is remuneration used to ensure delivery on the business' strategy ?
	Information of long-term and short-term incentives, as well as financial and other incentives

Source: Adapted from the survey conducted by Deloitte "Integrated Reporting Navigating your way to a truly Integrated report" February 2012.

disclosures and that focusing exclusively on annual report disclosures may yield irrelevant or misleading results (Unerman, 2000). Therefore, this study analyses integrated reports, sustainability reports and other reports, such as mineral resource and ore reserve reports, which are useful for conveying non-financial information (Coetzee and van Staden, 2011).

An analysis of the reports made available on the websites of the sample of companies highlights significant differences in their

Table 2. Semantic categories and items for content analysis.

Group profile		Key performance indicators and targets		Key features	
Projects	1,843	Performance	3,660	Feedback	133
Structure	387	Targets	813	Materiality	116
Black economic empowerment	156	Mining operations	443	Maps	12
Market review	26	Summary	421	Graphs	12
Company overview	22	intangible assets	198	Symbols	7
Approach to reporting	22	Sustainability review	165	Connectivity	7
Managed mines	20	Forecast	156	Timelines	6
Operations review	20	Financial performance	152	Illustration	5
Story	14	Trend	124	Diagrams	1
Business overview	11	ISO 14001	124	Pictures	
Mining production	8	Environmental performance	104	Navigation tools	
Corporate objectives	8	Social performance	99	Quick reading	
Operational information	3	Global Reporting Initiative	87	Interactive tools	
Location of mines		Key performance indicators	86	Qualitative characteristics	
Product description		Achievements	85	Visual elements	
Extract operation		Sustainability performance	76	Request for further information	
Nature of the organization		Comparison	71	Ready accessible	
Overview of activities		Human capital	58	Conciseness	
Corporate context		Key features	32	Electronic information disclosure	
		ESG	19	XBRL	
		Intangibles	17		
		ISAE 3000	10		
		Improvement programmes	5		
		Ethics performance	4		
		Summary financial information	3		
		Measurable targets	2		
		Structural capital	2		
		Non financial			
		Non financial disclosure			
		Non financial targets			
		Non financial indicators			
		AA 1000 AS			
		ESG performance			
		ESG indicators			
		Relational capital			
		Intellectual capital			
Total	**2,540**	**Total**	**7,016**	**Total**	**299**

Strategy vision values		Governance structure		Stakeholders	
Strategy	1,782	Quality	652	Stakeholder engagement	280
Objectives	563	Audit committee	611	Expectations	208
Vision	207	Board of directors	515	Reputation	97
Innovation	78	Executive directors	445	Key stakeholders	45
Future outlook	61	Commitment	415	Stakeholder concerns	16
Mission	44	Ethics	394	Engagement process	14
Business Model	38	Internal audit	299	Credibility	10
Forward looking statements	23	Executive committee	262	Stakeholder inclusiveness	1
Management framework	22	Management systems	133	Target audience	1
Future targets	2	Independent assurance	81	Stakeholder needs	

Table 2. Contd.

Strategies (strategy) planning	1	Governance structure	39		
Future objectives		Non executive directors	19		
		Civil society	17		
		Principles of Corporate governance	6		
		Key governance policies	1		
		Employee involvement	1		
		Governance of risks	1		
		Ethics disclosure			
Total	**2,821**	**Total**	**3,891**	**Total**	**672**

Material risks and opportunities		**Scope and boundary**		**Remuneration**	
Risk management	1,074	Reporting period	204	Remuneration committee	383
Opportunities	683	Time period	6	Compensation	330
Challenges	353	Scope of the report	2	Remuneration report	292
Goals	147	Time boundary		Executive remuneration	53
Uncertainties	98			Annual Bonus	51
Risk factors	86			Remuneration policies	44
Key risks	47			Remuneration strategy	19
Business risks	30			Share incentives	10
Risk mitigation	23			Long term incentives	8
Risk analysis	10				
Risk disclosure	2				
Risks indicators					
Total	**2,553**	**Total**	**212**	**Total**	**1,190**

Source: Our elaboration.

Table 3. 2011 SRI Index Best Performers* (in alphabetical order by environmental impact).

High impact	**Medium impact**	**Low impact**
Anglo American Plc	Barloworld Limited	Absa Group
AngloGold Ashanti	Massmart Holdings Limited	The Bidvest Group Limited
ArcelorMittal South Africa	Steinhoff International Holdings	Old Mutual
Exxaro Resources		Santam
Gold Fields Limited		Standard Bank Group
Impala Platinum Holdings		Vodacom Group Limited
Kumba Iron Ore		
Lonmin Plc		
Merafe Resources		
Mondi		
Pretoria Portland Cement Company Limited		
Sappi Limited		
Woolworths Holdings		

*Best performers are companies that meet the thresholds for best performance in relation to environment and climate change, as well as all relevant core indicators in relation to both Society and Governance and related sustainability concerns, including independent chairperson.

approaches. In some cases, companies only disclose one report, while in other cases, they either provide several reports or only summary reports. Alternately, sometimes an integrated report is provided as both a single document and separate segments focusing on specific subjects. This has forced us to make some choices, and there are cases where some data have not been

Table 4. SRI index best performers for five years running (2007 – 2011) (in alphabetical order).

Absa Group
Anglo American plc
AngloGold Ashanti
Gold Fields Limited
Merafe Resources
Standard Bank Group

The table refers to 6 December 2011.

included in the corpus because they were already inserted in the main document. In other cases, additional documents, such as tables with KPIs or the reports given to shareholders at Annual General Meetings, or other reports prepared on a voluntary basis, have been included.

The overall size of the *corpus* (that is, all reports analysed) totals 2,479,586 occurrences[5] of which 292,002 are occurrences of numerical elements, for a total of 2,187,584 text occurrences, excluding numerical occurrences. Textual analysis sought to identify the extent of the items belonging to nine semantic categories in the sample of corporate reports and highlight the correlation between mining companies and semantic categories. The analysis is carried out in three steps: 1. Identification of the semantic categories in the *vocabulary* and *corpus* through semantic tagging; 2. Extraction of the information by using software called Regular Expression (RE) and 3. Assessment of the correlation between companies and documents through an analysis of simple correspondences.

The lexical/textual analysis of the corpus has been carried out using TaLTaC2 software[6] (Bolasco, 2010a), whereas SPAD 5.0 software was used for the analysis of correspondences. Semantic tagging recognizes the simple and complex forms of the nine semantic categories listed in Table 6 and records them in the vocabulary. The application of the RE allows for the identification of semantic categories in the corpus that were previously recorded in the vocabulary. Because this operation, a text variable can be generated in which the occurrences of the different semantic categories are calculated for each document.

To better compare the use of items among the different companies, it is necessary to normalize the frequencies to delete the effect of the different sizes of the documents (Table 7 normalized frequencies) (Graph 1).

The results are also presented as percentages, which are used to measure to what extent each company discloses information in reference to each category of non-financial information within the analysed reports. Empirical findings are also shown using descriptive statistics (Yongvanich and Guthrie, 2005) to identify the companies with the highest and lowest disclosure levels for each category. In addition, the most commonly reported disclosure items were identified (Tables 8 and 9, Graphs 2 and 3).

Through an analysis of simple correspondences applied to the Documents x Variables matrix (items) it is possible to represent on the factorial plan the correlations between companies and thematic categories. In order to have a better representation of the factorial plan, it has been necessary to exclude the "scope and boundary" variable from the analysis, because it is of small size and strongly correlated to Coal of Africa. In order to properly explain the picture of the factorial plan it must be emphasized that the more distant the documents and the variables are from the origin, the greater their contribution to the determination of the axes, whereas the proximity of the documents refers to a correlation between the two characters (Bolasco, 2010b) (Graph 4).

RESULTS AND DISCUSSION

The results shown in Tables 6 and 7, including the total occurrences and the normalized frequencies relating to each category[7] enable us to evaluate the amount (how much) and the themes (what) of non-financial information disclosed by the mining companies listed on the JSE.

The first semantic category *Group Profile (Corporate context)* concerns the extent to which the information provided effectively communicates the "story" of the company to the stakeholders. Here, the main products and services of the organizations, its major markets and locations, key financial data and organization structure are described. Companies are generally doing well at setting out the corporate context in an easily readable and understandable format, sometimes using graphs, symbols, illustrations and diagrams, and the flow of information is generally logical. The disclosure checklist shown in Table 2 includes 19 items, 13 of which are detected with different absolute and normalized values (approximately 68% incidence). The following items have not been detected by the textual analysis:

(1) Location of mines
(2) Product description
(3) Nature of the organization
(4) Overview of activities
(5) Corporate context

The first and the second items concern technical aspects of the company's production, but the other items are generic and concern the company profile. We expected more information about the characteristics of production to clarify the environmental and social practices adopted by companies. If we analyse the normalized frequencies,

[5] The term "Occurrences" indicates the frequency words counts. For major details, see Beattie and Thompson, 2007.

[6] Tal. TaC2 is an acronym for "Trattamento automatico Lessicale e Testuale per l'analisi del Contenuto di un Corpus". It was developed following a study carried out at the University of Rome "La Sapienza" (Bolasco et al., 2002; www.taltac.it).

[7] For a detailed description of every category described in this section, see the survey conducted by Deloitte "*Integrated Reporting Navigating your way to a truly Integrated report",* February 2012.

Table 5. Summary of corporate reports.

#	Company	Financial statements	Integrated report	Sustainability report	Resources and reserves report	Other reports	Notes
1	African Rainbow Minerals		X	X	X	Sustainability case studies; Sustainable Development Report	One report
2	Anglo American Platinum		X	X		7 segments of the integrated report	The seven segments have not been analyzed because they are already included in the integrated report
3	Anglo American PLC	X	X		X	UK corporate governance checklist	The financial statement is separate from the integrated report
4	Anglogold Ashanti	X	X	X	X	Notice of Annual General Meeting 2011	The financial statement is separate from the integrated report
5	Assore Ltd		X			Notice of Annual General Meeting 2011	One report
6	Bhp Billiton PLC		X			Summary review	One report
7	Coal of Africa		X				One report without details about the integrated report (the name of the report is "annual report" without other details)
8	DRD gold		X	X		Sustainable Development Report	One report
9	Exxaro resources		X			Annual review	Both the integrated report and the annual review have been analyzed though the annual review is a synthesis of the full report
10	Gold fields	X	X		X	Memorandum of incorporation; Notice of Annual General Meeting 2011	The resources and reserve report has been included as an additional report and it includes 10 separate reports that have been analyzed too
11	Harmony		X	X		Abridged Report; Notice of Annual General Meeting 2011	Both reports have been analyzed, though the abridged report is a sinthesis of the integrated report
12	Implats Platinum		X	X	X	Sustainable Development Report	One report
13	Lonmin PLC	X		X		Notice of Annual General Meeting 2011	Two reports of which the first is called "annual report" without details on the integrated report
14	Merafe resources		X			Abridged report for the auditors	One report with a summary report which has been analyzed
15	Northam Platinum		X	X		Sustainable Development Report	One report
16	Pan African Resource		X			Report for the audited results	One report
17	Petmin Ltd	X	X			Some parts of the integrated report have been explained in separate reports; Notice of annual general meeting	The reserve and resources report is already included in the integrated report and it has been presented also separately
18	Royal Bafokeng Platinum		X				One report, but different reports are separately presented as the different parts of the one report
19	Sentula mining		X			KPIs tables; Memorandum of incorporation; Replacement Deed	One report but two KPIs tables are presented separately from the integrated report
20	Wesizwe platinum		X			GRI response table	One report

Source: our elaboration.

Table 6. Total occurrences in absolute values.

Company	Content size	Group profile	Scope boundary	Key features	Strategy vision values	Governance structure	Stakeholders	Material risks opportunities	KPI targets	Remuneration	Total
Anglogold Ashanti	243,318	350	2	13	645	257	92	395	771	162	2,687
Exxaro resources	189,747	202	21	21	216	380	67	251	645	54	1,857
Bhp Billiton PLC	175,517	230	2	28	133	259	37	174	607	234	1,704
Gold Fields	161,705	166	6	6	180	346	45	193	354	65	1,361
Anglo American Platinum	146,449	238	16	76	254	243	53	159	624	73	1,736
African Rainbow Minerals	136,657	158	12	17	128	343	40	186	575	86	1,545
Implats Platinum	121,477	145	8	22	160	151	26	138	499	68	1,217
Lonmin PLC	117,731	95	6	16	195	228	43	141	479	109	1,312
Harmony	112,080	144	9	10	146	227	25	100	477	42	1,180
DRD Gold	99,471	70	3	14	58	203	19	93	224	64	748
Anglo American PLC	95,202	123	7	16	146	288	29	94	389	43	1,135
Merafe resources	79,909	79	12	20	95	194	47	114	262	19	842
Sentula mining	77,292	29	15	0	45	74	13	51	124	26	377
Royal Bafokeng Platinum	75,747	91	13	9	132	142	36	138	239	22	822
Petmin Ltd	74,604	99	8	1	70	101	18	76	110	41	524
Northam Platinum	74,096	50	9	16	48	94	25	47	226	22	537
Pan African resource	55,764	82	11	2	57	104	5	43	156	6	466
Wesizwe Platinum	52,967	72	17	4	50	90	29	61	84	11	418
Assore Ltd	52,485	59	6	4	29	108	13	65	97	19	400
Coal of Africa	45,366	58	29	4	34	59	10	34	74	24	326
Total	2,187,584	2,540	212	299	2,821	3,891	672	2,553	7,016	1,190	21,194

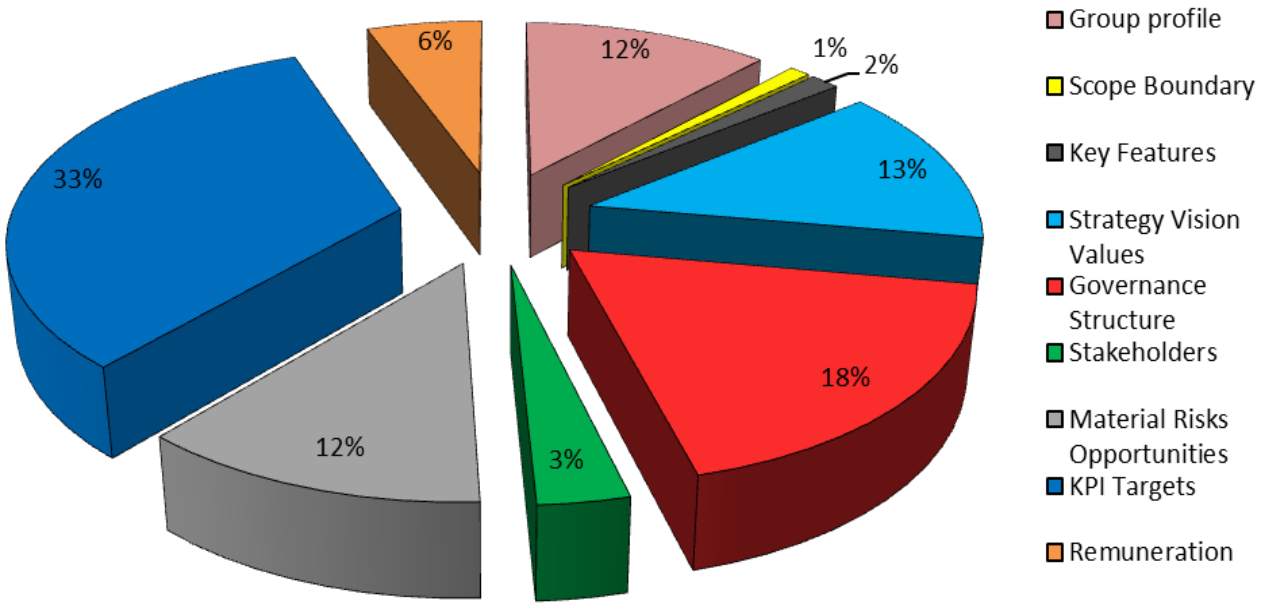
that is, those taking into account the size of the reports under analysis, the maximum value is attributed to Anglo American, whereas the minimum value remains associated with Sentula Mining. It is also interesting to estimate the percentage incidence of each item within the category: the item showing the highest incidence (72.6%) is "projects", whereas that with the lowest incidence is “operational information” (0.1%). Thus, there is clear evidence of a strong discrepancy among the disclosures of the different items. In particular, we may notice that some items showing a specific relevance to the mining sector actually have rather low values; for example, items such as “mining production” and "managed mines” have a very low incidence, below 1, and Black Economic Empowerment (BEE), in particular, has a value of approximately 6%. The BEE is indicated by the JSE as a required social indicator for the Socially Responsible Investment Index, and providing this information is one item of compliance with the rules established by the Broad-Based Black Economic Empowerment Act 53 2003 (the Act includes black Africans, Coloureds and Indians).

The part *Scope and Boundary* describes the comparability of financial and non-financial indicators, but it is necessary to note that the disclosure of non-financial data is relatively superficial and lacks information about non-financial targets, relational capital and intellectual capital. In this semantic category, only 4 items have been identified, making it the category with the smallest number of items and influencing the total number of occurrences that were identified in the analysis. The latter has detected only 3 items

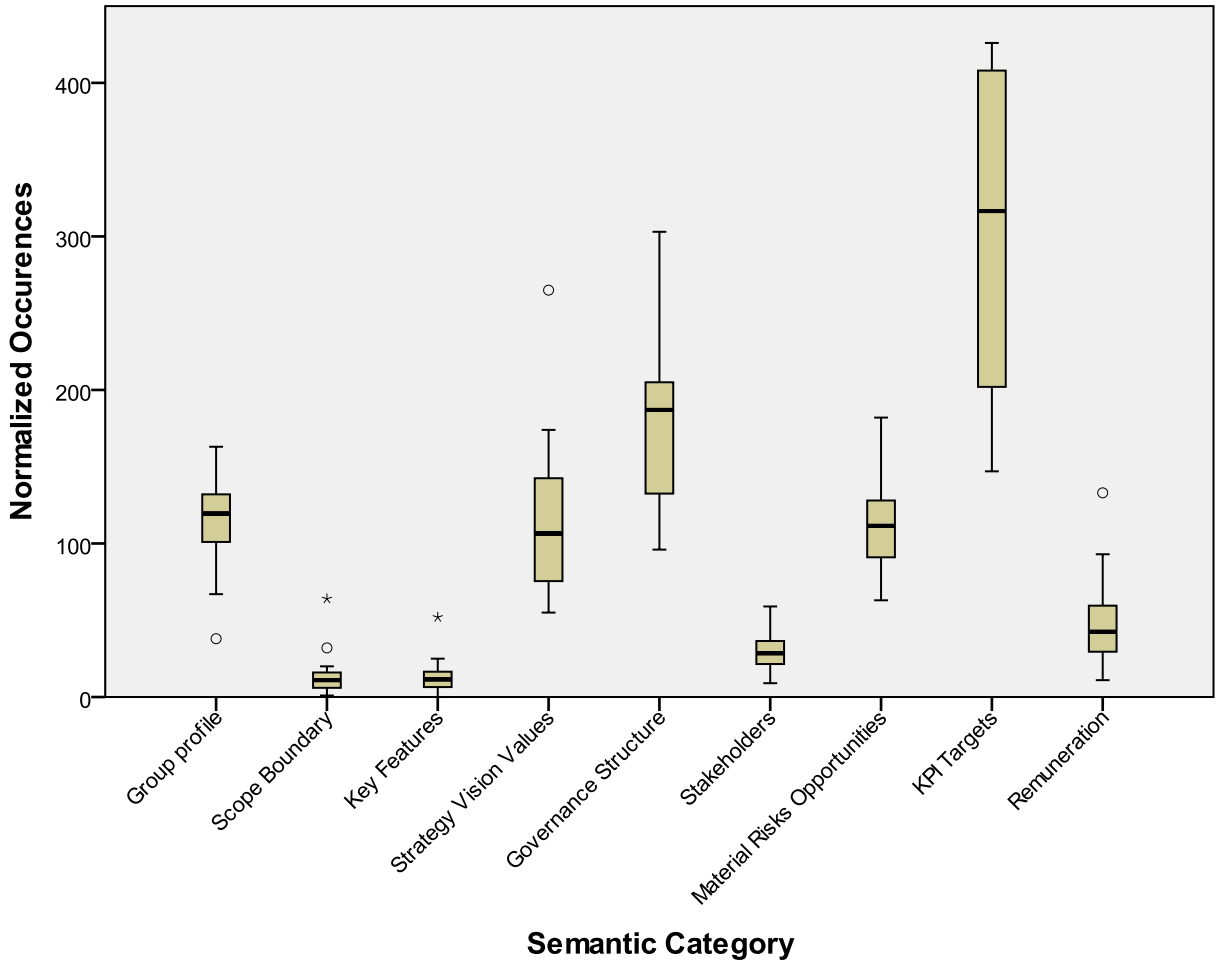
Table 7. Normalized frequencies.

Company	Group profile	Scope boundary	Key features	Strategy vision values	Governance structure	Stakeholders	Material risks opportunities	KPI targets	Remuneration	Total
African Rainbow Minerals	116	9	12	94	251	29	136	421	63	1,131
Anglo American Platinum	163	11	52	173	166	36	109	426	50	1,185
Anglo American PLC	129	7	17	153	303	30	99	409	45	1,192
Anglogold Ashanti	144	1	5	265	106	38	162	317	67	1,104
Assore Ltd	112	11	8	55	206	25	124	185	36	762
Bhp Billiton PLC	131	1	16	76	148	21	99	346	133	971
Coal of Africa	128	64	9	75	130	22	75	163	53	719
DRD Gold	70	3	14	58	204	19	93	225	64	752
Exxaro resources	106	11	11	114	200	35	132	340	28	979
Gold Fields	103	4	4	111	214	28	119	219	40	842
Harmony	128	8	9	130	203	22	89	426	37	1,053
Implats Platinum	119	7	18	132	124	21	114	411	56	1,002
Lonmin PLC	81	5	14	166	194	37	120	407	93	1,114
Merafe resources	99	15	25	119	243	59	143	328	24	1,054
Northam Platinum	67	12	22	65	127	34	63	305	30	725
Pan African resource	147	20	4	102	187	9	77	280	11	836
Petmin Ltd	133	11	1	94	135	24	102	147	55	702
Royal Bafokeng Platinum	120	17	12	174	187	48	182	316	29	1,085
Sentula mining	38	19	0	58	96	17	66	160	34	488
Wesizwe Platinum	136	32	8	94	170	55	115	159	21	789

out of 4 (with an incidence of 75%); one of them, "time boundary", was not detected in the occurrences. The calculation of normalized frequencies shows Coal of Africa having the maximum value of occurrences in relative value (64), whereas both Anglogold Ashanti and BHP Billinton show the minimum value. As for the percentage incidence of each item within a single category, we can see that the item with the highest incidence – 96.2% - is the "reporting period"; the other two items have a very low incidence. The "scope of the report", in particular, shows an incidence of approximately 0.01%. This may be seen as a sign of the companies' increased emphasis on correctly identifying the accounting period of the financial reports, rather than the purpose of the reports themselves. The part *Key Features* contains the general characteristics of the report to address the key requirements of IR, specifically focusing on the length of the report, to whom the report is addressed and the balance between financial and non-financial data. Many companies put out non-financial KPIs about environmental and social performance. The third category analysed is composed of 20 items, of which only 9 were detected: in this case the incidence is 45%. An analysis of the data deducted from the influence of the size of the documents confirms the results of the evaluation of the data expressed in absolute value. In fact, we have a maximum value of 52 occurrences in Anglo American Platinum and a minimum value of 0 occurrences in Sentula Mining. The next step allows us to consider the percentage of each item within the category, and the resulting data show that the item with the highest incidence is "feedback" (44.5%), whereas the lowest incidence is registered by "diagrams" (0.3%). This result suggests an assessment of the



Graph 1. Pie Chart of normalized frequencies.



Graph 2. Box plot - Semantic categories.

Table 8. Descriptive statistics.

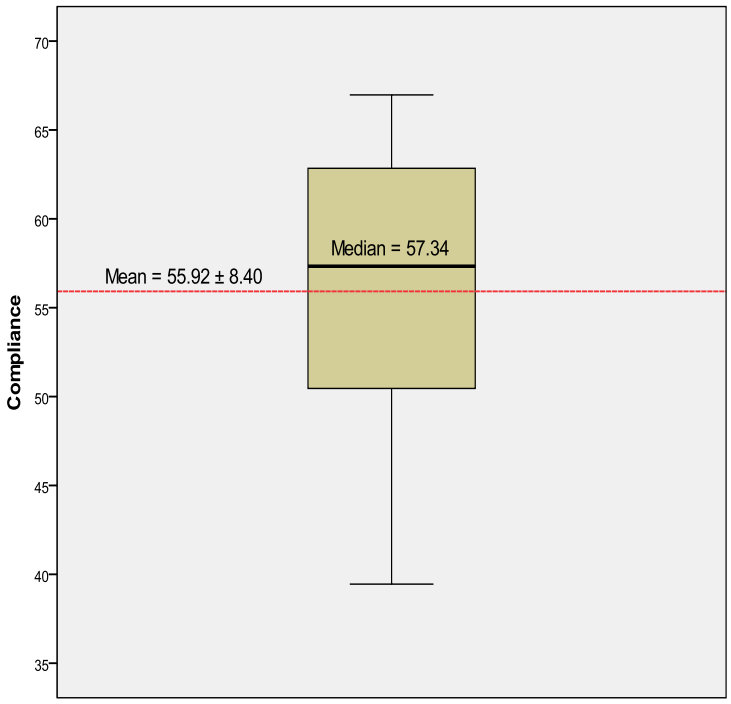
Statistics	Group profile	Scope boundary	Key features	Strategy vision values	Governance structure	Stakeholders	Material risks opportunities	KPI targets	Remuneration
Min	38	1	0	55	96	9	63	147	11
Max	163	64	52	265	303	59	182	426	133
Median	119.75	10.82	11.47	106.77	186.98	28.55	111.09	316.20	42.68
Mean	113.51	13.41	12.97	115.46	179.60	30.44	110.99	299.40	48.43
Std. Dev.	30.43	14.01	11.28	51.91	52.30	12.58	30.80	101.07	27.68

Table 9. Compliance.

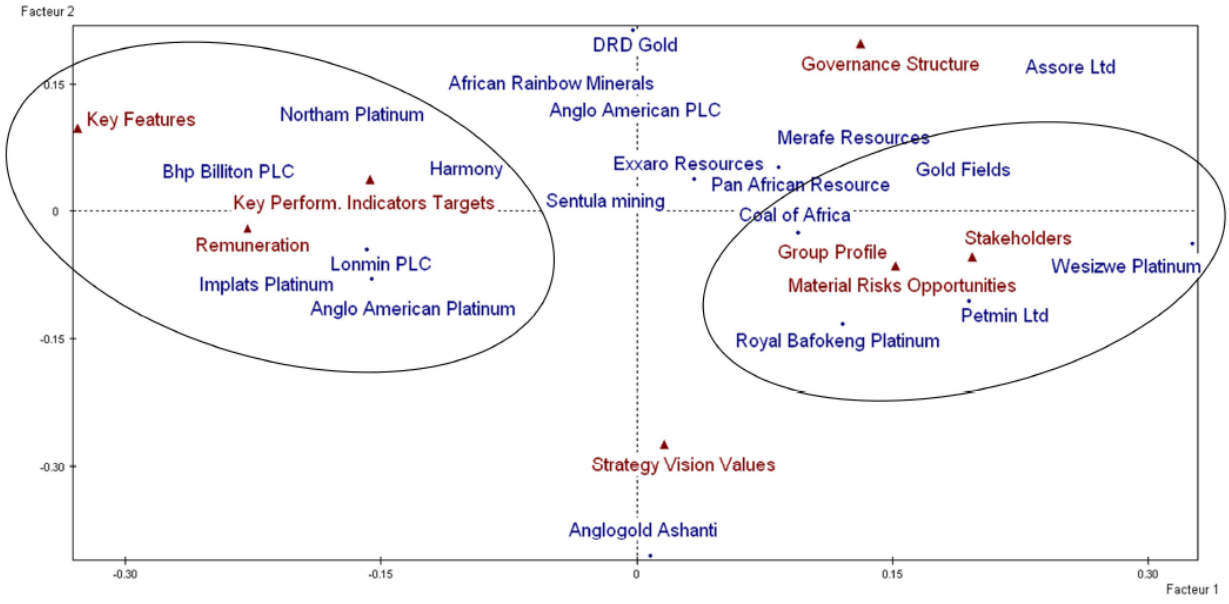
Company	Disclosed Items	Compliance
African Rainbow Minerals	71	65.14
Anglo American Platinum	73	66.97
Anglo American PLC	59	54.13
Anglogold Ashanti	72	66.06
Assore Ltd	52	47.71
Bhp Billiton PLC	66	60.55
Coal of Africa	43	39.45
DRD Gold	58	53.21
Exxaro resources	63	57.80
Gold Fields	62	56.88
Harmony	66	60.55
Implats Platinum	70	64.22
Lonmin PLC	72	66.06
Merafe resources	67	61.47
Northam Platinum	59	54.13
Pan African resource	47	43.12
Petmin Ltd	47	43.12
Royal Bafokeng Platinum	66	60.55
Sentula mining	48	44.04
Wesizwe Platinum	58	53.21

incidence of similar terms that indicate the presence of graphs, diagrams and representations. If, for example, we consider the value of items such as “symbols”, “illustration”, “graphs” and “maps”, the resulting values are quite low, from 4 to 2.3% and down to 1.7%. This would suggest that mining companies do not generally focus on the part of their integrated reports that are devoted to graphs and pictures.

The main characteristics that are described in the part *Strategy vision values* are useful for understanding the vision of the future through challenges and relevant opportunities for the organization. More specifically, it examines the level to which the strategy goals, values and objectives correlate with the sustainability vision and whether the company has adequately assessed its key risks and opportunities. As for the items relative to strategy reports, the results show that only one item ("future objectives') out of a total of 11 was not found in any analysed report. In this case, the percentage is therefore high (91.6%) and allows us to give the semantic category a prominent position in the mining sector. Clearly, the number of occurrences must be estimated as a normalized value, but the overall judgment is very positive. As for the normalized values, a maximum value of 265 was detected in Anglogold Ashanti’s reports, whereas a minimum value of 55 was associated with Assore Ltd. The next step is the assessment of the percentage of each item in the category. As expected, the item with the highest percentage is "strategy" (63%), and the one with the lowest percentage is "strategy planning" (0.03%). However, the above items could be considered synonyms; consequently, in light of the results, the input of a single item would have been correct. Another item with a very low percentage (0.07%) is



Graph 3. Box plot – Compliance.



Graph 4. Factorial plan. Source: our elaboration.

"future targets", where however, company disclosures have again preferred a more general term, such as "objectives", with an incidence of approximately 20%.

The part *Governance Structures* describes governance supports the strategic objectives of the organization related specifically to the approach to remuneration. The governance structure oversees the level to which strategy is linked to environmental, social and governance (ESG) risks and opportunities and the level of the integration with the business. The content of this part is formulated

directly from King III, which clearly sets out the requirements for governance and specifically requires boards to include a statement on the integrity of the integrated report. The corporate governance category includes 18 items, and only one of them was not found in the reports analysed (that is, “ethics disclosure”), but as mentioned above, this item may be associated with "ethics", which has an absolute value of 394 out of a total of 3,891. The significant presence of nearly all of the items (94%) is evidence of the top priority assigned to this semantic category, as one might have expected in light of the significance attached to this aspect by the King III code. The normalized frequency table shows different results with respect to the absolute values: the highest value is associated with Anglo-American Plc, the lowest one with Sentula Mining. Thus, in this case, the size of the reports has been fairly influential. If we consider the importance of each item, the one with the highest incidence is "quality" (16.7%), whereas three items show the lowest incidence, namely, "employee involvement", "governance of risks" and "key governance policies". Examining the results, we think the positive quantitative judgment can be undermined by the strong presence of rather general items such as “quality” and “board of directors” rather than items such as “employee involvement”, “governance of risks” or “ethics”. Compliance with the King III code may therefore result in inadequate corporate governance and little attention to ethical conduct.

Integrated reporting provides insight into companies’ relationships (Section Stakeholders) with their key stakeholders (internal and external) and how and to what level the organizations understand and takes into account and responds to their needs and expectations. It is also necessary to ensure that major stakeholders are not overlooked or incorrectly prioritized. The link to which credibility is also achieved through external assurance must be assessed. The materiality of issues to stake-holders, however, cannot be assessed. Considering the significance of these issues within the organization itself and the overlap between what is important to both stakeholders and the company will define the truly material interests that should be described in IR. As for the items in the category concerning stakeholders, we can further note a strong correspondence with the items shown in the checklist: only 1 item out of a total of 10, “stakeholder needs”, was not detected in the analysed documents. The resulting data of the normalized frequencies show that the minimum value is associated with Pan African Resource, whereas the maximum value is identified with Merafe Resources. As for the assessment of the incidence of each item, the highest percentage is associated with “stakeholder engagement” (41.7), the lowest one with "stakeholder inclusiveness" and "target audience" (0.15). The most significant aspect of the non-financial information provided to stakeholders Is therefore the need for the real involvement of all stakeholders in corporate life.

In the part *Material Risks and Opportunities*, there is a description of the circumstances under which the company works, including key resources and relationships on which it depends, the key risks and opportunities that will influence the organization, and how this will affect their business and the risk mitigation plan. It remains unclear, however, how organizations link these risks to their strategic objectives and how they translate to measurable KPI. The semantic category on risk and opportunity management totals 12 items, and only one (“risk indicators”) could not be detected by the TaL.TaC software. This category is therefore adequately represented in the reports of mining companies (91.67%). The results of the analysis of normalized frequencies shows that, with a value of 182, Royal Bafokeng scored the maximum value (182), whereas Pan Africa Resource scored the minimum value of 63. As for the percentage of each item within the category, it should be noted that the item showing the highest percentage (approximately 42%) is "risk management", with the lowest percentages belonging to "risk disclosure" (0.08%) and "risk mitigation" (0.4%).

The most important focus in the part *Key Performance Indicators and Targets* is obtaining an understanding of the level at which the chosen KPI meets the materiality criteria and whether the key targets linked to the sustainability strategy are described. The KPIs category has the greatest number of items; in fact, these indicators use both financial and non-financial information that can be located in different places within the companies’ reports. Thirty-six items are identified in the checklist, and if we observe the data expressed in absolute value, the total occurrences show the highest value. It is possible to note *in primis* that in the companies analysed, only 27 items (75%) were found in the reports. The results highlighted in the normalized frequency table are very different from the absolute values: the highest value is found for Anglo American Platinum and Harmony (426), whereas the lowest value (147) is that of Petmin Ltd. As for the incidence of single items, "performance" has the highest percentage (52.16%), whereas "intellectual capital", "measurable targets" (0.03%) and "improvement programmes" (0.07%) show the lowest percentage.

The part *Remuneration* covers the approach towards remuneration and how remuneration policies are aligned with the strategic objectives. The last category covers the disclosure of the board’s remuneration, and an analysis of the number of items in the checklist has shown that all of the 9 identified items appear on the table of total occurrences. The maximum normalized value is associated with BHP Billiton and the minimum with Pan African Resource. As for the incidence of each item within the category, "remuneration committee" is the item with the highest percentage (approximately 32%), whereas the lowest percentage is associated with "long term incentives". However, 100% compliance can be noted

because all companies have identified all of the items on the checklist.

Conclusions

South Africa is one of the most important mining countries in Africa and the world. It has the world's largest reserves of chrome, gold, vanadium, manganese and PGMs (platinum group metals) and accounts for nearly all of Africa's metals and mineral production (Burger, 2006). According to White (1995) and Stainbank (2012), the mineral extraction and processing industry is the most dominant industry in the South African economy in that it contributes a substantial amount to its export earnings and opens employment opportunities that are crucial to South Africa's economic and social concerns. In addition, due to their impact on the natural environment, mining companies are under close watch by environ-mental groups and society at large. There are many mining companies in emerging countries looking to Western stock exchanges to find markets for their stocks (Smith and Mokgoatlheng, 2003). Because the South African mining industry is in an emerging country, it may need to improve its non-financial disclosures to compete globally and meet the expectations of potential investors (Atkins and Maroun, 2015; Stainbank, 2012; PWC, 2013).

In South Africa, the elaboration of an integrated report has become compulsory after the recommendations included in the King Code of Governance Principles for South Africa 2009 (King III) and the definition of the listing requirements on the JSE (http://www.jse.co.za/Home.aspx). "South Africa is among the first countries in the world to require integrated reporting of listed companies. This puts way ahead of the game" Mervyng King told reporters (www.southafrica.info/news/business/143897.htm).

Companies listed on the JSE are obliged to comply with the JSE's listing requirements, which involve compliance with the King Report III and the SRI index. A previous study of the South African mining sector (Stainbank, 2012) noted that the number of companies reporting according to the GRI increased by 20% in 2006 compared to 2004 or 2005. In addition, some companies provided the GRI disclosure index for their non-financial reporting, which made it easy to follow the extent of their non-financial disclosures. As a consequence, non-financial information is affected by compliance with mandatory regulations, even if the pressure exerted by the stakeholders urges companies to further increase the amount of information, particularly with regard to the human capital. Therefore, issues such as human rights and health and safety have become a priority to enhance the contribution exerted by the sector with a view to sustainable development in the areas of emerging economies (ICMM, 2006; ICMM, 2012).

Given these premises, the empirical research conducted on the basis of the checklist displayed in Table 2 showed some interesting results in terms of disclosures relating to the items in the nine semantic categories listed above. In brief, the textual analysis showed the following results:

1) The semantic categories that display the greatest compliance by companies are n. 4 *Strategy Vision Values*, n. 5 *Governance Structures*, n. 6 *The Stakeholders*, n. 7 *Material Risks and Opportunities* and n. 9 *Remuneration*. Many items in category n. 8, *Key Performance Indicators and Targets*, were not detected.
2) For each category, it is not possible to find total homogeneity in absolute occurrences and normalized frequencies because the maximum and minimum values are quite different. Existing differences in the individual words are partially due to the type of item selected. In fact, in certain cases, the most general items had higher values than more specific words or expressions. The boxplots (Graph 2) show homogenous behaviours for certain groups of companies in relation to certain semantic categories: examining the width of the boxes and the length of the "flakes" - "Mustache", we could say that KIP Targets are isolated with a high variability, Strategy Vision and Values Governance Structure has an average variability, Group Profile, Material Risks and Opportunities Remuneration have a moderate variability and, finally, Scope Boundary, Key Features and Stakeholders have a low variability.
3) Checking the degree of compliance on the part of the sample companies leads to the analysis of the number of items found in the documents with respect to the item totals in relation to the individual companies. The assessment of each company makes it possible to perform a comparative evaluation in overall terms. The results show that on average, the degree of compliance with the disclosure checklist (Tables 2 and 9) is approximately 55.92%, and the best results are achieved by the company Anglo American Platinum (66.97%), while the company with the lowest value is Coal of Africa (39.45%) (Table 9).

Overall, the empirical findings do not indicate homogeneous behaviour among companies; nevertheless, it can be noted that the higher incidence of the issues set forth above may be due to the correspondence with some areas noted in the criteria themes of SRI index. For example, category n. 6 *Stakeholders* may be associated with the topic "Society", category n. 4 *Strategy vision values* with "policies and strategies", and category n. 5 *Governance Structures* with "governance and related sustainability concerns". Compliance with the essential requirements for ESG set by JSE for the SRI index may have exercised some influence (JSE and EIRIS, 2010).

The items related to environmental disclosures found in category n. 7 - such as sustainability review, environmental performance and sustainability performance - did not display significant values, and others, such as ESG indicators and ESG performance, were not detected. This

seems to contradict the strong pressure exerted by various stakeholders and society in general about the growth of disclosures concerning the environment. In particular, the SRI index requires special attention to the issue of climate change with the intention of leading companies to consider what risks they face due to the anticipated effects of climate change, and how they are managing and reporting on their efforts to reduce carbon emissions (JSE, 2010).

Further clarification about the items related to the disclosure CI is needed. In this case, the information is rather lacking: for example, the item *intellectual capital* (category n. 7) was not found in the documents analysed. This confirms the results of a previous survey of 75 companies carried out in South Africa (Firer and Williams, 2003), which indicated that the association between the efficiency of value added by a firm's major resource components (physical capital, human capital and relational capital) and the three traditional dimensions of corporate performance (profitability, productivity and market value) is limited and mixed. Consequently, the empirical findings of this study state that despite the efforts to improve its intellectual capital base, the business environment and market in South Africa still appear to place greater weight on corporate performance based on physical capital assets. This aspect also arises from another study (April et al., 2003) whose empirical results show that mining companies tend to report on fewer intellectual capital attributes than other companies. In addition, results show that mining companies rate intellectual capital highly, but appear to be lacking in its measurement and reporting.

This research does not provide an optimistic view of the implementation of IR in its early stage because the results exhibit a wide range of diversity in the type and quantity of information reported. This finding confirms that the lack of a precise framework and IR standards produce a high diversity of IR practices (Wild and van Staden, 2014) in spite of the mandatory listing requirements in South Africa. This suggests that the first adopters are unable to achieve the IIRC aims and cannot produce concise, consistent and comparable reports. The findings show a high heterogeneity among corporate reports produced by companies.

This appears to be worrying in view of the need of enhancing disclosures linked to human capital, in particular, given the high frequency of accidents at work, which have a strong impact on reputation and corporate image. This item can also be considered a part of the social disclosure as a peculiarity of the mining sector, as mining activities generate significant social concerns in terms of their environmental impact and employees' health and safety (Deegan and Rankin, 1996; Cho, 2009; Coetzee and van Staden, 2011). Davies et al. (2002) indicate that South Africa mining industry's employees are extremely vulnerable to HIV/AIDS because they generally come from remote areas and are far away from their families. Hence, the effects of this disease on the labour force may cause a considerable impact on the South African economy.

As is generally known, the use of content analysis to measure non-financial information disclosure as an end in itself (references) and as an input in statistical regression studies to investigate the determinants of non-financial disclosures is increasing in similar studies (Kang and Gray, 2011). Consequently, further research could help to identify the potential reasons behind companies' non-financial disclosures and practices. The determinants that influence disclosure and compliance are the firm's size and its trends in share price and performance. Finally, this study shows certain limits. The analysed period is restricted to one year; consequently, we did not evaluate the temporal trend of potential improvements of non-financial information disclosures, and it might be interesting to perform a longitudinal analysis. Another caveat of this paper is the lack of comparative analysis by means of the assessment of other industries in the South African economy.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

Abdo A, Fisher G (2007). The impact of reported corporate governance disclosure on the financial performance of companies listed on the JSE. Invest. Anal. J. 66:43-56.

Abeysekera I (2008). Intellectual capital disclosure trends: Singapore and Sri Lanka. J. Intellect. Capital 9(4):723-737.

Abeysekera I. (2013). A template for integrated reporting. J. Intellect. Capital 14(2):227-245.

ACCA and Eurosif (2013). What do investors expect from non-financial reporting? Available at www.accaglobal.com Last access 30 August 2015.

Adams S, Fries J, Simnett R (2011). The journey toward integrated reporting, Accountants Digest (ICAEW), Wolters Kluwer: UK.

ADVFN (2007). Johannesburg Stock Exchange (JSE), available at http://www.advfn.com/StockExchanges/about/JSE/JohannesburgStockExchange.html. Last access 28 August 2012.

Aerts W, Cormier D (2009). Media legitimacy and corporate environmental communication. Account Org Soc. 34(1):1-27.

Alrazi B, de Villiers C, van Staden CJ (2015). A comprehensive literature review on and the construction of a framework for, environmental legitimacy, accountability and proactivity. J. Clean Prod. 102:44-57.

Antonites E, de Villiers CJ (2003). Trends in South Africa corporate environmental reporting: A research note. Meditari Account. Res. 11(1):1.10.

April KA, Bosma P, Deglon DA (2003). IC measurement and reporting establishing a practice in SA mining. J. Intellect. Capital 4(2):165-180.

Atkins J, Maroun W (2015). Integrated reporting in South Africa in 2012: perspectives from South African institutional investors. Meditari Account. Res. 23(2):197-221

Beattie V (2000). The future of corporate reporting: A review article. Irish Account. Rev. 7(1):1-36.

Beattie V, McInnes B, Fearnley S (2004). Through the eyes of management: narrative reporting through three sectors, Institute of Chartered Accountants in England and Wales: London.

Beattie V, Pratt K (2003). Issues concerning web-based business

reporting: An analysis of the views of interested parties. Brit. Account. Rev. 36(2):155-187.
Beattie V, Thomson SJ (2007). Lifting the lid on the use of content analysis to investigate intellectual capital disclosure. Account. Forum 31:129-163.
Bolasco S (2010a). Taltac2.10 Sviluppi, esperienze ed elementi essenziali di analisi automatica dei testi (Taltac2.10, experiences and essential topics of automatic analysis of texts), LED:Milan.
Bolasco S (2010b). Analisi Multidimensionale dei dati. Metodi, strategie e criteri di interpretazione (Multidimensional analysis. Methods, strategies and criteria of comprehension), Carrocci:Rome,, 4th edition.
Bolasco S, Canzonetti A, Capo F (2005). Text Mining – Uno strumento strategico per imprese e istituzioni (Text Mining – A strategic tool for companies and institutions). Cisu Editor:Rome.
Bollen A (2004). The rise and rise of non financial reporting: How to use research to measure your reputation. London MORI, available at http://www.ipsos-mori.com/publications/ahb/rise-and-rise.pdf. Last access 30 September 2015.
Borkowski SC, Welsh MJ, Wentzel K (2012). Sustainability reporting at Johnson & Johnson: A case study using content analysis. Int. J. Bus. Insight Transform. 4:96-105.
Boyatzis ME (1998). Transforming qualitative information. Thematic Analysis and Code Development, Sage, Case Western Reserve University: Cleveland USA.
Burritt RL (1997). Corporate environmental performance indicators: Cost allocation-boon or bane? Greener Manage. Int. 17:89-100.
Busco C, Frigo ML, Quattrone P, Riccaboni A (2013). Redefining Corporate Accountability through Integrated Reporting. What happens when values and value creation meet? Strat. Finan. August. pp. 33-41.
Carels C, Maroun W, Padia N (2013). Integrated reporting in the South African mining sector. Corporate Ownersh. Control 11:991-1005.
Chauvey JN, Giordano-Spring S, Cho C, Patten DM (2013). The normativity and legitimacy of the CSR disclosure. Evidence from France. Working paper 36th European Accounting Association Congress, Tallinn, April.
Cho CH (2009). Legitimation strategies used in response to environmental disaster. A French case study of Total SA's Erika and AZF incidents. Eur. Account Rev. 18(1):33-62.
Churet C, Eccles RG (2014). Integrated Reporting, Quality of Management and Financial Performance. J. Appl. Corporate Finan. 26(1):56-64.
Coetzee CM, van Staden CJ (2011). Disclosures responses to mining accidents: South African evidence. Account. Forum 35:232-246.
Coram P, Monroe GS, Woodliff D (2009). The value assurance on voluntary nonfinancial disclosure. An experimental analysis. Audit. J Pract. Theory 28(1):137-152. http://dx.doi.org/10.2308/aud.2009.28.1.137.
CorporateRegister.com., (2013). CR Perspectives 2013. Global CR Reporting Trends and Stakeholders View, available at http://www.corporateregister.com/.m Last access 30 August 2015.
Davies JR, de Bruin DG, Deysel M, Strydom M (2002). The SA mining industry enters the HIV/AIDS war zone. Meditari Accountancy Res. 10:25-51.
De Klerk M, De Villiers C (2012). The value relevance of corporate responsibility reporting: South African evidence. Meditari Accountancy Res. 20(1):21-38.
De Villiers CJ (1999). Corporate social reporting in South Africa: signs of a pygmy awakening? Soc. Environ. Account. 19(2):5-7.
De Villiers CJ, Alexander D (2014). The institutionalization of corporate social responsibility reporting. Brit. Account. Rev. 46:198-212.
De Villiers CJ, Barnard P (2000). Environmental reporting in South Africa from 1994 to 1999: A research note. Meditari Accountancy Res. 8:15-23.
De Villiers CJ, Low M, Samkin G (2014). The institutionalization of mining company sustainability disclosures. J. Clean Prod. 84:51-58.
De Villiers CJ, Lubbe JC (2001). Industry differences in respect of corporate environmental reporting in South Africa: A research note. Meditari Accountancy Res. 9(1):81-91.
De Villiers CJ, Van Staden (2006). Can less environmental information be legitimising? Evidence from Africa. Account Org. Soc. 31(8):763-781.
Deegan C, Rankin N, Voght P (2000). Firm's disclosure reactions to major social incidents: Australian evidence. Account. Forum 24(1):101-130.
Deegan C, Rankin R (1996). Do Australian companies report environmental news objectively? An analysis of environmental disclosures by firms prosecuted successfully by the environmental authority. Account. Audit. Accountabil. J. 9(2):50-67.
Deloitte (2011). Integrated Reporting – A better view?, 2011, Deloitte Global Service Limited. Available at http://www.iasplus.com/en/binary/sustain/1109integratedreportingview.pdf, Last access 30 August 2015.
Deloitte (2012). Integrated Reporting Navigating your way to a truly Integrated Report, Issue 3, The future for corporate reports, February, available at http://www.iasplus.com/en/publications/south-africa/other/integrated-reporting-issue-3/view, Last access 30 August 2015.
Dumay J, Cai L (2015). Using content analysis as a research methodology for investigating intellectual capital disclosure: A critique, J. Intellect. Capital 16(1):121-155.
Eccles RG, Armbrester K (2011). Integrated Reporting in the Cloud, First Quarter 2011, 8:13-20.
Eccles RG, Krzus MP (2010). One Report: Integrated Reporting for a Sustainable Strategy, John Wiley & Sons:New York.
Eccles RG, Krzus MP (2014). The Integrated Reporting Movement: Meaning, Momentum, Motives, and Materiality. John Wiley & Sons:New York.
FEE (Fédération des Experts comptables Européens) (2008). Discussion Paper, Sustainability Information in Annual Reports. Building on Implementation of the Modernisation Directive, available at http://www.fee.be/images/publications/sustainability/DP_Sustainability_Information_in_Annual_Reports_08125122008561444.pdf
Firer SS, Williams SM (2003). Intellectual capital and traditional measures of corporate performance. J. Intellect. Capital 4(3):348-360.
Fonseca A, McAllister ML, Fitzpatrick P (2014). Sustainability reporting among mining corporations: A Constructive Critique of the GRI Approach J. Clean Prod. 84:70-83.
Frik C (2002). Direct foreign investment and the environment: African mining sector, OECD Global Forum on International Investment and the Environment, Lessons to be learned from the Mining Sector, 7-8 February.
Gazdar K (2007). Reporting non-financials. John Wiley & Sons:England.
Global Reporting Initiative (GRI) G3 (2010), Sustainability Reporting Guidelines, Amsterdam, Available at www.globalreporting.org Last access 30 August 2015.
Goh PC, Lim KP (2004). Disclosing intellectual capital in company annual reports: Evidence from Malaysia. J. Intellect. Capital 5(3):500-510.
Gray R, Adams CA, Owen D (2014). Accountability, Corporate Responsibility and Sustainability: Accounting for Society and the Environment, Pearson: UK.
Gray R, Kouhy R, Lavers S (1995). Constructing a research database of social and environmental reporting by UK companies. Account. Audit. Accountabil. J. 8(2):78-101.
GRI (2001) Sustainability Reporting Guidelines & Mining and Metals Sector Supplement version 3.0, available at www.globalreporting.org Last access 30 August 2015.
Guenther E, Hoppe H, Poser C (2007). Environmental Corporate Social Responsibility of Firms in the Mining and Oil and Gas Industries: Current Status Quo of Reporting Following GRI Guidelines, Greener Manage. Int. 53:7-25.
Gumb B, Noël C (2009). CEO's Reports about Internal Control: A Content Analysis. Account. Eur. 6(1):81-106.
Guthrie J, Abeysekera I (2006). Content analysis of social and environmental: What's new." J. Hum. Resour. Costing Account. 10(2):114-126.
Hayes AF, Krippendorff K (2007). Answering the call for a standard reliability measure for coding data. Commun. Meth. Meas. 1:77-89.
Hindley T, Buys TW (2012). Integrated Reporting Compliance With The Global Reporting Initiative Framework: An Analysis of The South African Mining Industry. Int. Bus. Econ. Res. J. 11(11):1249-1260.

Hopwood A, Unerman J, Fries J (2010). Accounting for sustainability. Practical Insights, Earthscan: London.
Iannou I, Serafeim G (2014). The Consequences of Mandatory Corporate Sustainability Reporting: Evidence from four countries, Work. Pap. 11-100:1-35.
ICMM International Council of Mining & Metals (2006). International Council on Mining & Metals, available at http://www.icmm.com/ Last access 28 August 2012
ICMM - International Council of Mining and Metals (2012). Trends in the mining and metals industry, available at https://www.icmm.com/document/4441 Last Access 30 August 2015.
IIRC - International Integrated Reporting Council (2011). Towards Integrated Reporting - Communicating Value in the 21st Century, Discussion Paper September 2011.
IIRC (2013a). International Integrated Reporting Council (December 2013), The International <IR> Framework available at http://integratedreporting.org/ Last access 30 August 2015.
IIRC (2013b). International Integrated Reporting Council (December 2013). Basis for conclusions - The International <IR> Framework available at http://integratedreporting.org/ Last access 30 August 2015.
IRC (Integrated Reporting Committee) (2012). South Africa, Discussion Paper 25 January 2010, available at http://www.sustainabilitysa.org. Last access 30 October 2012.
Islam MA, Deegan C (2008). Motivations for an organization within a developing country to report social responsibility information: Evidence from Bangladesh. Accounting Audit. Accountabil. J. 21:850-874.
Jenkins H, Yakovleva N (2006). Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure. J. Clean Prod. 14:271-284.
JSE and EIRIS, (2010). JSE SRI Index background and selection criteria 2010, South Africa, JSE and EIRIS, available at httpp://www.jse.co.za. Last access 30 August 2015.
Kang H, Gray S (2011). The content of voluntary intangible assets disclosures. Evidence from emerging market companies. Int. J. Account. 46(4):402-423.
Kemp D, Bond CJ, Franks DM, Cote C (2010). Mining water and human rights: Making the connection. J. Clean Prod. 18(15):1553-1562.
King III (2009). Integrated Reporting – Sustainability Reporting No Longer a Poor Cousin to the Financial Numbers, available at www.pwc.com/za/en/press-room/king-iii-integrated-reporting.jhtml. Last access 28 August 2012
King M, Roberts L (2013). Integrate: Doing business in the 21st Century, September, Juta & Company Ltd: Cape Town.
KPMG (2006). Global mining reporting survey. Energy and natural resources, available at www. http://www.kpmg.com.br/publicacoes/industrial_markets/Global_Mining_survey.pdf Last access 30 August 2015.
KPMG (2011a). Integrated Reporting Performance insight through Better Business Reporting, Issue 1, available at https://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/road-to-integrated-reporting.pdf, Last Access 30 August 2015.
KPMG (2011b). International Survey of Corporate Responsibility Reporting 2011, available at https://www.kpmg.com/PT/pt/IssuesAndInsights/Documents/corporate-responsibility2011.pdfwww.kpmg.com, Last access August 2015.
Krippendorff K (1980). Content Analysis; An Introduction to its Methodology, CA: Sage Beverly Hills.
Krippendorff KH, Bock MA (eds.) (2009). The Content Analysis Reader, CA: Sage: Thousand Oaks.
Kumah A (2006). Sustainability and gold mining in the developing world. J. Clean Prod. 14(3-4):315-323.
Lebart L, Salem A (1994). Statistique Textuelle (Textual Statistics) Dunod:Paris.
Leuner JB (2012). Integrated reporting takes hold. Communication World 3-4:33-35.
Lodhia S, Hess N (2014). Sustainability accounting and reporting in the mining industry: Current literature and directions for future research. J. Clean Prod. 84:43-50.
Lodhia S, Martin N (2014). Corporate Sustainability Indicators: An Australian Mining Perspective. J. Clean Prod. 84:107-115.
Maffini GC., Kneipp JM, Kruglianskas I, Barbieri da Rosa LA, Schoproni BR (2015). Management for sustainability: An analysis of the key practices according to the business size. Ecol. Indic. 52:116-127.
Mangena M, Tauringana V (2007). Disclosure, Corporate Governance and Foreign Share Ownership on the Zimbabwe Stock Exchange. J. Int. Financ. Manage. Account. 18(2):53-85.
Maubane P, Prinsloo A, Rooyen NV (2014). Sustainability reporting patterns of companies listed on the Johannesburg securities exchange. Public Relat. Rev. 40(2):153-160.
Milne MJ, Adler RW (1999). Exploring the reliability of social and environmental disclosures content analysis. Account. Audit. Accountabil. J. 12(2):237-256.
National Treasury (2010). Available at www.treasury.gov.za, Last access 30 August 2015.
Newson M, Deegan C (2002). Global Expectations and their Association with Corporate Social Disclosure Practices in Australia, Singapore and South Korea. Int. J. Account. 37(2):183-213.
Palenberg M, Reinicke W, Witte JM (2006). Trends in non-financial reporting, November 2006. Paper prepared for the United Nations Environment Programme, Division of Technology, Industry and Economics, Global Public Policy Institute available at www.gppi.net Last access 30 August 2015.
Pellegrino C, Lodhia S (2012). Climate change accounting and the Australian mining industry: Exploring the links between corporate disclosure and the generation of legitimacy. J. Clean Prod. 26:68-82.
Porter ME, Kramer MR (2011). Creating Shared Value. Harvard Bus. Rev. 89(1-2):62-77.
Price Waterhouse Coopers (2010). Steering Point Integrated Reporting; Integrated Reporting – What does your reporting say about you? Harvard Business School Faculty Research Symposium May 20.
Price waterhousecoopers (2013). Extractive value. What do investment professionals need from mining company reporting? September 2013, available at www.pwc.co.uk/mining Last access 30 August 2015.
Raemaekers K, Maroun W, Padia N (2016). Risk disclosures by South African listed companies post-King III. S. Afr. J. Account. Res. 30(1):41-60.
Rensburg R, Botha E (2014). Is Integrated Reporting the silver bullet of financial communications? A stakeholders perspective from South Africa. Public Relat. Rev. 40:144-152.
Robb SWG, Single LE, Zarzeski MT (2001). Non financial disclosures across Anglo American countries. J. Account. Audit. Taxation 10:71-83.
Rossouw R (2010). King III Integrated Report – Why it's crucial to plan ahead. Board Room 3:537-538.
Setia N, Abhayawansa S, Joshi M, Huynh AV (2015). Integrated reporting in South Africa: Some initial evidence. Sustain. Account. Manage. Policy J. 6(3):397-424.
Singleton-Green B (2010). Commentary: Is the Reporting Model Broken? Austral. Account. Rev. 20(4):409-410.
Stainbank LJ (2012). The nature and extent of non-financial disclosures in the South African mining industry. Conference Proceedings Faculty of Ljubljana 35th Annual Congress European Accounting Association EAA, Ljubljana, May 9-11.
Striukova L, Unerman J, Guthrie J (2008). Corporate reporting of intellectual capital: Evidence from UK companies. Br. Account. Rev. 40:297-313.
Sullivan D (2001). Document Warehousing and Text Mining: Techniques for Improving Business Operations, Marketing, and Sales John Wiley & Sons, Inc.: New York.
Tawiah KA, Dartey-Baah KD (2005). Corporate Social Responsibility in Ghana International Journal of Business and Social Sciences, Special Issue on Contemporary Issues in Business Studies, 2(17):107-122.
The Institute of Directors in Southern Africa (IoDSA) (2009). King Report on Governance for South Africa and King Code of Governance Principles (King III) available at http://www.iodsa.co.za/?kingIII. Last access 28 August 2015.
Unerman J (2000). Methodological issues: reflections on quantification in corporate social reporting content analysis. Account. Audit. Accountabil. J. 13(5):667-680.

Van Staden CJ (2003). The relevance of theories of political economy to the understanding of financial reporting in South Africa: The case of value added statements. Account. Forum 27(2):224-246.
Vanstraelen A, Zarzeski MT, Robb SWG (2003). Corporate nonfinancial disclosure practices and financial analyst forecast ability across three European countries. J. Intl. Financ. Manage. Account. 14(3):249-278.
Warhurst A (1998). Corporate social responsibility and the mining industry, Presentation at Euromines, Mining and Environmental Research Network (MERN), June 4th, Brussels.
Weber RP (1990). Basic Content Analysis, Sage Publications: Newburry Park, CA.
White AL (2005). New wine, new bottles: The rise of Non-Financial reporting, A Business Brief by Business for Social Responsibility. June, available from http://www.bsr.org. Last access 28 August 2015.
Wild S, van Staden C (2015). The Development of Integrated Reporting: A Paradigm of Regulatory Capture? Paper presented at the ATINER 13th Annual International Conference on Accounting, 23-25 May 2015, Athens, Greece.
Yakovleva N, Vazquez-Brust D (2012). Stakeholders perspectives on CSR of Mining MNCs in Argentina. J. Bus. Ethics 106(2):191-211.
Yongvanich K, Guthrie J (2005). Extended performance reporting: an examination of the Australian mining industry. Account. Forum 29:103-119.
Zambon S (2011). The managerialisation of Financial Reporting: An introduction to a destabilizing accounting change. Financ. Rep. Spec. Iss.: pp. 5-16.
Zanasi A (2005). Text Mining and its applications to intelligence, CRM and knowledge management Southampton: WIT Press.

Appendix 1. Sample of listed mining companies.

Name	Business activity
Coal of Africa Exxaro resources	Companies engaged in the exploration for or mining of coal
BHP Billiton Anglo American Assore Ltd African Rainbow Minerals Ltd Merafe Resources Petmin Ltd Sentula Mining	Companies engaged in the exploration, extraction and refining of minerals not defining elsewhere within the mining sector
Anglogold ashanti Gold fields Harmony Pan African resources DRD gold	Prospectors for and extractors or refiners of gold bearing ores
Anglo American platinum Impala Platinum Hds Lonmin PLC Northam Platinum Royal Bafokeng Platinum Wesizwe Platinum	Companies engaged in the exploration for and production of platinum, silver and other precious metals not defined elsewhere

Source: JSE.

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Decision support model for supplier selection in healthcare service delivery using analytical hierarchy process and artificial neural network

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The healthcare industry today has grown rapidly and emphasizing the efficiency and effectiveness within the healthcare delivery systems has become a major priority in the field. In order to increase the satisfaction and safety of patient, hospitals must improve their overall performance. We established from our review that a number of models have been developed for supplier selection using diverse methods. Most of the models were used to evaluate the performance of healthcare service sector but there is little emphasis on suppliers of health service facilities. And also to the best of our search, we could not find research works on models for evaluating and selecting suppliers in the healthcare unit of tertiary institution. Hence our focus in this study is to develop a decision support model for evaluating and selecting suppliers in the healthcare service of universities. The use of manual techniques for supplier selection in healthcare unit of universities in developing countries is quite tedious and inefficient particularly when several criteria are taken into consideration. These make decision making difficult and also cause the health centre to frequently stock out. Moreover deciding when to order and how much to order is not very easy and hence not meeting patients' demands adequately. This study focuses on investigating and developing a decision support model for evaluating and selecting suppliers in the healthcare service of tertiary institutions using analytical hierarchy process (AHP) and artificial neural network (ANN). Our case study is the health center of Redeemers University, Nigeria. According to the Overall Priority Vector, the priority values for the respective criteria are: Quality = 0.2192, Service = 0.2160, Delivery = 0.2102, Cost = 0.1968 and Risk = 0.1860. Our results revealed that the quality of product supply by the supplier is the most important criterion, while the risk on the supplies is the least important. To improve on the accuracy of these results, the AHP model was supplemented by a 3-layer artificial neural network, adding a learning component to the model. The result also shows that quality is the most important criterion, but with a high index of 0.6845 as opposed to 0.2192 for the AHP alone. This shows that the hybrid model is much better than the AHP alone.

Key words: Supply chain management, AHP, ANN, decision making and supplier selection.

INTRODUCTION

The healthcare industry today as grown rapidly and emphasizing the efficiency and effectiveness within the healthcare delivery systems has become a major priority in the field. In order to increase patients; satisfaction and

safety, hospitals must improve their overall performance. Therefore, the best equipment and drugs have to be used. This brought about the issues of supplier selection which have captivated the enthusiasm of analysts since the 1960s, and exploration around there has expanded. The need for effective delivery in the health system using a supply chain system has been a welcoming idea in the overall output and performance. The supply chain management frameworks is the incorporation of exercises to get materials, change them into quick products and last item and convey them to clients (Heizer and Render, 2001). The supply chain management (SCM) underlines the key helpful relationship between main enterprise and enterprise coalition. The choice of vital accomplices is a critical choice making issue in SCM and is the way to fruitful SCM.

Despite the numerous studies that have been conducted over the years, there is still need to develop a supplier selection decision support system that will enhance the university's current system of approach in the area of supplier selection which is quite inefficient where decision making on how to choose a supplier are based on either reference or cost, whereas, there are several criteria to take into considerations which includes price, delivery, risk, quality and service. This difficulty in decision making has led the Health Centre to frequent stock outs, deciding when to order and how much to order and adequately meet patients' demand.

Though there are traditional cost-based approaches for evaluating and selecting suppliers, evidences were provided in various researches reviewed (Ho et al., 2010; Liberatore and Nydick, 2008) that the multi-criteria decision making approaches are better than the traditional cost-based approaches. According to Baltussen and Niessen (2006), an approach that has been gaining momentum in the healthcare supply sector is the Multi-Criteria Decision Making (MCDM) which is a method to aid decision making, where decision are based on more than one criteria. An example is the Analytical Hierarchy Process (AHP). The Analytic Hierarchy Process (AHP) is a multi-criteria decision making (MCDM) method. The model is a technique used in supplier selection and assessment. It makes selection process transparent as well as reveals the relative benefits of alternate answers for a multi criteria choice making issues (Drake, 1998). It is a model developed by Thomas Saaty in the 1970s as a method for managing weapons tradeoffs, asset and resource distribution, and choice making. It utilizes the judgments of leaders to shape a breakdown of issues into chains of hierarchies. The hierarchies are for deriving ratio-scaled measures for choice making and the relative value that alternatives have against organizational goals and project risks. AHP utilizes matrix algebra to deal with variables to land at a numerically ideal arrangement. It derives ratio scales from matched examination (paired comparisons) of com-ponent and decision alternatives. It additionally utilizes genuine measures like value, checks, or subjective assessment as inputs into a numerical matrix. The yields comprise ratio scales and consistency records derived by computing eigenvalues and eigen-vectors.

AHP model in decision making and supply chain management consist of four steps which include: (1) Model development and problem formulation, (2) Pair-wise comparison of determinant, (3) Evaluation of alternatives and (4) Calculation and final result.

Supplier selection decision is a multi-criterion problem (Kahraman et al., 2003) and as a result, some attributes are important in supplier selection process. Van der Rhee et al. (2009) established the relative impact of cost, flexibility, delivery and service features on supplier selection based on perspectives of respondents from manufacturing organizations in Europe (that is, Germany, France, Italy, and UK) using a computer-based supplier selection discrete choice survey. Suppliers' flexibility was valued most and next was the cost variable. In addition, Hsu et al. (2013) identified the key criteria influencing the supplier selection with regard to carbon management competencies. Decision-making Trial and Evaluation Laboratory (DEMATEL) approach was applied and its application revealed both the structure and interrelationships between the criteria.

In Kahraman et al. (2003), fuzzy analytic hierarchy process (FAHP) was used to select the best supplier firm providing the most satisfaction for the criteria determined. Fuzzy based AHP was used because of the complex and unstructured nature of the supplier selection process.

This paper concentrates on the application of AHP-ANN model for supply chain management in healthcare service delivery and also to identify appropriate decision making processes discussing the advantages and disadvantages of traditional decision making process and focusing more on designing an AHP based model having enhanced features. AHP is used to assign the weights of the alternatives with regard to one or more of the criteria to ANN. ANN utilizes the weight of each criterion from AHP model to select the best supplier and find alternate suppliers on the basis of performance score of each supplier.

AHP modelling methodology was utilized in this study for the following reasons (Saaty, 1996; Chan and Chan, 2004; Sarkis and Surrandaj, 2006; Liberatore and Nydick, 2008):

a. AHP is not proportionately complicated as compared

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Figure 1. Flow of a supply chain management (Bakar et al., 2010).

modeling technique.
b. It has the supplemental power of being able to mix quantitative and qualitative factors into a decision. It uses a hierarchical structuring of the factors involved. The hierarchical structuring is universal to the composition of virtually all complex systems, and is a natural problem-solving paradigm in the face of complexity.
c. In AHP, judgments evoked are completed using a decomposition approach, which has been shown in experimental studies to reduce decision making errors.
d. AHP is validated from the decision maker's perspective as well in recent empirical studies. It is a technique that can prove valuable in helping multiple parties (stakeholders) arrive at an agreeable solution due to its structure, and if implemented appropriately can be used as a consensus-building tool.
e. Justification for ANN

AHP modelling, though, depends on human intuition, especially in the process of pair wise comparison. Thus, any lack of information regarding the supplier selection criteria may disturb the evaluation process. To overcome this difficulty, we combine the AHP with Artificial Neural Network (ANN) and propose a hybrid AHP-ANN methodology in this paper to improve the data analysis of AHP. The ANN provides a new way for feature extraction (using hidden layers) and classification, as well as adding a learning mechanism to the AHP. This, it is hoped, will produce better results than the ordinary AHP method (Ghodsypour and O'Brien, 1998; Al-Barqawi and Zayed, 2008; Simunovis et al., 2009).

REVIEW OF RELATED LITERATURE

Review of works on supplier selection and assessment

Over the years, the rate at which quality healthcare expenses is increasing is becoming a source of major concern. A noteworthy piece of medicinal services expense is the pharmaceutical supply segment. Enhancing medicinal services supply chains is discriminating due to the monetary size as well as due to the way that it affects such a large number of individuals. Health is a total state of complete well-being or balance often physical (free from disease, illness or malfunction) but sometimes also mental and social. Being healthy does not mean you are totally free from ailment or diseases and this leads to the issue of healthcare. Healthcare is a costly, complex, globally used service that massively influences economy and the quality of life (Berry and Bendapudi, 2007).

Due to the rise in competition of global world markets, the supply chain management system framework is turning into a hot issue in the international market today. Organizations are under extreme weight to discover approaches to slice out material expenses and production to survive and maintain their economic position in their individual markets.

According to Christopher (1994), a supply chain networks are system of establishments that are involved in the different procedures and exercises that convey value in the form of products and services in the hands of a customer through upstream and downstream linkages. SCM connects with the administration of streams between and among stages in an inventory network system to minimize total cost. The SCM framework is the combination of exercises to procure materials, change them into immediate goods and final product then convey them to clients (Heizer and Render, 2001). It includes all exertion included in producing, delivering and conveying a finished product or service from the supplier to the customer (Styles et al., 2012; Bradley and Solutions, 2007). SCM framework is a procedure of arranging, controlling and observing of the supply chain operations with the aim of fulfilling customers' demand in an effective, successful and gainful way (Bakar et al., 2010). It manages the aggregate stream of exercises or activities from suppliers through end users (Jones and Riley, 1985; Ware et al., 2012). The activities incorporate arranging, sourcing, making, and improvement of procedures with its constituent parts to incorporate material suppliers, production facilities, distribution centers, and customers. Cooper et al. (1997) characterized supply chain network as an integrative theory to manage the total stream of a circulation channel from supplier to a definitive client as presented in Figure 1. Thus SCM alludes to an arrangement of strategies for feasibly consolidating suppliers, makers, merchants and retailers to create stocks and convey them accordingly, minimizing framework cost under the precondition of guaranteeing administration level and conveying stocks of legitimate amounts to right places in suitable time.

SCM strategies have been demonstrated effective in various commercial enterprises, for example, producing, rural business, aviation, retailing, development, steel, auto, railroad, keeping money and budgetary establishments, material and even little and medium measured ventures (Bakar et al., 2010).

The medicinal services industry is experiencing aggravating patterns related to cost, quality, and expanded competition. It is surely understood that no industry can survive without considering much about diminishing cost wherever possible. The same is valid for the healthcare industry, which is experiencing sharp rise in expense and in every one of its items and administrations. The alarming high stride of upward advancement of costs is making the produce of the business past the range of the mass. Due to this weights, firms have swung to supply chain management (SCM) as intend to upgrade adaptability, versatility, cost, quality, and responsiveness (Chen and Paulraj, 2004). Supply chain in this industry being a huge driver of expense is accordingly getting all the consideration from industry stakeholders. The healthcare industry has also sought to reap some of the proposed benefits of effective SCM in recent years as the concept of partnering with customers, suppliers, and thus various strategic service providers has gained momentum. As indicated by Walters and Rainbird (2007), the medicinal services store network system offers different likenesses with different chains, not just as far as strategies (e.g. acquirement, warehousing and circulation), additionally regarding recognizing clients and administration structures.

SCM in healing centers includes the inside chain (that is, patients' consideration unit, clinic stockpiling, patient etc) and the outer chain (that is, merchants, makers, wholesalers and so on). Human services SCM procedures have three sorts of streams: physical item stream, data stream, and budgetary stream. The physical item stream oversees modified items and administrations for the treatment of patients and their needs. Data and money related streams are identified with production network outline choices for powerful item stream and enhanced hierarchical execution (Lee et al., 2011).

Supplier selection and assessment is the procedure or method of finding a supplier who is capable of giving the purchaser quality items at little expense or cost, and providing the right amount at a précised time. It is an imperative part for creation and logistics administration in numerous organizations (Min, 1994; Sonmez, 2006). In the present time, purchasers request less expensive, superb items, on-time conveyance and magnificent after-deal administrations. Qualified supplier is a key component and a decent asset for a purchaser in decreasing expenses; therefore, assessment and determination of the potential suppliers has turn into an imperative part of supply chain management. Selecting right suppliers significantly lessens the material buying cost and enhances corporate competitiveness (Cheraghi et al., 2011). A lot of works have been carried out on supplier selection and assessment and thus Table 1 presented a few of them.

A review of analytical hierarchy process (AHP)

The Analytical Hierarchy Process since its development has been an apparatus for decision makers and specialists. The AHP model makes use of MCDM strategy, which is a system to help choice making, where decision are based on more than one criterion. The model is a method utilized as a part of supplier determination and assessment. It makes selection process transparent, straightforward and in addition uncovers the answers for a multi criteria choice making issues (Drake, 1998). It is a model developed by Thomas Saaty in the 1970s for managing weapons tradeoffs, asset and resource assignment, and decision making. The AHP model consists of four major operations which include: Structuring of the decision problem (hierarchy construction); Making pairwise comparison and obtaining judgment matrix; Computing local weight and consistency of the comparisons; Aggregation of local weight.

AHP permits some little irregularity in judgment on the grounds that human is not generally consistence. The proportion scales are obtained from the principal eigenvectors and the consistency file is obtained from the major eigenvalue.

There are several advantages to using the AHP model and one major advantage is that the purchaser has the capacity to get a decent picture of the supplier's execution by utilizing the hierarchy of the criteria and assessing the suppliers (Omkarprasad and Kumar, 2006). Other advantages include stability and flexibility where it is able to makes changes and add to an already existing hierarchy; though AHP could be difficult to implement. Selecting suitable suppliers is the establishment of productive acquisition. On the other hand, perceiving suitable suppliers is not a straightforward undertaking. One can contend that it is difficult for any single supplier to exceed expectations in all criteria (Verma and Pullman, 2009). Along this line, establishing objective systems of supplier selection will develop organizations successful procurement process.

Supplier choice procedures have advanced with time as established in literature (Min, 1994; Karande and Chakraborty, 2012); that is, from using cost as the single standard to Multi-Criteria Decision-Making (MCDM), weighted-downright system, network approach, vendor profile analysis (VPA), Analytical hierarchy process (AHP), and multiple objective programming (MOP). Shockingly, most writing on supplier choice is within domestic market and several researchers examined on global supplier choice are minor upgrade from the local strategies with included persuasive criteria.

According to Asamoah et al. (2012), from 2000 to 2011, scientists, in the wake of inspecting sixty articles from different diaries and gatherings, found that the most extensively connected technique in supplier determination was Data Envelopment Analysis (DEA); they recommended using AHP to successfully adjust supplier choice issues later on. As said by Vijayvargiya and Dey (2010), instead of recommending a right choice, the AHP helps the decision makers locate the particular case that best suits their needs.

Table 1. Brief review of few literatures on supplier selection and assessment.

Author(s)	Brief description of research	Application Area/ Place of Application	Tool(s)/Approach used
Cheng et al. (2009)	Critical factors for water supplier selection and evaluation were identified and a fuzzy multi-criteria selection model was developed selecting and evaluating water supplier. The critical factors identified were: (1) water quality, (2) delivery time, (3) service, (4) price, (5) process capability, (6) reputation, and (7) past performance	Water supply in semiconductor industry	Fuzzy AHP
Kannan Govindan, Roohollah Khodaverdi, Ahmad Jafarian (2013)	Sustainable supply chain initiatives were explored and the problem of identifying an effective model based on the Triple Bottom Line (TBL) approach was identified. Qualitative performance evaluation was done using triangular fuzzy numbers for finding weights of criteria and then fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) for ranking suppliers.	Supply chain management	Fuzzy logic and triple bottom line approach
Hokey (1994)	An analytical approach known as MAUT (Multiple Attribute Utility Theory) was proposed for international supplier selection and it was proved to have strong ability to handle practical size problem. MAUT can effectively handle qualitative and quantitative factors in multiple criteria and uncertain decision environments.	International supplier selection	Multiple Attribute Utility Theory (MAUT)
Ferhan and Demet (2003)	This study proposed an integrated model for supplier selection.	Food company	Lexicographic Goal Programming (LGP) and Analytic Hierarchy Process (AHP)
Sloane et al. (2003)	Analytic Hierarchy Process (AHP) was used to carry out a microeconomic Health Technology Assessment (HTA) in order to evaluate critical care neonatal ventilators for a new women's health facility that appear to be expensive and complex.	Health care sector	Analytic Hierarchy Process (AHP)
Lee et al. (2009)	In this research a multi-criteria decision-making (MCDM) model was proposed to select a suitable wind farm project amongst many possible wind farm projects using analytic hierarchy process (AHP) and the critical variables used for assessment were benefits, opportunities, costs and risks (BOCR).	Wind farm	Analytic Hierarchy Process (AHP)
Akarte et al. (2001)	The authors designed a decision-support system used to cast supplier evaluation which was linked to a web-based system for casting buyer-supplier interaction. Six objective and twelve subjective variables were used for evaluation and weights were assigned to the variables using AHP methodology	Automobile castings sector	Analytic Hierarchy Process (AHP)
Sonmez (2006)	A critical review of supplier selection process and practices was done and it was revealed that there were emphases on the following: decision criteria and associated weightings that are used for supplier selection and the methods/tools that are proposed for decision making in supplier selection. It was also discovered that though there are more studies are emerging on the study of the effects of buyer-seller relationships, international supplier selection and e-commerce on the supplier selection process and practices but the use of a combination of qualitative and quantitative criteria in supply selection processes should be encouraged. Many of the studies did not consider this.	Supplier selection	Structured literature review method
Cheraghi et al. (2011)	This study did critical review on the success factors for supplier selection with the view of establishing significant change in the relative importance of various critical success factors in the research reported during 1966-1990 versus 1990-2001. The study concluded that criteria for supplier selection will be changing based on an expanded definition of excellence to include traditional aspects of performance (that is, quality, delivery, price, service) in addition to non-traditional, evolving ones (that is, Just-in-Time (JIT) communication, process improvement, supply chain management).	Supplier selection	Systematic literature review
Punniyamoorthy et al. (2011)	Supplier selection being a multi-criteria decision making problem, thus the authors developed supplier selection model using multidimensional constructs that were both tangible and intangible criteria. They used SEM (Structural Equation Modeling) and fuzzy AHP because the fuzziness of human opinion should be put into consideration.	Supplier selection	Structural Equation Modeling and Fuzzy AHP method
Amindoust et al. (2012)	The authors proposed fuzzy inference system (FIS) for supplier selection using sustainable supplier selection criteria and sub-criteria. The linguistic nature of some of the criteria vis-à-vis the subjectivity of the decision makers' assessments called for the application of fuzzy logic. The FIS was able to evaluate and rank a given set of suppliers.	Supplier selection	Fuzzy logic

Table 1. Contd.

Hsu and Hu (2009)	Supplier selection model was proposed using analytic network process (ANP) which incorporated hazardous substance management (HSM). HSM criteria were classified into four dimensions and the applied ANP was characterized by interdependencies among decision structure components. The proposed system was applied in an electronics company demonstrating the selection of most appropriate supplier in accordance with the requirements of hazardous substance for environmental regulations.	Electronic company	Analytical network process (ANP)
Godse and Mulik (2009)	This paper presented an approach that made use of Analytic Hierarchy Process (AHP) technique to prioritize software-as-a-service (SaaS) product features and scoring of the product by experts with the view of selecting the most appropriate SaaS product for their needs.	Software selection	Analytical Hierarchy Process (AHP)
Liberatore and Nydick (2008)	This study did a review of past works on the application AHP on medical and health care decision making; thus establishing that AHP is a support tool that aids decision making between patient and doctor, evaluation and selection of therapies and treatments, and the evaluation of health care technologies and policies.	Health care service delivery	AHP
Handfield et al. (2002)	The authors proposed a decision support model using Analytical Hierarchy Process (AHP) to help managers understand the trade-offs between environmental dimensions. They demonstrated the use of AHP to evaluate the relative importance of diverse environmental traits and to assess the relative performance of suppliers along these traits. How AHP could be incorporated into a comprehensive information system that could support Environmentally Conscious Purchasing (ECP) was examined.	Supplier assessment	AHP
Ware et al. (2012)	This study provided extensive state-of-the-art literature review and critique of the studies related to various aspects of supplier selection problem over the past two decades.	Supplier selection	Structured literature review
Rahman and Smith (2000)	A review of location-allocation model in health service development planning in developing countries was carried out in this study with the view of examining the suitability of the models and their relevance to overall development problems in such nations.	Health care service development planning	Structured literature review
Wang et al. (2004)	This study developed an integrated analytic hierarchy process (AHP) and preemptive goal programming (PGP) and takes into account both qualitative and quantitative factors in supplier selection process. Supply chain operations reference (SCOR) model level I performance metrics were adopted as the decision criteria. The model was able to match product characteristics with supplier characteristics and qualitatively determine supply chain strategy; it also determined the optimal order quantity from the chosen suppliers.	Supplier selection	AHP and PGP
Büyüközkan et al. (2011)	Factors of service quality were examined in this study and fuzzy AHP was structured to measure the proposed service quality framework. The model was tested in healthcare sector in Turkey with the view of clarifying the methodology.	Healthcare sector	Fuzzy AHP

AHP is applied in various areas such as: decision making (Levary and Wan, 1999); forecasting (Korpela and Tuominen, 2001); medicine ((Rossetti and Selandari, 2001); priority and ranking (Labib et al., 1998); evaluation (Akarte et al., 2001).

The following are our deductions from literatures reviewed: 1) A number of models have been developed for supplier selection using diverse methods; 2) There are models developed for evaluating the performance of healthcare service sector but there is little emphasis on suppliers of health service facilities/equipment; 3) to the best of our search, we could not find research works on evaluating and selecting suppliers in the healthcare service of tertiary institution. Hence our focus in this study is to develop a decision support model for evaluating and selecting suppliers in the healthcare service of tertiary institutions.

A review of artificial neural network

The knowledge acquired from the study of the structure and functions of the human body system is being used today to build human-like intelligent computing system. Thus the artificial neural network system is built from the concepts of the biological neural system. The artificial neural network technology characterized the sixth generation of computing (Singh and Chauhan, 2005).

An Artificial Neural Networks (ANN) is composed of simple elements operating in parallel. These elements

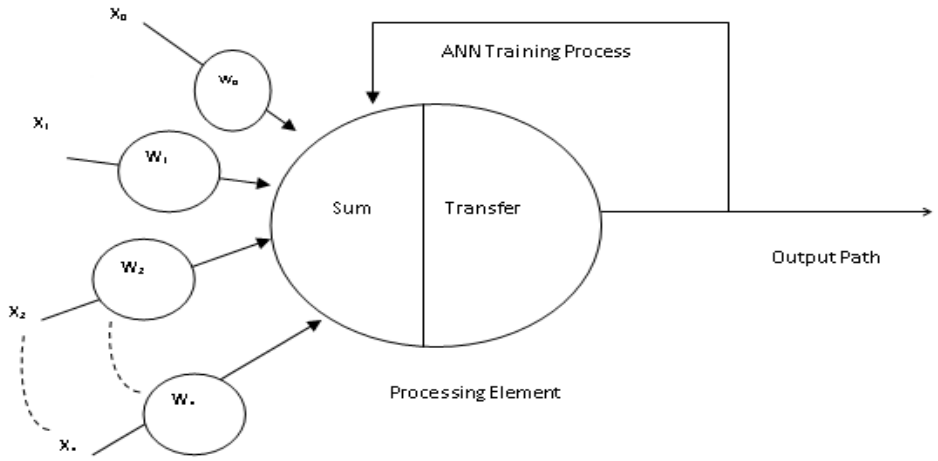

Figure 2. A basic artificial neuron (Negnevitsky, 2002). I*nputs* = x_i and *weights* = w_i; *Summation:* $I = \sum w_i x_i$; *Transfer:* $Y = f(I)$.

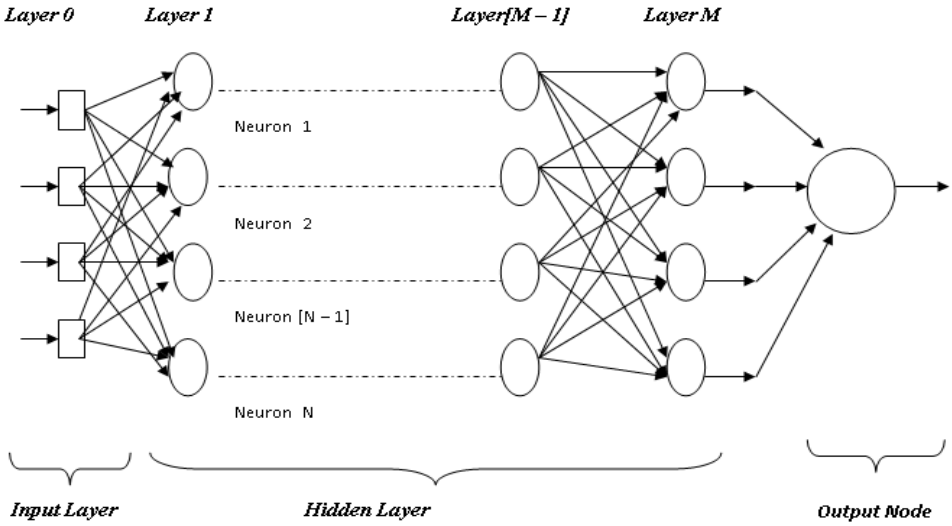

Figure 3. Multi-layer perception architecture (Xiaoguange et al., 2003)

are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. A neural network is trained to perform a particular function by adjusting the values of the connections (weights) between elements. Typically, neural networks are adjusted, or trained, so that a particular input leads to a specific target output (Howard et al., 2008).

In addition ANNs are the electronic models used to analyze data and recognize patterns within the data. ANN is composed of node(s) and each node operates on a principle similar to a biological neuron. In a biological neuron, each incoming synapse of a neuron has a weight associated with it. When the weight of each synapse, times its input, is summed up for all incoming synapses, and that sum is greater than some threshold value, then the neuron fires, sending a value to another neuron in the network. Also for ANN, each node has a set of input lines which are analogous to input synapses in a biological neuron. Each node also has an activation function (also known as a transfer function) which tells the node when to fire, similar to a biological neuron. In its simplest form, this activation function can just be to generate a '1' if the summed input is greater than some values or a '0' otherwise. A basic artificial neuron (single layer perceptron) is presented in Figure 2. The weights are adjusted systematically based on a given dataset to optimize the output vector produced from a given input vector. A neural network is trained through repeated adjustments of these weights (Negnevitsky, 2002). ANN could also be of multiple layers (Figure 3). This is referred to as multiple layer perceptron.

Table 2. Initial identification of possible supplier selection criteria.

Criteria	Authors
Performance plans, structure production	Ozden and Karpak (2005)
Cost, quality, delivery, responsiveness, facility and technology, professionalism, quality of relationship with vendor	Huan-Jyh Shyur and Hsu-Shih Shih (2006)
Cost, quality, delivery, supplier profile, Risk	Fu and Hongli (2007)
Cost, quality, service, supplier profile, Risk	Felix et al. (2007)
Cost, quality, service	Weijun Xia and Zhiming Wiu (2007)
Cost, quality, delivery, service, supplier profile, technology and capability	Min (2007)
Cost, quality, supplier profile, technology and capability	Sanjay and Shankar (2007)
quality, supplier profile, technology and capability	Cevriye and Gurpinar (2007)
Cost, quality, delivery, service, supplier profile, technology and capability, mutual trust and easy communication	Ezgi and Ozden (2007)
Cost, delivery, technology and capability, collaboration	Ali and Zeyrep (2008)
Cost, quality, service	Wang et al. (2008)
Reliability, risk	Reuven (2008)
Plans and structure, quality, R&D	Chia-Wei and Allen (2009)
Cost/price, technology capability, production facilities and capacity, financial capability	Keskin et al. (2010)

Supervised learning

Supervised learning is based on direct comparison between the actual output of an ANN and the desired correct output, also known as the target output. In supervised learning, a set of example pairs (x, y), x ε X, y ε Y is inputted. The aim is to find a function *f* in the allowed class of functions that matches the examples (Kumar and Roy, 2010).

Unsupervised learning

The unsupervised learning is solely based on the correlations among input data. No information on "correct output" is available for learning. In unsupervised learning with a given input data *x*, sigmoid function is to be minimized which can be any function of *x* is related to the network's output, y = f (w, x), where w is the matrix of all weight vectors. This method of learning is adopted in this study (Kumar and Roy, 2010).

Reinforcement learning

The reinforcement learning is a special case of supervised learning where the exact desired output is unknown. It is based only on the information of whether or not the actual output is correct (Fashoto, 2014).

A review of existing supplier selection system in Redeemers University, Nigeria

The existing supplier selection system at the Redeemer's University health center has been in use since 2005 when the university as well as the health centre was established.

The healthcare centre makes use of cost as the major criteria for choosing a supplier whereas there are several other criteria like risk, quality, efficiency, service and delivery.

The use of cost alone as the major criteria for selecting a supplier does not only prove inefficient but also ineffective as seen in the case of healthcare utility delivery. It took several months for the health centre beds and other things several months to arrive from China.

Technical solution to the existing problem

Having considered the problem of the current system, this research is focused on providing and implementing the solution to the problem. Under this sub-topic, technical details on how to provide solution to the problem will be discussed.

The solution this study provides is how the AHP model can aid decision making on how to select suitable supplier in the healthcare centre considering five (5) criteria and also considering five (5) alternatives rather than just cost which was used in the existing system

METHODOLOGY

Initial variables identified from literature

Numerous variables influence a supplier selection execution, some of which include: Cost, Quality, delivery, mutual trust and easy communication, technology and capability, structure production, collaboration, risk, service, responsiveness, supplier profile, reliability, R&D, financial capability, quality relationship with vendors, performance, professionalism and facility and technology and this mostly adds to the supplier selection issue. Presented in Table 2 is the initial identification of supplier selection criteria as established in literature.

Table 2 is a summary of suppliers selection variables/criteria identified from existing literature. These selection variables play a key role in the suppliers' selection process.

Study design on ranking of criteria/variables

Supplier selection process is a multi-criteria problem, which includes both qualitative and quantitative factors. In order to select the best supplier in the healthcare industry it is necessary to make a trade-off between tangible and intangible factors some of which may conflict.

Traditionally, the selections of suppliers are often based on the cost/price criterion. The cheapest supplier is usually selected without taking into consideration additional costs this supplier may introduce in the value chain of the purchasing organization. Thus, the costs related to unreliable delivery, limited quality of goods supplied, and poor communication are not involved in the selection process.

Supplier decisions are one of the most important aspects that firms must incorporate into their strategic processes. With the increasing importance of the purchasing function, supplier management decisions have become more strategic. As organizations become more dependent on suppliers, the direct and indirect consequences of poor decision making become more critical (Marvin et al., 2003). Selecting the most appropriate suppliers is considered an important strategic management decision that impacts all areas of an organization. Because of this reason, this study describes the extent to which criteria/factors are using as supplier selection criteria in the healthcare industry by using a survey. It presents an exploratory factor analysis that describes which criteria/factors are used by companies as supplier selection criteria.

We carried out a review of some related research works that focused on the selection of suppliers' criteria/variables from existing literature. Existing criteria/variables for evaluating supplier selection are cost, quality, delivery, mutual trust and easy communication, technology and capability, structure of production, collaboration, risk, service, responsiveness, supplier profile, reliability, R&D, financial capability, quality relationship with vendors, facility and technology, performance, and professionalism.

The evaluation process requires thorough consideration between all criteria/variables for supplier selection because some criteria are difficult to evaluate since they can only be measured in a qualitative way and not quantitative way. These criteria are more subjective and more people dependent. Examples of quantitative criteria are those that can be measured by a concrete quantitative dimension such as cost. For example the criterion "cost" of the product is easy to measure, it can be obtained directly. Examples of qualitative criteria are the quality of products and services. They cannot be measured directly (Benyoucef et al., 2003).

Some researchers have discovered that the importance of supplier attributes/factors such as quality, cost, delivery, and service are not consistent with their actual choices (Li et al., 2006).

The objective here is to identify some supplier selection criteria/variables that can serve as health organizational variables and also to establish if previous research works relate directly or indirectly to the supplier selection criteria.

At present, there are no existing multi-criteria decision making techniques that help to identify promising criteria/variables for supplier selection that must be considered and evaluated for critical decision factors in tertiary institution healthcare center.

The research methodology applied here starts with the selection of criteria/variables and ends with an AHP model for supplier selection.

The design of the first questionnaire is derived from the issues and questions raised in the literature on how to select the key criteria/variables. Based on these sources 18 criteria used to select suppliers were identified (Table 2).

Respondents were asked to indicate the importance their firms assigned to these supplier selection criterions in the supplier selection process. A five-point Likert scale, which ranged from 1 (Low Importance) to 5 (High Importance), was used to assess importance. The questionnaire was pre-tested for content validity by 10 bulk purchase committees' members.

Pretest questionnaire was not used in the subsequent analyses. The revised instrument was sent to healthcare centre management. It was assumed that the committee members (respondents) were familiar with the university health centre supplier management activities and could make reasonable judgments regarding suppliers' performances.

Prior to assessing the impact of supplier selection factor analyses were conducted by the help of SPSS 15.0. Factor analysis was carried out to reduce each scale to smaller number of underlying factors. Principal components analysis was used to extract factors (eigen-values > 1.627) and Varimax rotation used to obtain a more interpretable factor matrix. With few exceptions, variables had factor loadings of at least 0.50. The 18 supplier selection criteria were reduced to five underlying factors (Table 3). The five factors (cost, quality, delivery, risk and service) accounted for 84.13 percent of total variance in the data.

Choosing the most outstanding supplier out of numerous suppliers to deliver goods is frequently very difficult, since supplier selection relate to multi-criteria and multi-objective problems (Bayazit and Karpak, 2005). The Analytical Hierarchy Process model was used for the supplier selection problem in healthcare delivery. Both primary and secondary data were used in this study. Interview with the healthcare providers using questionnaire at the University Health Centre make up the primary data while other materials for the study which was sourced from the internet, journals, articles and textbook constitute the secondary data and the JAVA programming language was used for the implementation. The objectives of this study will be achieved through eleven stages using the AHP.

There are eleven stages to the Analytical Hierarchy Process (AHP).

Step 1

Decomposing the problem into a hierarchy

AHP starts with an identification of the criteria to be used in evaluating different alternatives which are organized in a tree-like hierarchy.

How to structure a hierarchy

1) Identify the overall objective or goal.
2) Identify criteria to satisfy the goal.
3) Identify, where appropriate, sub-criteria under each criterion.
4) Identify alternatives to be evaluated in terms of the sub-criteria.
5) If the relative importance of the sub-criteria can be assessed and the alternatives can be evaluated in terms of the sub-criteria, the hierarchy is finished.
6) Otherwise, continue inserting levels until it is possible to link levels and set priorities on the elements at each level in terms of the elements at the level above it.

In the case of this study, the criteria used and their definition are listed in Table 4. The suppliers in the case of this study are the alternatives in Figure 4. These are the different suppliers to be evaluated in order to be selected as the best supplier

Step 2

Designing the questionnaire for the health centre.

Step 3

Collecting input data by pair-wise comparisons of criteria at each

Table 3. Principal component analysis.

Component	Total	Initial % of variance	Eigenvalues	Extraction sums of square loadings		
			Cumulative %	Total	% of Variance	Cumulative %
1	15.194	84.413	84.413	15.194	84.413	84.413
2	0.757	4.204	88.616			
3	0.678	3.769	92.385			
4	0.551	3.061	95.446			
5	0.326	1.808	97.254			
6	0.293	1.627	98.882			
7	0.120	0.664	99.546			
8	0.049	0.273	99.819			
9	0.033	0.181	100.000			
10	1.37E-015	7.60E-015	100.000			
11	1.04E-015	5.80E-015	100.000			
12	2.43E-016	1.35E-015	100.000			
13	1.88E-016	1.04E-016	100.000			
14	1.61E-016	8.95E-016	100.000			
15	8.06E-018	4.48E-017	100.000			
16	-7.6E-018	-4.24E-017	100.000			
17	-1.3E-016	-7.20E-016	100.000			
18	-4.1E-016	-2.29E-015	100.000			

Table 4. Criteria definition table.

Criteria	Definition
COST	Total cost of purchasing products from supplier including freight cost and product price
SERVICE	Ability of supplier to respond to change based on health centre demand, provide technical support for problems and warranty of supplied product.
RISK	Economic stability of the supplier country (currency exchange rate).
QUALITY	How effective and efficient a product is.
DELIVERY	Amount of time it takes a supplier to deliver supplies and willingness to expedite an order.

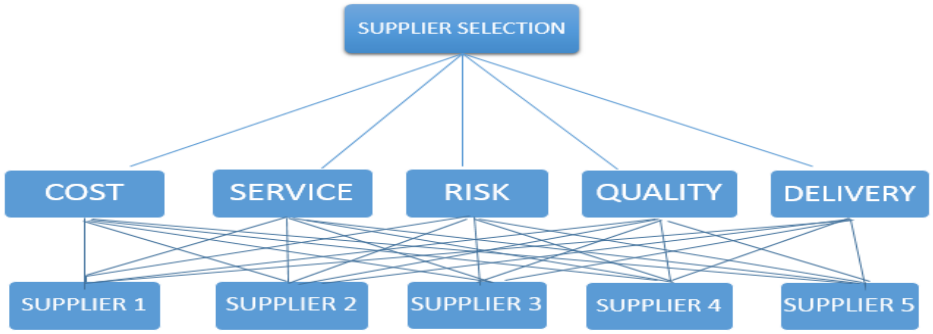

Figure 4. Structure of the hierarchy with goals criterion and alternative.

level of the hierarchy and alternatives.

Define the relative importance of criteria at each level of the hierarchy and relative importance of alternatives by means of pair-wise comparisons (Table 5).

Step 4

Estimate the relative importance (weights) of criteria and alternatives and check the consistency in the pair-wise comparisons. This is done using the Saaty Scale for Pair-wise

Table 5. Defining criteria at each level of the hierarchy.

Criteria	Criterion (Alternative) 1	Criterion (Alternative) 2	…	Criterion (Alternative) n
Criterion (Alternative) 1	W_1/W_1	W_1/W_2	…	W_1/W_n
Criterion (Alternative) 2	W_2/W_1	W_2/W_2	…	W_2/W_n
. . .	…	…	…	…
Criterion (Alternative) n	W_n/W_1	W_n/W_2	…	W_n/W_n

comparisons

1) 1 – Equally preferred
2) 3 – One is moderately preferred over another
3) 5 – One is strongly preferred over another
4) 7 – One is very preferred over another
5) 9 – One is extremely preferred over another
6) 2,4,6,8 intermediate values
7) Reciprocals for inverse comparison

Step 5

Calculate the column sum $\sum C_{ij}$ for each column in the pair-wise comparison table

Step 6

Standardize each cell by $X_{ij}=\frac{C_{ij}}{\sum C_{ij}}$

Step 7

Calculate row sum by $R_i = \sum X_{i\ j\ and}$ weight(W_i)= $(R1 +R2 +R3+R4+R5)^{1/n}$ *by using geometric mean formula*
n = number of Criteria/Sub-criteria or Alternative.

Step 8

Calculate the Eigen value and Eigen vector

$V_i = AW_i$ *for i = 1, 2, 3,…, n*

$\lambda = V_i / W_i$ *and calculate* λ_{max} *by using the geometric mean formula to find the* λ_i*'s in the table*

Step 9

Calculate Consistency Index (CI) and Consistency Ratio (C.R)

$CI=\frac{\lambda_{max}-n}{n-1}$

$CR=\frac{CI}{RI}$

Step 10

Repeat Step-3 to Step- 9 for the other questionnaire and check the consistency ratio for every judgment matrix.

Step 11

Calculate the Geometric mean of each cell of the entire questionnaire for calculating the overall weight for each alternative of each criterion.

Population and sampling technique

Population refers to the entire group of people from whom data can be sourced, investigated and which the researcher can make reference to.

With reference to the scope of this study, the population consists of the healthcare provider in Redeemers University Health Centre.

This includes nurses, doctors, pharmacist, laboratory technicians, medical assistant, store managers, supply officers and store keepers. The stratified sampling method was adopted to choose the respondents and then the respondents were divided into two (2) in order to ensure that each was represented appropriately in the survey sample.

1) Stratum 1 comprises the inventory managers (store managers, store keepers and supply officers).
2) Stratum 2 comprises the healthcare providers (nurses, doctors, pharmacist, Medical Assistants).

The stratified sampling method, which is a type of probability sampling technique was used so as to divide the entire population into different subgroups or strata, then randomly selects the final subjects proportionally from the different strata. This helps to eliminate as many as possible biases in the choice of the sample.

Data collection procedure

In this study, the questionnaire method was adopted. This method enables the collection of large amount of data on the variables considered to be important to the research topic. Furthermore, questionnaire survey afforded respondents the privilege of been anonymous.

The respondents interviewed were selected from Redeemer's University Health Centre and simple random was used to select facilities and respondents. To meet the requirement of the research topic, few people were selected for the study. This comprises majorly of the health workers.The purpose of the research was explained to every respondent and they were informed that participation was voluntary and the result would be used for academic purpose and furthermore, respondents were assured that all responses would remain confidential.

Research instrument

The data were collected by means of questionnaire. Questionnaires were used because it is more economical and convenient for the respondent to answer.

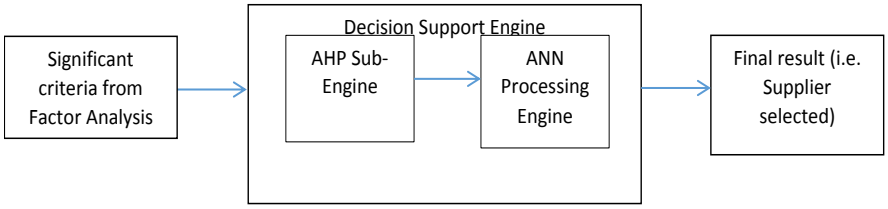

Figure 5. Contextual diagram of the decision support system.

Table 6. Analysis of respondents' sex.

Sex	Frequency	%
Male	10	55.6
Female	8	44.4
Total	18	100

Secondly, it encourages the provision of true and honest response on sensitive issues. The questionnaire helped in the collection of information that was not readily available which tend to enrich the answers and these enhance the eventual result of the study.

This was to help in getting good response from the different group of respondents.

DEVELOPMENT AND DATA ANALYSIS TOOLS

The raw data gotten from the use of the questionnaire were captured, presented and analyzed using the analytical hierarchy process (AHP) and artificial neural network (ANN) model. The model was used because it provides better explanation to the data collected concisely.

System architecture

The system architecture for supplier selection using AHP and ANN shown in Figure 5 is such that will receive the significant criteria / factors generated by factor analysis. The significant factors go into the AHP for further processing and the result of AHP weight goes to the ANN for final output.

Algorithm on how a supplier is selected using AHP-ANN model

Step 1: Start **AHP module**
Step 2: List and identify supplier selection criteria.
Step 3: List the registered supplier.
Step 4: Build the AHP model.

Neural network module

Step 5: Create a matrix for hidden layer by using the following formula:

Main criteria weight: Output value for hidden layer using sigmoid function

$$Y_{mc_i} = \frac{1}{1+e^{-\propto(\sum X_i W_{mc_i})}}$$

Step 6: Create a matrix for output layer by using following formula:

Sub-criteria weight: Value for output layer using sigmoid function

$$Y_{sc_i} = \frac{1}{1+e^{-\propto(\sum X_i W_{mc_i})}}$$

Y_{sci} = Total score of supplier

Step 7: Select the supplier with maximum score from the above matrix for the best supplier.

Step 8: Stop

Questionnaire analysis

A total number of 20 questionnaires were randomly distributed to respondents at the health centre. These respondents comprise majorly the health workers which include the doctors, nurses, pharmacist, store keeper and so on. 18 out of this questionnaire were duly filled and returned which is what is used for analysis.

PART A – Respondents' demographic status

Table 6 shows 55.6% representing 10 respondents are males while 44.4% representing 8 respondents are females.

Table 7. Analysis of respondents' age.

Age	No of Respondents	Percentage
30-39	12	66.7
40-49	4	22.2
50-59	2	11.1
60 and above	0	0
Total	18	100

Table 8. Analysis of respondents' academic qualification.

Academic qualification	NO of respondents	Percentage
BA/BSC	10	55.6
MBA/MSC	8	44.4
TOTAL	18	100

Table 9. Analysis of research question.

Parameter	COST	SERVICE	RISK	QUALITY	DELIVERY
COST	Equally important	Moderately more important	Strongly more important	Strongly more important	Strongly more important
SERVICE	Moderately important	Equally important	Very strongly important	Very strongly important	Very strongly important
RISK	Strongly important	More very strongly important	Equally important	Equally important	Equally important
QUALITY	Strongly important	More very strongly important	Equally important	Equally important	Equally important
DELIVERY	Strongly important	More very strongly important	Equally important	Equally important	Equally important

Table 10. Pair-wise comparison table obtained from the analysis of our questionnaire.

Criteria	Cost	Service	Risk	Quality	Delivery
COST	1	1/3	1/5	1/5	1/5
SERVICE	3	1	7	7	7
RISK	5	1/7	1	1	1
QUALITY	5	1/7	1	1	1
DELIVERY	5	1/7	1	1	1

Table 7 shows 66.7% representing 12 respondents are between ages 30-39, 22.2% representing 4 respondents are age 40-49, 11.1% representing 2 respondents are between ages 50-59.

Table 8 shows 55.6% representing 10 respondents are BA/BSc holders while 44.4% representing 8 respondents are MBA/MSc holders.

PART B –Analysis of research question

Research question 1: In your opinion which of the following criteria is of importance over the other in selecting a specific supplier in this healthcare centre (Table 9).

Table 10 is the pair-wise comparison table obtained from the analysis of our questionnaire.

Implementation

To implement the AHP model, we developed a new software, named ExpertplusX. ExpertplusX has a data entry interface for keying in the data obtained from the questionnaire. It consists of modules for executing all the steps of the AHP as outlined under the Methodology, with appropriate command buttons to initiate each step.

In this section, we walk through the AHP model computations with the data of Section 3, showing screen shots from ExpertplusX. The first step is to enter the pairwise comparison table and initiate the first set of computations. This is shown in Table 11.

This first step yields the column sum $\sum C_{ij}$ for each column in the table as shown in Table 12. The values in the table are then standardized by $X_{ij}=\frac{c_{ij}}{\sum c_{ij}}$ as shown in Table 13.

Table 11. Pairwise comparison values for the five criteria.

Criteria	DELIVERY	QUALITY	COST	RISK	SERVICE
DELIVERY	1	0.1429	0.2	0.2	0.2
QUALITY	7	1	7	7	7
COST	5	0.1429	1	1	1
RISK	5	0.1429	1	1	1
SERVICE	5	0.1429	1	1	1

Table 12. Calculation of column sums.

Criteria	DELIVERY	QUALITY	COST	RISK	SERVICE
DELIVERY	1	0.1429	0.2	0.2	0.2
QUALITY	7	1	7	7	7
COST	5	0.1429	1	1	1
RISK	5	0.1429	1	1	1
SERVICE	5	0.1429	1	1	1
SUM	23	1.5716	10.2	10.2	10.2

Table 13. Standardized or normalized matrix.

Criteria	Standardized Matrix				
	DELIVERY	**QUALITY**	**COST**	**RISK**	**SERVICE**
DELIVERY	0.0434	0.0909	0.0196	0.0196	0.0196
QUALITY	0.3043	0.6362	0.6862	0.6862	0.6862
COST	0.2173	0.0909	0.0980	0.0980	0.0980
RISK	0.2173	0.0909	0.0980	0.0980	0.0980
SERVICE	0.2173	0.0909	0.0980	0.0980	0.0980

Table 14. Calculation of row sums.

Criteria	DELIVERY	QUALITY	COST	RISK	SERVICE	SUM	W
DELIVERY	0.0434	0.0909	0.0196	0.0196	0.0196	0.1932	0.0312
QUALITY	0.3043	0.6362	0.6862	0.6862	0.6862	2.9994	0.5745
COST	0.2173	0.0909	0.0980	0.0980	0.0980	0.6024	0.1132
RISK	0.2173	0.0909	0.0980	0.0980	0.0980	0.6024	0.1132
SERVICE	0.2173	0.0909	0.0980	0.0980	0.0980	0.6024	0.1132

The row sums are calculated by $R_i = \sum X_{ij}$, as shown in Table 14.

The Eigen vector or Priority vector is next computed as $W_i = (R1 + R2 + R3 + R4 + R5)^{1/n}$, where n = number of criteria (*n* here is 5). This is shown in Table 15. This is followed by the calculation of the principal Eigen value by calculating the Eigen vector as, Vi = AWi, where W is the Priority vector, and A is the original matrix and $\lambda_i = V_i / W_i$.

The Eigen value is then $\lambda_{max,}$ obtained by using geometric mean formula to find the λ_i's in Table 16.

Next is the calculation of the Consistency Index (CI) and Consistency Ratio (C.R), as

$$CI=\frac{\lambda_{max}-n}{n-1}$$

$$CR=\frac{CI}{RI}$$

The result is shown in Figure 6. Up to this point, we have

Table 15. Calculation of priority vector.

Criteria	DELIVERY	QUALITY	COST	RISK	SERVICE	W	P.VECTOR
DELIVERY	1	0.1429	0.2	0.2	0.2	0.0312	0.1812
QUALITY	7	1	7	7	7	0.5745	3.1714
COST	5	0.1429	1	1	1	0.1132	0.5780
RISK	5	0.1429	1	1	1	0.1132	0.5780
SERVICE	5	0.1429	1	1	1	0.1132	0.5780
SUM	23	1.5716	10.2	10.2	10.2	0.9455	5.0870

Table 16. Calculating the principal Eigen value.

Criteria	DELIVERY	QUALITY	COST	RISK	SERVICE	W	P.VECTOR	LAMDA	MAX
DELIVERY	1	0.1429	0.2	0.2	0.2	0.0312	0.181	5.801	5.319
QUALITY	7	1	7	7	7	0.5745	3.171	5.520	
COST	5	0.1429	1	1	1	0.1132	0.578	5.104	
RISK	5	0.1429	1	1	1	0.1132	0.578	5.104	
SERVICE	5	0.1429	1	1	1	0.1132	0.578	5.104	
SUM	23	1.5716	10.2	10.2	10.2	0.9455	4.508		

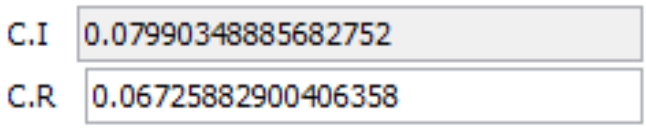

Figure 6. Output for CI and CR.

Table 17. Pairwise supplier comparison table for Delivery.

DELIVERY	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5
SUPPLIER1	1	1	3	3	5
SUPPLIER2	1	1	3	3	5
SUPPLIER3	0.33	0.33	1	1	2
SUPPLIER4	0.33	0.33	1	1	2
SUPPLIER5	0.2	0.2	0.5	0.5	1

used the pairwise comparison table, with values for the relative importance of each criterion to the others in the supplier selection process. When the CR ≤ 0.1 it is assumed that the judgmental values of the respondent are consistent.

This pairwise comparison will now be done between suppliers for each of the criteria. Thus, we build five tables, one for each criterion. In this way, we weigh the way each supplier compares with the others for each criterion.

The supplier comparison table for delivery is shown in Table 17.

Steps leading to obtainment of the five criteria (Delivery, Quality, Cost, Risk and Service)

We followed the same steps as previously done to arrive at the Priority Vector for the five criteria (Cost, Delivery, service, Quality and Risk) table, shown in Tables 18 and 19.

Same is also done for the other 4 criteria, viz; Quality as expressed in Tables 20 and 21; Cost as expressed in Tables 22 and 23; Risk as expressed in Tables 24 and 25; and Service as expressed in Tables 26 and 27.

Overall priority matrix of the alternatives

The last stage in the AHP modeling process is the derivation of the overall priority matrix for the criteria versus suppliers. The rows of the matrix are labelled with the criteria while the columns are labelled by the Suppliers. We, thus, have a 5x5 matrix as shown in Tables 28 to 30.

Table 18. Priority table for Delivery.

DELIVERY	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5	SUM	PRIORITY
SUPPLIER1	0.1176	0.3496	0.3529	0.3529	0.3333	1.5065	0.3013
SUPPLIER2	0.3496	0.3496	0.3529	0.3529	0.3333	1.7385	0.3477
SUPPLIER3	0.1153	0.1153	0.1176	0.1176	0.1333	0.5993	0.1198
SUPPLIER4	0.1153	0.1153	0.1176	0.1176	0.1333	0.5993	0.1198
SUPPLIER5	0.0699	0.0699	0.0588	0.0588	0.0666	0.3241	0.0648

Table 19. Pairwise comparison table for Quality.

QUALITY	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5
SUPPLIER1	1	0.33	1	0.33	0.33
SUPPLIER2	3	1	3	1	1
SUPPLIER3	1	0.33	1	0.33	0.33
SUPPLIER4	0.33	1	0.33	1	1
SUPPLIER5	0.33	1	0.33	1	1

Table 20. Priority table for Quality.

QUALITY	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5	SUM	PRIORITY
SUPPLIER1	0.1766	0.0901	0.1766	0.0901	0.0901	0.6238	0.1247
SUPPLIER2	0.5300	0.2732	0.5300	0.2732	0.2732	1.8797	0.3759
SUPPLIER3	0.1766	0.0901	0.1766	0.0901	0.0901	0.6238	0.1247
SUPPLIER4	0.0583	0.2732	0.0583	0.2732	0.2732	0.9362	0.1872
SUPPLIER5	0.0583	0.2732	0.583	0.2732	0.2732	0.9362	0.1872

Table 21. Pairwise comparison table for Cost.

COST	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5
SUPPLIER1	1	3	1	5	5
SUPPLIER2	0.33	1	0.33	2	2
SUPPLIER3	1	3	1	5	5
SUPPLIER4	0.2	0.5	0.2	1	1
SUPPLIER5	0.2	0.5	0.2	1	1

Table 22. Priority table for Cost.

COST	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5	SUM	PRIORITY
SUPPLIER1	0.3663	0.375	0.3663	0.3571	0.3571	1.8218	0.3643
SUPPLIER2	0.1208	0.125	0.1208	0.1428	0.1428	0.6524	0.1304
SUPPLIER3	0.3663	0.375	0.3663	0.3571	0.3571	1.8218	0.3643
SUPPLIER4	0.0732	0.0625	0.0732	0.0714	0.0714	0.3518	0.0703
SUPPLIER5	0.0732	0.0625	0.0732	0.0714	0.0714	0.3518	0.0703

Table 23. Pairwise comparison table for Risk.

RISK	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5
SUPPLIER1	1	5	1	5	5
SUPPLIER2	0.2	1	0.2	1	1
SUPPLIER3	1	0.2	1	0.2	0.2
SUPPLIER4	0.2	1	0.2	1	1
SUPPLIER5	0.2	1	0.2	1	1

Table 24. Priority table for Risk.

RISK	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5	SUM	PRIORITY
SUPPLIER1	0.3846	0.6097	0.3846	0.6097	0.6097	2.5984	0.5196
SUPPLIER2	0.0769	1219	0.0769	1219	1219	0.5196	0.1039
SUPPLIER3	0.3846	0.0243	0.3846	0.0243	0.0243	0.8424	0.1684
SUPPLIER4	0.0769	0.1219	0.0769	0.1219	0.1219	0.5196	0.1039
SUPPLIER5	0.0769	0.1219	0.0769	0.1219	0.1219	0.5196	0.1039

Table 25. Pair-wise comparison table for Service.

SERVICE	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5
SUPPLIER1	1	2	2	0.33	1
SUPPLIER2	0.5	1	1	0.2	0.5
SUPPLIER3	0.5	1	1	0.2	0.5
SUPPLIER4	3	5	5	1	3
SUPPLIER5	1	2	2	0.33	1

Table 26. Priority table for Service.

SERVICE	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5	SUM	PRIORITY
SUPPLIER1	0.0909	0.1818	0.1818	0.1601	0.1666	0.7814	0.1562
SUPPLIER2	0.0833	0.0909	0.0909	0.0970	0.0833	0.4455	0.0891
SUPPLIER3	0.0833	0.0909	0.0909	0.0970	0.0833	0.4455	0.0891
SUPPLIER4	0.5	0.4545	0.4545	0.4854	0.5	2.3945	0.4789
SUPPLIER5	0.1666	0.1818	0.1818	0.1601	0.1666	0.8571	0.1714

Table 27. Overall priority matrix

Priority matrix	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5
SUPPLIER1	0.30130	0.34770	0.11980	0.11980	0.06480
SUPPLIER2	0.12470	0.37590	0.18720	0.18720	0.18720
SUPPLIER3	0.36430	0.13040	0.07030	0.07030	0.07030
SUPPLIER4	0.51960	0.10390	0.10390	0.10390	0.10390
SUPPLIER5	0.15620	0.08910	0.47890	0.47890	0.17140

Table 28. Overall Priority Matrix with column sums (OPV)

Priority Matrix	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5
DELIVERY	0.3013	0.3477	0.1198	0.1198	0.0648
QUALITY	0.1247	0.3759	0.1247	0.1872	0.1872
COST	0.3643	0.1304	0.3643	0.0703	0.0703
RISK	0.5196	0.1039	0.1684	0.1039	0.1039
SERVICE	0.1562	0.0891	0.0891	0.4789	0.1714
OPV	1.4661	1.047	0.8663	0.9601	0.5976

The values in the table are obtained from the Priority vectors, each row being filled by the values from the Priority vector for the corresponding criterion. Thus, row 1 is filled by the Priority vector, row 2 by the Priority Vector, and so on. The solution for the AHP supplier selection model studied in this work is given by the

Table 29. Overall Priority Matrix with the Overall Priority Vector (OPV) shown

Priority Matrix	SUPPLIER1	SUPPLIER2	SUPPLIER3	SUPPLIER4	SUPPLIER5	SUM	PRIORITY
DELIVERY	0.3478	0.3320	0.1382	0.1247	0.1084	1.0513	0.2102
QUALITY	0.0850	0.3590	0.1439	0.1949	0.3132	1.0962	0.2192
COST	0.2484	0.1245	0.4205	0.0732	0.1176	0.9844	0.1968
RISK	0.3544	0.0992	0.1943	0.1082	0.1738	0.9301	0.1860
SERVICE	0.1065	0.0851	0.1028	0.4988	0.2868	1.0801	0.2160

Table 30. Output values for hidden layer

Main criteria	Weight(W_{mci})	Input value(X_i)	$\sum X_i W_{mc_i}$	Output value for hidden layer (Y_{mci})
Delivery	0.0312	0.2	0.2312	0.5575
Quality	0.5745	0.2	0.7745	0.6845
Cost	0.1132	0.2	0.3132	0.5777
Risk	0.1132	0.2	0.3132	0.5777
Service	0.1132	0.2	0.3132	0.5777

Table 31. Data analysis model.

Main criteria	AHP	AHP-ANN
Delivery	0.2102	0.5575
Quality	0.2192	0.6845
Cost	0.1968	0.5777
Risk	0.1860	0.5777
Service	0.2160	0.5777

Overall Priority Vector. According to the OPV, the priority values for the respective criteria are: Quality = 0.2192, Service = 0.2160, Delivery = 0.2102, Cost = 0.1968 and Risk = 0.1860. According to the model, therefore, this is the order of priority ascribed to these criteria by the client, which in this case in Redeemer's University. This means that the quality of product/goods supply by the supplier is the most important criterion, while the risk of the supplies is the least important. Given that the case study in the work relates to supplier selection for the University's Health Centre, we may infer that the current selection process is deficient.

After careful analysis of the questionnaire and with respect to the overall priority matrix of the alternatives, we come to a conclusion that QUALITY is the major criteria for selecting a suitable supplier instead of cost which was believed to be the major criteria. Their order of importance is:

QUALITY…SERVICE…...DELIVERY…..COST…..RISK

AHP and ANN module

The input values for all neurons in this study are the same because each of the criteria is considered to be of equal importance diagonally on the AHP matrix and it depends on the number of suppliers. The bias accounts only for the degree of fitting the given data, but not for the level of generalization. A bias term can be treated as a connection weight from a special unit with a constant, nonzero activation value. The term "bias" is usually used with respect to a "bias unit" with a constant value of one (Kumar and Roy, 2010).

Let input value X_i for input layer = the reciprocal of the number of suppliers considered in this study= 1/5=0.2

W_{mci} = weight of main criteria
W_{sci} = weight of sub-criteria
Ymci = output value for hidden layer = input value for output layer

$$Y_{mci} = \frac{1}{1+e^{-\propto(\sum X_i W_{mc_i})}}$$

Y_{si} = output value for output layer on suppliers

From Table 31, we are able to determine that quality is the most important of all the main criteria but delivery is the least important based on the hybridized model while

Table 32. Matrix for output layer

Supplier	Y_{mc1}= 0.5575	Y_{mc2}= 0.6845	Y_{mc3}= 0.5777	Y_{mc4}= 0.5777	Y_{mc5}= 0.5777	$\sum Y_{mci} W_{sc_i}$	Y_{sci}
Supplier1	0.30130	0.34770	0.11980	0.11980	0.06480	0.781827	0.68607
Supplier2	0.12470	0.37590	0.12470	0.18720	0.18720	0.815154	0.69321
Supplier3	0.36430	0.13040	0.36430	0.07030	0.07030	0.747486	0.67863
Supplier4	0.51960	0.10390	0.16840	0.10390	0.10390	0.778127	0.68528
Supplier5	0.15620	0.08910	0.08910	0.47890	0.17140	0.77522	0.68465

quality is the most important and risk is the least important in the AHP model.

The hybrid AHP-ANN approach also supplies us information on the ranking of the suppliers. Based on the overall criteria as shown in Table 32, Supplier 2 is the best supplier to be selected, followed by supplier 1, supplier 4, supplier 5 and supplier 3 in that order. By comparing the results of AHP-ANN supplier selection with the weights from AHP model, it can be concluded that AHP-ANN model prediction accuracy is higher than that of the AHP model.

The accuracy of the hybridized model (AHP-ANN) result is better than that of the AHP model in all cases especially for Quality with 68.45% while that of AHP model is 21.92%. This makes the case for the decisions much stronger than with only AHP.

Conclusion

In this study, we have used the AHP methodology and a hybrid AHP-ANN approach to model the supplier selection process for the Health Centre of Redeemer's University, Nigeria. Up till now no systematic study of the supplier selection had been carried out and the centre has been suffering from regular stock outs of essential supplies.

The five supplier selection criteria (service, delivery, cost, risk, and quality) used in the model were selected after careful study of the literature and a study of the applicability and relative importance of the 18 most commonly used criteria. A questionnaire was prepared and administered on the members of the University Health Centre Purchasing Committee to indicate the importance of each of these 18 criteria on the Likert scale. The responses were subjected to Factor Analysis and Principal Component Analysis with SPSS 15 to extract the most important criteria for the AHP model; hence, the five criteria that were eventually employed.

Having settled for the 5 most relevant criteria, another questionnaire was designed and administered on a cross section of health care workers at the Redeemers University Health centre. They include Nurses, Doctors, Pharmacist, Laboratory Technicians, Medical Assistants, Store Managers, Supply Officers and Store keepers. They were required to rate the relative importance of each supplier selection criterion to the others using the Saaty scale. The outcome was a 5x5 pairwise comparison table for the five criteria. This matrix was fed into Expert plusX, a new software we developed to implement the AHP methodology as described in Section 3.

By studying the supplier selection method currently in use at the Health Centre and building the AHP model, we have been able to determine that the order of importance of the 5 five criteria are: service, delivery, cost, risk and quality. This finding shows that quality and service are the two most important criteria that the supplier selectors should be applying for customer selection, they should put very little premium on cost and risk. Delivery has played a fairly neutral place in the selection process.

To improve on the accuracy of these results, the AHP model was supplemented by a 3-layer artificial neural network, adding a learning component to the model. The result also shows that Quality is the most important criterion, but with a high index of 0.6845 as opposed to 0.2192 for the AHP alone. This shows that the hybrid model is much better than the AHP alone. The hybrid model also suggested a ranking of the suppliers. It, thus, provides an improved basis for decision-making when compared to the AHP model.

Conflict of Interests

The author has not declared any conflicts of interest.

REFERENCES

Akarte MM, Surendra NV, Ravi B, Rangaraj N (2001). Web based casting supplier evaluation using analytical hierarchy process. J. Oper. Res. Soc. 52(5):511-522

Al-Barqawi H, Zayed T (2008). Infrastructure Management: Integrated AHP/ANN Model to Evaluate Municipal Water Mains' Performance. J. Infrastruct. Syst. 14(4):305-317

Amindoust A, Ahmed S, Saghafinia A, Bahreininejad A (2012). Sustainable supplier selection: A ranking model based on fuzzy inference system. Appl. Soft Co. 12(6):1668-1677.

Asamoah D, Annan J, Nyarko S (2012). AHP approach for supplier evaluation and selection in a pharmaceutical manufacturing firm in Ghana. Int. J. Bus. Manage. 7(10):49-62.

Bakar A, Lukman HAH, Chong SC, Lin B (2010). Measuring supply

chain performance among public hospital laboratories. Int. J. Prod. Perform. Manage. 59(1):75-97.
Baltussen R, Niessen L (2006). Priority setting of health interventions: the need for multi- criteria decision analysis. Cost Eff. Resour. Allocation 4:14
Bayazit O, Karpak B (2005). An AHP application in vendor selection. ISAHP, Honolulu, Hawaii, July 8-10, pp. 1-24.
Benyoucef L, Ding,H, Xie X (2003). Supplier Selection Problem : Selection Criteria and Methods. [Research Report] RR-4726, INRIA. 2003, P 38.
Berry LL, Bendapudi N (2007). Health care a fertile field for service research. J. Serv. Res. 10(2):111–122.
Bradley D, Solutions CC (2007). Canada-Sustainable Forest Biomass Supply Chains. Ottawa, ON: Climate Change Solutions. Available @ http://w.bioenergytrade.org/downloads/sustainableforestsupplychains oct192007.pdf. Access date: September 15, 2015
Büyüközkan G, Çifçi G, Güleryüz S (2011). Strategic analysis of healthcare service quality using fuzzy AHP methodology. Expert Syst. Appl. 38(8):9407-9424.
Chan FTS, Chan HK (2004). Development of the supplier selection model - A case study in the advanced technology industry. Proceeding of the Institution of Mechanical Engineers part B- J. Eng. Manuf. 21(12):1807-1824.
Chen IJ, Paulraj A (2004). 'Towards a theory of supply chain management: The constructs and measurements'. J. Oper. Manage. 22(2):119-150.
Cheng Ch, Kuo-Lung Y, Chia-Lung H (2009). Evaluating attack helicopters by AHP based on linguistic variable weight. Eur. J. Oper. Res. 116(2):423–435.
Cheraghi SH, Dadashzadeh M, Subramanian M (2011). Critical success factors for supplier selection: an update. J. Appl. Bus. Res. 20(2):91-108.
Christopher M (1994). Logistics and Supply Chain Management. Richard D. Irwin, Inc. Financial Times NY.
Cooper MC, Douglas ML, Janus DP (1997). Supply Chain management: More Than a New Name for Logistics. Int. J. Logist. Manage. 8(1):1-14
Drake PR (1998). Using the Analytic Hierarchy Process in Engineering Education, Int. J. Eng. Edu. 14:3.
Fashoto SG (2014). A Hybrid Approach to Fraud Detection in Health Insurance Based on Improved K-means Clustering and Multilayer Perceptron. Ph.D thesis, University of Ilorin Nigeria, 2014
Ferhan Ç, Demet B (2003). An integrated approach for supplier selection." Log. Inform. Manage. 16(6):395 -400
Ghodsypour SH, O'Brien C (1998). A decision support for supplier selection using an integrated analytic hierarchical process and linear programming. Int. J. Prod. Econ. 56-57:199-212.
Godse M, Mulik S (2009). An approach for selecting software-as-a-service (SaaS) product. Cloud Computing, 2009. CLOUD'09. IEEE International Conference on Cloud Computing. 155-158. Available @http://dspace.library.iitb.ac.in/jspui/bitstream/100/2447/2/An%20approach%20for%20selecting%20%20(SaaS).pdf, Accessed date: September 25, 2015.
Govindan K, Khodaverdi R, Jafarian A (2013). A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach. J. Cleaner Prod. 47:345-354.
Handfield R, Walton SV, Sroufe R, Melnyk SA (2002). Applying environmental criteria to supplier assessment: A study in the application of the Analytical Hierarchy Process. Eur. J. Oper. Res. 141(1):70-87.
Heizer J, Render B (2001). Operations Management. 6th Edn. Prentice-Hall, Englewood Cliffs, NJ.
Hokey M (1994). International Supplier Selection: A Multi-attribute Utility Approach. Int. J. Phys. Distrib. Log. Manage. 24(5):24-33.
Howard D, Mark B, Matin H (2008): "Neural Network ToolboxTM 6 User's Guide". The MathWorks, Inc. 3 Apple Hill Drive Natick, MA 01760-2098.
Hsu C, Hu AH (2009). Applying hazardous substance management to supplier selection using analytic network process. J. Cleaner Prod. 17(2):255-264.
Hsu CW, Kuo TC, Chen SH, Hu AH (2013). Using DEMATEL to develop a carbon management model of supplier selection in green supply chain management. J. Cleaner Prod. 56:164-172.
Jones TC, Riley DW (1985). Using inventory for competitive advantage through supply chain management. Int. J. Phys. Distrib. Mater. Manage. 5(5):16-26
Kahraman C, Cebeci U, Ulukan Z (2003). Multi-criteria supplier selection using fuzzy AHP. Log. Inform. Manage. 16(6):382-394.
Karande P, Chakraborty S (2012) Decision making for supplier selection using MOORA method. IUP J. Oper. Manage. XI(2):6-18.
Keskin GA, Ilhan S, Özkan C (2010). "The Fuzzy ART Algorithm: A Categorization Method For Supplier Evaluation And Selection." Expert Syst. Appl. 37(2):1235–1240.
Korpela J, Lehmusvaara A, Tuominen M (2001). Customer service based design of the supply chain. Int. J. Prod. Econ. 69(2):193-204
Kumar J, Roy N (2010). A Hybrid Method for Vendor Selection using Neural Network. Int. J. Comput. Appl. 11(12):35-40.
Labib A, Williams G, O'Connor R (1998). An Intelligent Maintenance Model: An Application of the AHP and a Fuzzy Logic Rule-Based Controller. JORM, 49 (7):745 -757.
Lee AH, Chen HH, Kang H (2009). Multi-criteria decision making on strategic selection of wind farms. Renew. Energy 34(1):120-126.
Lee AK, Mogi G, Li Z, Hui KS, Lee SK, Hui KN, Park SY, Ha YJ, Kim JW (2011). Measuring the relative efficiency of hydrogen energy technologies for implementing the hydrogen economy: An integrated fuzzy AHP/DEA approach. Int. J. Hydrogen Energ. 36(20):12655-12663.
Levary RR, Wan K (1999). An analytic hierarchy process based simulation model for entry mode decision regarding foreign direct investment. Omega 27(6):661-677.
Liberatore MJ, Nydick RL (2008). The analytic hierarchy process in medical and health care decision making: A literature review. Eur. J. Oper. Res. 189(1):194-207.
Min H (1994). International supplier selection: A multi-attribute utility approach. Int. J. Phys. Distrib. Log. Manage. 24(5):24-33.
Negnevitsky M (2002). "Artificial Intelligence – A Guide to Intelligent Systems". First Edition, Addison-Wesley, England.
Omkarprasad SV, Kumar S (2006).Analytic hierarchy process: An overview of application. EJOR 169:1-29
Punniyamoorthy M, Mathiyalagan P, Parthiban P (2011). A strategic model using structural equation modeling and fuzzy logic in supplier selection. Expert Syst. Appl. 38(1):458-474.
Rahman S, Smith DK (2000). Use of location-allocation models in health service development planning in developing nations. Eur. J. Oper. Res. 123(3):437-452.
Rossetti MD, Selandari F (2001). Multi-objective analysis of hospital delivery systems. Comput. Ind. Eng. 41(3):309–333.
Saaty TL (1996). Decision Making with Dependence and Feedback: The Analytic Network Process. RWS Publications, Pittsburgh, PA.
Sarkis J, Sundarraj RP (2006). Evaluation of Enterprise Information Technologies: A Decision Model for High-Level Consideration of Strategic and Operational Issues. IEEE Trans. Syst. Man Cybernet.—Part C (Appl. Rev.) 36(2):260-273.
Simunovis K, Simunovis G, Saric T (2009). Application of Artificial Neural Networks to Multiple Criteria Inventory Classification. Strojarstvo 51(4):313-321.
Sloane EB, Liberatore MJ, Nydick RL, Luo W, Chung QB (2003). Using the analytic hierarchy process as a clinical engineering tool to facilitate an iterative, multidisciplinary, microeconomic health technology assessment. Comput. Oper. Res. 30(10):1447-1465.
Sonmez M (2006). A review and critique of supplier selection pro-cess and practices. Occasional Paper, 2006:1. Loughborough: Business School, Loughborough.
Styles D, Schoenberger H, Galvez-Martos JL (2012). Environmental improvement of product supply chains: A review of European retailers' performance. Resour. Conserv. Recycl. 65:57-78.
Van der Rhee B, Verma R, Plaschka G (2009). Understanding trade-offs in the supplier selection process: The role of flexibility, delivery, and value-added services/support[Electronic version]. Retrieved [September 13, 2015], from Cornell University, School of Hotel Administration site: http://scholarship.sha.cornell.edu/articles/518/
Verma R, Pullman ME (1998). An analysis of the supplier selection process. Omega 26(6):739-750.
Vijayvargiya A , Dey AK (2010). An analytical approach for selection of

a logistics Provider. Manage. Decis. 48(3):403-418.
Walters D, Rainbird M (2007). Strategic operations management: A value chain approach. Palgrave Macmillan, Basingstoke.
Wang G, Huang SH, Dismukes JP (2004). Product-driven supply chain selection using integrated multi-criteria decision-making methodology. Int. J. Prod. Econ. 91(1):1-15.
Ware N, Sing S, Banwet D (2012). Supplier selection problem: A state-of-the-art review. Manage. Sci. Lett. 2(5):1465-1490.

QUESTIONNAIRE FOR HEALTHCARE PROVIDERS AT THE REDEEMER'S UNIVERSITY HEALTH CENTER

INTRODUCTION

I am a Computer Science Lecturer of Redeemer's university, conducting a research on supplier selection process, and its role in healthcare delivery. You have been identified as someone who can assist by responding to the questionnaire intended for this research. I wish to assure you of utmost confidentiality of any information you may provide and also that your responses are only for the purposes of this research, Thank you.

BACKGROUND INFORMATION

1. Sex a) Male b) Female
2. Age group a) 30 – 39 b) 40 – 49 c) 50 – 59 d) 60 and above
3. Marital Status a) Never married b) Married c) Divorced d) Separated e) Widowed
4. Position in organization …….
5. What is your academic qualification? a) 'A'/ 'O'/ SSS level b) HND c) BA/BSc d) MBA/MSc e) Others (specify) ……
6. How would you describe your role in the health centre? a) Prescriber b) User c) Supervisor d) Others (specify) ……..
7. How many years have you been working in this health centre? a) < 1 b) 1 – 3 c) 4 – 6 d) > 6
8. Have you ever received any training in healthcare delivery? a) Yes b) No
9. How is the selection of health supplies done in your facility? a) Essential Medicines b) Non Medicines list c) Based on services provided d) Others (specify) ……
10. Do you establish Maximum, Minimum, and Re-order levels for the health supplies? a) Yes b) No
11. If yes to question 10, how often do you update these levels? a) Daily b) Weekly c) Monthly d) Quarterly e) Bi-annually
12. If No to question 10, how do you control your stock levels? ……..
13. Are there separate records for all health supplies? a) Yes b) No
14. How do you determine the quantity of health supplies needed? a) Past Consumption b) Requests from Users c) Availability of Funds d) Others (specify) ……
15. How often is the quantity of health supplies needed requested? a) Daily b) Weekly c) Bi-weekly d) Monthly e) As the need arises
16. From where does your Unit receive its health supplies? Specify …….....
17. How long does it take your unit to receive supplies once a request has been placed? a) Within a day b) 2 to 4 days c) 5 to 7 days d) 8 to 14 days e) After 14 days
18. Have you ever experience a situation where you run short of supplies needed, whilst rendering service? a) Yes b) No
19. If yes to question 18, how did you deal with the situation? .....……
20. How do you request for the health supplies for your Unit? ……
21. What do you do if your requested quantities are not met? .....
22. How do the supplies get to the unit? .....
23. Who determines the quantity of supplies to be requested? ……..

AHP Questionnaire

(1) Equally important (2) moderately important (3) strongly important (4) very strongly important (5) extremely important. You can add any scale between 1 and 9.

Which of the criteria is more important over the other in terms of healthcare delivery? Please rate your response based on the scale above.

Criteria	COST	SERVICE	RISK	QUALITY	DELIVERY
COST					
SERVICE					
RISK					
QUALITY					
DELIVERY					

Select the degree of relative preference of each alternative relative to the criteria using the scale above.

COST	SUPPLIER 1	SUPPLIER 2	SUPPLIER 3	SUPPLIER 4	SUPPLIER 5
SUPPLIER 1					
SUPPLIER 2					
SUPPLIER 3					
SUPPLIER 4					
SUPPLIER 5					

SERVICE	SUPPLIER 1	SUPPLIER 2	SUPPLIER 3	SUPPLIER 4	SUPPLIER 5
SUPPLIER 1					
SUPPLIER 2					
SUPPLIER 3					
SUPPLIER 4					
SUPPLIER 5					

RISK	SUPPLIER 1	SUPPLIER 2	SUPPLIER 3	SUPPLIER 4	SUPPLIER 5
SUPPLIER 1					
SUPPLIER 2					
SUPPLIER 3					
SUPPLIER 4					
SUPPLIER 5					

QUALITY	SUPPLIER 1	SUPPLIER 2	SUPPLIER 3	SUPPLIER 4	SUPPLIER 5
SUPPLIER 1					
SUPPLIER 2					
SUPPLIER 3					
SUPPLIER 4					
SUPPLIER 5					

DELIVERY	SUPPLIER 1	SUPPLIER 2	SUPPLIER 3	SUPPLIER 4	SUPPLIER 5
SUPPLIER 1					
SUPPLIER 2					
SUPPLIER 3					
SUPPLIER 4					
SUPPLIER 5					

Names of suppliers

NO	NAME	SUPPLIER
1	SUPPLIER 1	EMZOR
2	SUPPLIER 2	MAY & BAKER
3	SUPPLIER 3	GSK
4	SUPPLIER 4	SYNERGY
5	SUPPLIER 5	HOVID

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Strategic management in retail pharmacy: The case of Zimbabwean companies

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Retail pharmacies operating in developing and emerging nations are faced with a myriad of intractable macro-economic conditions including over-regulation, government interference, inept policy implementations and intensive competition. These conditions demand that retail pharmacies become strategic in their approach to business management in order to diminish the impact of macro-economic conditions conspiring to influence their performance in the market. From that perspective, this study investigates the specific strategic management approaches employed by retail pharmacies in Zimbabwe to navigate the country's harsh economic conditions. In order to examine their management approaches, a questionnaire survey consisting of 90 retail pharmacies was carried out. Data collected from the survey was analysed using regression analysis. From this, the study developed a nuanced strategic management model that can be applied in managing businesses operating in unpredictable markets either in developing, emerging or advanced nations.

Key words: Developing and emerging nations, retail pharmacies, strategic management, macro-economic conditions

INTRODUCTION

Operating and managing a business in a developing or emerging economy demands dynamic and high level strategic management capabilities. Extensive market regulation, inept policy implementation, hypercompetition and government interference are common features in most developing or emerging economies. In Zimbabwe, a country of focus in this study, government interference in the pharmaceutical manufacturing and retail pharmacy markets, in particular, and the economic environment, in general, significantly influence business operations and management.

In an attempt to control the pharmaceutical sector through extensive market regulations and policy implementation, the Zimbabwe government only succeeded in forcing world renowned pharmaceutical companies to cease operating in the country. The closures at Central Admixture Pharmacy Services (CAPS) (Pvt) Ltd and Wallace Laboratories are well-documented events demonstrating the impact of a government's ill-conceived policy for indigenisation termed the 'Black Indigenisation' agenda (Deloitte and Touché, 2013). Although this (Black Indigenisation) was done to stimulate organic growth; the sudden pressure on retail pharmacies to provide essential health services to meet customer demands was immense However, the Black Indigenisation policy gave both private and state-owned retail pharmacies the impetus

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to exploit the opportunities it created (Criminal Investigation Agency (CIA) World Fact Book, 2012). As a direct consequent of this, there was a surge, in numbers, of retail pharmacies vying for market share in a country with customers whose purchasing power had been severely eroded by a malfunctioning economy, heavily controlled by politicians and on the brink of collapse. This market system created a sternly challenging combination of macro-economic conditions whereby relying on traditional tactics for selling pharmaceutical products was less effective. This meant that retail pharmacies had to be strategic in their business approaches. Therefore, in order to understand their strategic approaches in the pharmaceutical sector in Zimbabwe, this study addresses the following key questions:

1. How do retail pharmacies in Zimbabwe identify business opportunities in the country's pharmaceutical sector?
2. Which operations and management strategies have they adopted to enhance their market performance and survival in Zimbabwe?
3. How effective are their business methods?

To address the earlier stated questions, the study explores the interplay between strategizing, entrepreneuring, change and investing as the key determinants of enhanced market performance and business survival in unpredictable market conditions. In doing so, the study provide useful knowledge regarding the most appropriate business strategies managers operating in harsh macro-economic conditions often a common feature in most developing and emerging markets could adopt. This is refreshing considering that existing strategic management concepts/ models fall short of representing the specific approaches to business management in developing and emerging economies. The research study contributes to the discourse on strategic management in developing and emerging economies.

LITERATURE REVIEW

The process of developing an effective business model is so complex and multi-dimensional and yet it is a key catalyst for survival and better market performance in markets that are constantly evolving. It is therefore imperative that businesses operating in such complex and unstable market conditions recognise strategic planning as a key strategic management function (Desai, 2000).

According to Kuratko and Audretsch (2009) strategic planning 'is the formulation of long-range plans for the effective management of environmental opportunities and threats in light of a business's strengths and weaknesses'. Consistent with this, Hitt et al. (2011) explained that strategic planning should encompass an organisation's mission clearly highlighting achievable objectives, developing strategies, and setting policy guidelines. Evidently, the literature on strategic planning is littered with evidence emphasising that strategic management enables entrepreneurial businesses to:

1. Deal with causal effects and provide possible solutions.
2. Understand their macro-economic environment.
3. Define the purpose of the business.
4. Clarify the motives, values and resource-requirements of the business (Scarborough, 2014; Goncalves, 2009; Mazzarol et al., 2009; Mason, 2007; Mintzberg, 1987; Stacey, 1995).

Consistent with this, Sandada et al. (2014) and Normann and Ramfrez (1993) agree that effective strategic planning underpins the management process responsible for creating stability in a business particularly in unstable markets. While complexity and market turbulence can be anticipated, many businesses often lack a plan of how to cope in such conditions; it therefore makes more sense to find ways of handling such situations (Mason, 2007). Inspired by the study observations of Zimbabwe's pharmaceutical sector, the study argue that strategic planning as a function of management must form the foundations of any attempt for better market performance in volatile market. The strategic plan should cover entrepreneuring, strategizing, changing and investing processes

Operationalizing the concept of strategic management

The concept of strategic management within the discipline of business management and strategy has generated huge interest from management scholars who have looked at it from different angles. Some scholars have placed emphasis on rethinking strategic planning as well as on the strategic intent of an organisation to capture the essence of winning (Prahalad and Hamel, 1989; Mintzberg, 1994; Johnson et al., 2008; Ansoff and Sullivan, 1993). Others have conceptualised strategic management as an important business approach needed in today's dynamic and highly unpredictable business environments (Hamel, 1996; Anderson and Atkins, 2001; Al-Shaikh, 2001; Mazzarol et al., 2009; Hitt et al., 2011; De Wit and Meyer, 2014). In Larsen et al. (1998) a different definition encompassing the strength and weaknesses of a company and potential opportunities as platforms for developing its future growth strategies was adopted. Kraus et al. (2007) viewed strategic planning as a process of strategic management arguing that it is an attempt to prepare future contingencies to account for environmental dynamics and complexities.

Taking into account the multi-faceted dimension of the concept of strategic management, the study combine

more than one perspective and focus on strategizing, entrepreneuring, changing and investing as the key determinants for survival, economic prosperity and better performance in chaotic markets.

Strategizing

In unstable macro-economic conditions effective companies can be identified by their desire to exploit the unfolding opportunities and their preparation for potential threats (Porter, 1985). A number of studies universally acknowledge that dealing with problems of a strategic nature requires top management teams (TMTs) to go through a strategic reasoning process searching for ways to define and resolve problems at hand (Barney, 1991; Mintzberg, 1994; Teece et al., 1997; Picken and Dess, 1996; Adner and Helfat, 2003).

In Fraser and Stupak (2002) study strategizing is conceptualised as a way of ensuring clarity of goals, communication of strategic intent and more importantly, the development of a plan for responding to the business environment. Clearly, the underlying thesis is that it is of paramount importance that businesses operating in fragile market conditions continue to align/renew their business processes to enhance their prosperity (Sandada et al., 2014). Similarly, Johnson et al. (2008) commented that in a changing environment, organisations should be clear about their direction and scope over a long-term period.

Hypothesis 1

Strategizing is an essential strategic management capability which helps in formulating a vision for the future success of an organisation while anticipating changes in the macroeconomic environment.

It would however be naïve to assume that strategizing is the panacea to solving a myriad of challenges for managing an organisation in chaotic markets. Careful consideration should be given to the position of the company in the market to avoid strategic drift (Johnson et al., 2006) which may have an impact on survival, economic prosperity and better performance. In the literature (Johnson et al., 2008; Mason, 2007; Eisenhardt and Sull, 2001; Hamel, 2000; Prahalad and Hamel, 1989) there is consensus that managers should develop strategies that are appropriate to the specific macro-economic conditions facing their firms.

Entrepreneuring

The importance of being entrepreneurial among strategy managers is widely recognised as the driving force for creating new markets and for establishing new positions in existing markets as well as for creating new order from the old (Hamel and Prahalad, 1995; Markides, 1999; Shane, 2000; Shane and Venkataraman, 2000; De Wit and Meyer, 2014; Kuratko, 2014). Linking entrepreneurship with uncertainty Knight (1921) explained that uncertainty is an unavoidable aspect of the entrepreneurial management phenomenon. This is can be true for organisations operating in fast-moving market conditions. Coping with uncertainty should be part of demonstrating resilience in entrepreneurial organisations (Burns, 2012). Any wrong strategic choices by the top management teams may have devastating consequences (Hamel and Prahalad, 1995). Notwithstanding this, Kuratko and Audretsch (2009) regarded entrepreneurship as a dynamic process of vision, change, and creation in challenging market conditions. As far as the discourse concerning entrepreneurship goes Kirzner's (1973) dated yet still influential conceptualisation of the entrepreneurial phenomenon provided a useful starting point. Kirzner (1973) explained that an entrepreneur is someone who is alert to opportunities and creates a vehicle to exploit them.

Adding to this Hitt et al. (2001) view entrepreneurial strategy as a course of action taken by strategy managers with a view to adapt to environmental changes in order to take advantage of the opportunities arising from uncertainty and discontinuities in wealth creation. A convincing argument regarding entrepreneuring was made in Sarasvathy (2001). Sarasvathy (2001) put forward the notion that, 'successful entrepreneurs have long created firms, industries, and even economies by matching up the offspring of human imagination with human aspirations' (2001).

This is an unquestionable endorsement that visioning, inspiration and protracted determination can be vital for economic prosperity. Consistent with this Dess et al. (1997) discussed the idea of entrepreneurial strategy-making. Dess et al. (1997) agreed that entrepreneurial strategy-making comprises a collection of activities within an organisation with a view to formulating their strategic mission and future goals. Hart (1992) shared similar views but went as far as outlining the activities including: strategic planning, strategic decision-making and entrepreneurial firms should be engaged in to achieve economic prosperity. In their contribution to this debate Lumpkin and Dess (1996) argued that there is a significant link between entrepreneurial-orientation (EO) with better performance.

Hypothesis 2

An entrepreneurial minded manager is fundamental to the survival and the performance of an organisation that is faced with a myriad of challenges in markets characterised by uncertainty.

Admittedly, the entrepreneurial environment is highly

unpredictable and inherently chaotic (Gleick, 1987). This implies that the connectivity of various components of strategic management is stochastic. As such, entrepreneurial organisations are likely to favour the intricate combination of aspects of strategizing, entrepreneuring, changing and investing. The last word on entrepreneuring can be left to Anderson and Atkins (2001) who provided useful advice which entrepreneurial firms cannot afford to dismiss. Anderson and Atkins (2001) explained that entrepreneurial firms should be aware of 'the fallacy of misplaced reliance on forecasts and prepare strategies that reflect a mind-set that is open to change'.

Changing

In fast-moving macro-economic conditions, it is necessary for strategy managers to continue adjusting/modifying various internal business configurations to align with the immediate surroundings. Change management is a concept well-represented in the strategic management literature (Stacey, 1995; Mintzberg and Waters, 1985), management and organisational behaviour scholarship (Mullins, 2005). These management domains are increasingly being studied alongside entrepreneurship and strategy (Katila et al., 2012; Santos and Eisenhardt, 2009; Companys and McMullen, 2007; Hitt et al., 2001; Mosakowski, 1998) showing their interconnectedness. Kuratko and Audretsch (2009) made more sense of this by proposing a new term '*Strategic Entrepreneurship'* which they argued represents the intersection of strategy and entrepreneurship. This presumed linkage permits entrepreneurial firms to influence (manage and control) the configuration of individuals in the firm and shape their behaviours (culture) with a view to facilitating an entrepreneurial business model. Clearly, developing a system within the organisation has more to do with strategic management especially, the re-organisation of the key individuals/units/process in it in such a way that they collectively influence economic prosperity and better organisational performance. In a literature-based study by Companys and McMullen (2007), it was explained that organizational re-structuring is an important developmental step which significantly aids economic prosperity in organisations facing intractable challenges prolonged by constantly changing market conditions.

Adding to the discourse about business re-structuring for economic development Mullins (2013) commented that culture reduces complexity and uncertainty by facilitating a sense of shared responsibility. Similarly, Johnson et al. (2006) proposed the cultural web paradigm highlighting its usefulness towards understanding desirable culture within an organisation. Culture manifests itself in organisational values, routines, rituals and norms.

According to Mullins (2005) culture provides the basic ingredients that are necessary for enhanced organisational performances and strategy managers should champion the implementation of acceptable behaviour in their organisations.

Hypothesis 3

Strategy managers should develop business systems that are underpinned by common values, beliefs, routines and norms. They should outline current and future desired behaviour to assist economic prosperity in chaotic market conditions. Crucially, building flexibility within their businesses allows entrepreneurial individual to respond timely to changes in harsh market conditions while enabling better overall performance.

The entrepreneurial activity of an individual in an organisation is dependent on an established organisational culture and management style. Strategy managers in entrepreneurial organisations should develop and communicate their vision, scope and direction, choose quality individuals and build an entrepreneurial architecture (structures, systems and culture) for their organisations (Singer et al., 2009; Morris et al., 2008). This is especially important as a plan for responding better to the challenges synonymous with chaotic markets.

Investing

Investing in key strategic resources enables strategy managers to renew their business processes in anticipation of the future. Making the right investment decisions is a crucial part of strategic management in entrepreneurial firms as it shapes managerial and strategic destiny (Wiltbank et al., 2009). Indeed, strategic planning involves, to a greater extend, choices concerning resource-related investments to achieve corporate goals (Bowan and Hurry, 1993) while accounting for some degree of uncertainty in the process. The resource-investments and unfolding strategy choices are inversely related determinants of enhanced firm performance, economic growth and development (Penrose, 1959). Bowan and Hurry (1993) extended this by suggesting that invested resources can be the launch pad for an organisation's strategy.

In a related study, Gunther and Nerkar (2004) explained that investing in real options can allow organisations to gain access to opportunities markets offer than they would if their investments took the form of a full scale launch. Similarly, Kogut and Kulatilaka (1994) commented that the use of platforms as investment options is a valuable approach in the sense that it mitigates the risks associated with uncertainty and time dependency. Consistent with this, Bowan and Hurry (1993) and Dixit (1992) acknowledged that applying the investments option lens as a tool for strategic management offers an economic logic that underpins the notion of incremental resource investments. Investment appraisal methods

Table 1. The position of the key participants in their retail pharmacy.

Variable	Frequency	Percentage (%)	Valid Percentage (%)	Cumulative percentage (%)
Owner	22	33.8	33.8	33.8
Manager	38	58.5	58.5	92.3
Locum pharmacist	9	13.8	13.8	106.1

should capture the components of flexibility and strategic value as they may significantly contribute to the firm's economic development in unstable markets (Smit and Trigeorgis, 2004).

Hypothesis 4

Strategy managers should routinely engage in making strategic investments with a degree of flexibility. Their effective allocation of resources on key projects is fundamental to a company's economic prosperity and survival in turbulent markets

Generally, investments that promise to generate returns in the long term are riskier, especially in volatile markets, than short-term options making them harder to take (De Wit and Mayer, 2014). Investing in a long-term strategic position attached to anticipated better performance and economic prosperity involves a high degree of uncertainty about the expected effects as the macro-economic conditions continue to evolve. This therefore makes committing huge amounts of resources to achieve strategic goals (economic prosperity, survival and better performance) both riskier and more uncertain given the unpredictability of today's markets both in developing and developed nations.

METHODOLOGY

The main purpose of this study was to explore the strategic management approaches adopted in retail pharmacies operating in a developing nation, and to formulate a new concept (business model) to be used as a strategic tool for survival, economic prosperity and better performance in unstable macroeconomic conditions. From that perspective, the study can be described as explanatory by design. Designing the study this way enabled the study to explain the considered impact of strategic management in unstable markets such as those found in Zimbabwe. Lewis and Saunders (2012) described the connection as 'cause-and-effect relationships'.

Therefore, to explain this occurrence it was deemed appropriate to utilise both quantitative and qualitative research methods. As such, a triangulation of research methods was adopted for data collection, and it included a review of the existing literature, structured field observations and survey questionnaires. An in-depth literature review (Creswell, 2014) was used to identify the key components that militate strategic management including: strategizing, entrepreuring, changing and investing. This assisted us to construct four hypotheses as presented in the subsets of section two. These were then tested using regression analysis providing us with additional insights into the effectiveness of the strategic management approaches adopted in retail pharmacies operating in Zimbabwe.

To ensure that data collected using questionnaires was relevant, structured questions were focussed on the key variables (themes) (Bellamy and Perri, 2009; Creswell, 2014) outlined earlier as the key components of strategic management. Electronic questionnaires were also used at the data collection stage. The technique facilitated access to a large number of suitable participants. The research sample consisted of 90 retail pharmacies predominantly based in Harare the capital city of Zimbabwe. The total number of pharmacies operating in the city centre is currently 233 with a margin for error.

The sampled pharmacies were divided into four groups Central Business District (CBD), High Density (HD), Medium Density (MD) and Low Density (LD). LD has a total of 18 pharmacies which are few and as such, it was fused to make one strata with those operating in the MD. Simple random sampling was used to choose 35 pharmacies for each stratum. Thirty-five (35) questionnaires were then distributed to each of the three groups CBD, HD, LD and MD to make a total of 105 questionnaires. Out-off the 95 returned questionnaires only 90 were usable.

Ninety percent (90%) is a high response rate which is acceptable in studies that incorporate quantitative methods (Field, 2013). The high response rate can be attributed to the keen interest and enthusiasm that most of the key participants had in this study as it was about presaging their stalwartness in dealing with market uncertainty. The demographic data representation for this study is presented in terms of the position of the participants in their selected organisations. Table 1 presents the positions of the key informants in their pharmacies. From the data on the Table 1 it can be established that the highest number (38) of participants were pharmacists and were in managerial positions, the owners of founders of the selected pharmacies were 22, and those pharmacists working on contacts of up to 12 months termed *locums* were only 9.

Structured field observations are prevalent in studies within the marketing discipline. In this study, structured field observations were used for surveillance and fact-finding purposes (Lewis and Saunders, 2012). The method gave us an opportunity to learn more about retail pharmacies in Zimbabwe. More so, structured field observations were chosen with the view to complementing the literatures in chapter two. Furthermore, structured field observations enabled the study to observe the activities of the pharmacies and the macroeconomic conditions they face in Zimbabwe.

FINDINGS

The study aims to develop an understanding of the importance of strategic management in developing nations. Beyond that, a nuanced business management model was developed for use in chaotic and unpredictable markets in which sustainable business development is presumed to be anchored on strategic management (Figure 1). The research study found that

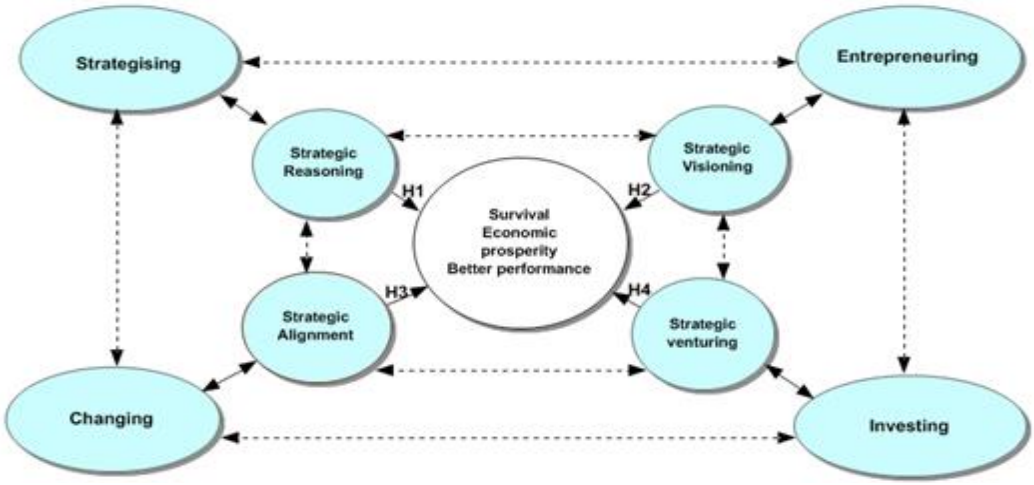

Figure 1. A new strategic management model for organisations intending to withstand/survive unstable macro-economic conditions

Table 2. The impact of strategic management in unstable macro-economic conditions.

Variable	N	Minimum	Maximum	Mean	Standard deviation
How important is planning ahead, in your business to your survival, economic prosperity, and better performance in the pharmaceutical sector? (Strategizing)	3	3	80	28.33	44.747
How important is anticipating the future market conditions to your to survival, economic prosperity, and better performance in the pharmaceutical sector? (entrepreneuring)	4	2	75	22.50	35.180
How important is adjusting or modifying your internal business structures to your survival, economic prosperity, and better performance in the pharmaceutical sector? (changing)	4	2	78	22.50	37.063
How important is making the right resource investment decision, in your business for survival, economic prosperity, and better performance in the pharmaceutical sector? (investing)	4	1	85	22.50	41.677
Valid n (listwise)	3	-	-	-	-

most of the retail pharmacies in Harare were aware of the conditions in their macro-economic environment, and they were determined to 'make it happen' for their businesses. When responding to a survey question regarding business operations-related challenges encountered in Zimbabwe, a third (77%) of the participants indicated that the economic climate was not conducive. The same number identified forecasting, anticipating and planning as key to their businesses and they were determined to improve the positions of their companies in the market.

From this, one cannot be judged to be out of context by claiming that these retail pharmacies are applying strategic management techniques specific to developing and emerging nations. Table 2 provides a summary of the views of all the participants on the subject of strategic management. Specifically, the table highlights that a significant proportion of those who responded to the questions relating to strategy formulation felt that strategic management was key to their survival, economic prosperity and better performance in the pharmaceutical sector in Zimbabwe. A mean average of 24 on aggregate,

Table 3. Correlation between survival, economic prosperity, better performance and strategic management.

Model	R	R square	Adjusted R square	Standard error the estimate
1	0.995[a]	0.989	0.979	6.341

[a]Predictors: (constant), strategizing, entrepreneuring, changing and investing.

Table 4. The significance of association between survival, economic prosperity, better performance and strategic management.

Model	Sum of squares	df	Mean square	F	Sig.
Regression	3741.795	1	3741.795	93.067	0.00[b]
Residual	40.205	1	40.205	-	-
Total	3782.000	2	-	-	-

Dependent variables: survival, economic prosperity and better performance; Predictors: (constant0, strategizing, entrepreneuring, changing and investing.

indicated that strategic management involving the key components of strategizing, entrepreneuring, changing and investing is an essential capability that can 'make it happen' for businesses operating in harsh market conditions. There were no significant variations regarding the importance of strategic management in their market.

To test the four hypotheses developed, regression analysis was carried out by running simple regression. Significant evidence confirming a strong correlation between strategizing and survival, economic prosperity and better performance in the pharmaceutical sector in Zimbabwe was there. Tables 2 and 3 illustrate the value for R and R^2 for the model that has been derived. For these data, R has a value of 0.995 representing the simple correlation between survival and the key components/determinants of strategic management. The value of R^2 is 0.989 demonstrating that strategizing, entrepreneuring and advertising can account for 98.9% of the variation for surviving in harsh macroeconomic conditions.

In other words, this explains the importance of strategic management in a typical pharmaceutical market found a developing nation, Zimbabwe. Only a small percentage of about 1.1% cannot be explained by strategic management alone. There may well be other variables which were not accounted for in the study survey. In Table 3 the most important reading that helps us to understand the significance of the determinants of strategic management essential for survival in Zimbabwe is the *F-ratio* which is calculated using the equation (8.9) and the associated significance of the generated *F-ratio* (Field, 2013). For these data, *F* is 93.1 which is significant at p< 0.001 because the value for *Sig.* is less than 0.001 as illustrated on Table 3. The results shown earlier denote that there is less than a 0.1 chance that an *F-ratio* this large would occur if the null hypothesis were true.

Therefore, the study can conclude that regression model results in significantly better predication of the impact of strategizing on survival, economic prosperity and better performance in harsh market conditions such as those offered by Zimbabwe's pharmaceutical industry. The study applied regression analysis to the other four components of strategic management yielding similar results confirming this study hypothesises 1 – 4 stated. To measure the significance of the relationship between survival, economic prosperity and better performance and the key determinants of strategic management, Pearson's ***r*** correlation coefficient was used. Table 4 illustrates the correlation coefficients of all the components/ determinants of strategic management: strategizing = 1, 0; entrepreuring = 1, 0; changing = 0.998 and investing =1, 0. The other readings demonstrate a similar pattern confirming the impact of strategic management in Zimbabwe's pharmaceutical sector. *N* denotes the sample size used *(90)* on which the correlation coefficient was based.

The significance values denoted by the double asterisk are higher than 0.01. This significance value indicates that the probability of getting a correlation coefficient this big in a sample of 90 participants if the null hypothesis were true that is, if there was no relationship between these variables was very high. The significance values are below or equals to a standard criterion of 0.05 indicating a 'statistical significant' relationship of the components of strategic management and survival, economic prosperity and better performance (Table 5).

In addition to statistical evidence provided earlier, structured field observations revealed pharmacies in Zimbabwe were increasingly embracing the principles of strategic management. There was logical evidence pointing to the fact that the pharmacists at the helm of these retail health services were mainly driven by intense

Table 5. The relationship between the determinants of strategic management and market performance.

Dependent variables		Strategizing	Entrepreneuring	Changing	Investing
Importance of planning ahead to (1) survive; (2) economic prosperity; and (3) better performance	Pearson Correlation	1	1.000*	0.998*	1.000**
	Sig. (2-tailed)	-	0.005	0.007	0.007
	N	90	90	90	90
The importance of anticipating the future market conditions to (1) survive; (2) economic prosperity; and (3) better performance	Pearson Correlation	1.000*	1	0.990*	0.997**
	Sig. (2-tailed)	0.005		0.001	0.003
	N	90	90	90	90
The importance of adjusting or modifying internal business structures to (1) survive; (2) economic prosperity; and (3) better performance	Pearson Correlation	0.998*	0.990*	1	0.997**
	Sig. (2-tailed)	0.007	0.010		0.003
	N	90	90	90	90
The importance of making the right resource investment decisions to (1) survive; (2) economic prosperity; and (3) better performance	Pearson Correlation	1.000**	0.997**	0.997**	1
	Sig. (2-tailed)	0.007	0.003	0.003	
	N	90	90	90	90

commitment and determined perseverance irrespective of the chaotic macro-economic conditions in Zimbabwe. This was clearly displayed by their desire to invest in sophisti-cated resources including computerised inventory systems and learned human capital. A look into the profiles of the key individuals in the pharmacies also showed that they all had attained high levels of qualifications in pharmacy education from abroad. Based on this, it is plausible to infer that the positioning of key individuals within the pharmacies was designed to enhance enhanced organizational performance in a fragile market.

Related to this, there was documentary evidence indicating that these key individuals were embracing the principles of strategic management which proved essential in terms of understanding market variations. Concerning the notion of hedging against the shortages of essential clinical apparatus and prescription drugs often associated with deteriorating markets, the pharmacies established strategic distribution networks with pharmaceutical companies within the Southern African Development Community (SADC) region including Zambia, South Africa, Swaziland, Mozambique and Botswana. This clearly demonstrated the importance of strategic management and the desire by the pharmacists to 'make it happen' in harsh economic conditions widespread in Zimbabwe's pharmaceutical sector. This is consistent with the literature of Fraser and Stupak (2002) who agreed that developing a strategic plan for responding to the business environment is essential for any organi-sation faced with uncertainty. Indeed, the structured field observations showed an existence of well-established alliances with pharmaceutical companies mainly originating from South Africa.

It was also recognisable that these business-like relationships (Simba, 2013), though informal, were of paramount importance to retail pharmacies in the study sample. Interestingly, the pharmacists in the research sample appeared to be exploiting the government's 'Black Indigenisation' agenda by developing new markets. Specifically, the pharmacies were experimenting with in-store clinics, wellness programs, health screenings and disease management services in Zimbabwe. This showed that they were considering all feasible options, evaluating their market environment and simulating new ideas with a view to developing an effective plan for going to the market. Arising from this, new insights were developed. Especially, evidence of widespread application of strategic management techniques enhances better market performance and business survival.

New concept formation

Following the statistical representation and the qualitative interpretation of the results in this study a new business model was proposed. It was however deemed necessary that before outlining the model, some time is spent on briefly explaining the process underpinning its creation. The formation of a new business model is fundamental to what we were trying to address in this research. Precisely, the model helps us to contextualise the social world of the retail pharmacies in Zimbabwe. This is consistent with

the views of other authors for example; Gerring (2001) who explained that theories are instrumental in social science as they help researchers to make connections between the world people live in, and how they interpret it. The strength of the proposed model lies in its formation – its variables are grounded in the literature and the empirical findings (Glaser and Strauss, 1967; Collier and Mahon, 1993; Mills and Birks, 2014).

To ascertain the applicability of the model the study invite other scholars to test it in different settings either in a developing, emerging or developed nation so as to measure its effectiveness as a blue-print for enhanced market performance (survival, economic prosperity and better performance). The paradox of the political and social-economic conditions in Zimbabwe appears to have spurred pharmaceutical companies, especially retail pharmacies in the City of Harare to apply the principles of strategic management through spontaneous business re-configuration.

This provided new knowledge suggesting that retail pharmacies in Zimbabwe are employing strategic management techniques to navigate the various operational and business management-related challenges they face. Learning from their processes of going to the market (Piercy, 2002) the study was intrigued by their ingenuity and creativeness. This led to the formation of a new business instrument. Figure 1 diagrammatically illustrates the connectivity of the key determinants of strategic management intended to succour organisations operating in developing, merging or developed nations to prevail in unstable macro-economic conditions. Figure 1 emphasises that paying attention to the specific configurations of the key determinants of strategic management is pivotal to the survival, prosperity and enhanced performance of companies operating in chaotic markets. This was confirmed to be true when we tested the extent to which these determinants influence market performance using regression analysis.

Undoubtedly, harsh market conditions force organizations to be strategic in how they operate. The proposed conceptual model does not, in any way, portray that the process of developing an effective way of going to the market (Piercy, 2002) is a simple procedure but, it rather provides a starting point for organisations in mapping an overarching plan to guarantee survival, economic growth and better performance in ephemeral markets.

Crucially, the framework advances the notion that adopting a strategic management approach by employing strategic reasoning (Mintzberg, 1994), strategic visioning (Johnson et al., 2008), strategic alignment (Thompson, 1999), and strategic venturing (Smit and Trigeorgis, 2004) considerably increases the probability of survival, economic prosperity and better performance of an organisation confronted with challenging market conditions. Clearly, the strength of this model can be directly attributed to the effectiveness of strategic management.

As the study has already alluded to, the framework shows the inter-connectedness of all the constituent components of strategic management. A point to note here is that; a misalignment of these components with the macro-economic environment will have an impact on both current and future market performance especially in turbulent markets irrespective of the fact that an organisation originates from a developing or developed nation. The study accepts that no one can accurately predict the future, but preparing for eventualities can be crucial for any business organisation. Business renewal (De Wit and Meyer, 2014) as projected by the study model has the power to facilitate stability within the organization while enabling sustainable development. From this, it is imperious that business managers of organisations which operate in ephemeral markets use their managerial capabilities to increase the market performance of their firms. More so, they must implement the key components of the strategic management process: strategizing, entrepreneuring, change and investing processes if they are to thrive in such extremely unpredictable market conditions.

DISCUSSION

A look into the entrepreneurial landscape of Zimbabwe revealed that, to some extent, ingenuity was embraced as the main attribute essential for enhanced market performance in the increasingly deteriorating market conditions (Shumba, 2014). Indeed, such market conditions placed huge operational challenges on organisations requiring them to sense opportunities and threats (Dess et al., 1997) and devise fresh and alternative strategies. In view of this, the study does not take lightly the challenges that retail pharmacies encountered in the process of providing health services in Zimbabwe.

As such, the study argues that strategic management must be recognised as a crucial factor in fostering an effective business model in developing, emerging market or advanced nations. There is universal acknowledgement among scholars that strategy managers enhance the probability of better market performance when they take stock of their sources and rearrange them in ways that are valuable (Lumpkin and Dess, 1996; Miller, 1983; Zahra, 1993; Romer, 2007). Clearly, strategic management is a process widely considered to be a facilitator of economic prosperity, better performance for generating positive externalities in fast-moving business sectors.

Notwithstanding this view, it would be short-sighted to assume that developing a winning formula in unstable macro-economic conditions is a straight forward process. What amounts to strategic management is so complex and extremely challenging. The real challenge in formulating a strategy lies in detecting the subtle discontinuities that may undermine the business in the

future (Mintzberg, 1994). Arguably, getting the mix of the key components, illustrated in the study nuanced strategic management model presented on Figure 1, and fit them well in internal business processes significantly assists organisations to achieve their corporate goals.

Undoubtedly, it is not easy to predict the future; but the findings of this study provide a useful insight into the management capabilities essential for organisations operating in developing and emerging nations. Ample evidence demonstrated that the retail pharmacies in Zimbabwe were aware of the complexities of operating in unpredictable market conditions, and were determined to 'make it happen'. As such, strategic management was used to integrate their strategic goals and the sequences of their actions (Anderson and Atkins, 2001).

This new development maybe better explained by the observed skills and the awareness of the pharmacists who were responsible for providing the scope and direction of the retail pharmacies. Their well-documented education and training received from abroad appeared to have also provided useful knowledge which was typified by their strategic thinking the study detected in the way they carried out their business operations. Furthermore, their determination and desire to 'make it happen' performed a major role in helping their retail pharmacies to survive a myriad of intractable politically and economically-driven challenges in Zimbabwe. The strategic management manoeuvres evidenced in the retail pharmacies had a direct impact on their performance. The adoption of the principles of strategic management by these pharmacies was mainly driven, to a greater extent, by the characteristics of the industry in which they operated. An important lesson that managers can learn from this research is that; operating in a turbulent market requires organisations to continually renew their internal business processes consistent with the macroeconomic environment.

CONCLUSION

The study has demonstrated that strategic management as a management process significantly contributes to the survival and better market performance in uncertain markets. It has shown that embracing the principles of strategic management helps to predict future market possibilities while informing the development of appropriate strategies to adopt. The research provides a conceptual framework which, arguably, can be adopted in transient markets which can be found in developing, emerging or developed nations. It was also accepted in this research that strategic management is a process fraught with challenges, but if it is embraced by managers whose organisations are exposed to unpredictable markets the probability that the business will survive, and prosper economically is considerably enhanced.

Although there were no formal strategic management training programs in Zimbabwe. The study provided concrete evidence showing that pharmacists who are currently managing these retail pharmacies are using their management initiatives to minimize the effects of a deteriorating market on their businesses. The strategic-minded pharmacists demonstrated a desire to 'make it happen' through their determination and entrepreneurial orientation even if the macro-economic conditions suggested otherwise. Finally, the study can infer that developing nations are increasingly embracing strategic management. As such, entrepreneurial developments of this magnitude should be exposed to the field of management in order to provide valuable knowledge which can be used in managing businesses operating in today's worldwide markets which appear to be in turmoil.

LIMITS OF THE STUDY

Although the chosen research methodology was deemed appropriate the study is aware of its inherent limits. The fact that the study relied on a survey to generate data for analysis restricted it from obtaining rich data which could have been achieved by conducting qualitative (face-to-face) interviews with the key informants. Though the study was mainly interested in generalising the findings to a larger population, a detailed case-by-case analysis would have provided rich data enabling the study to better explain the strategic planning processes of the pharmacies in Zimbabwe. Furthermore, concentrating on pharmacies in the capital city Harare alone allowed the study to remain reasonable in scope (Miles and Huberman, 1994) but it resulted in the reduction of the number of pharmacies that were subjected to the analysis. The bigger the sample, the better would have been the study estimate of *R* (regression value) generated using a regression technique.

Conflict of Interests

The authors have not declared any conflict of interests.

REFERENCES

Al-Shaikh FN (2001). Strategic planning process in developing countries: The case of United Arab Emirates business firms. Manage. Res. News 24(12):7-16.

Anderson AR, Atkins MH (2001). Business strategies for entrepreneurial small firms. Strategic Change 10(6):311-324.

Adner R, Helfat, CE (2003). Corporate effects of dynamic managerial capabilities, Strat. Manage. J. 24:1011-1025

Ansoff IH, Sullivan PA (1993). Optimizing profitability in turbulent environments: A formula for strategic success. Long Range Plan. 26(5):11-23.

Barney JB (1991). Firm resources and sustained competitive advantage. J. Manage. 17(1):99-120

Bellamy C, Perri 6. (2009). Principles of Research Design: A Guide to Methodology in Social Science, Sage Publications Inc., London.

Burns P (2012). Entrepreneurship and Small Business: Start-up, Growth and Maturity, 3rd Edition, Palgrave MacMillan.

CIA World Fact book. (2012). Zimbabwe Economy 2012. Available at:

http://www.theodora.com/wfbcurrent/zimbabwe/zimbabwe_economy.html.
Collier D, Mahon JE (1993). Conceptual "Stretching" Revisited: Adapting Categories in Comparative Analysis. Am. Polit. Sci. Rev. 87(04):845-855.
Companys YE, McMullen JS (2007). Strategic entrepreneurs at work: the nature, discovery, and exploitation of entrepreneurial opportunities. Small Bus. Econ. 28(4):301-322.
Creswell JW (2014). Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th Edition, International Student Edition, Thousand Oaks: California
De Wit B, Meyer R (2014). Strategy: An International Perspective, 5th Edition, Cengage Learning, EMEA.
Dixit A (1992). Investment and hysteresis. J. Econ. Perspect. pp. 107-132.
Deloitte, Touché (2013). Doing business in Zimbabwe: The jewel of Africa, Deloitte Studio, Johannesburg, (801321/chr). Available at: http://www2.deloitte.com/content/dam/Deloitte/au/Documents/international-specialist/deloitte-au-aas-doing-business-zimbabwe-13.pdf.
Desai AB (2000). Does strategic planning create value? The stock market's belief, Manage. Decis. 38(10):685-693.
Dess GG, Lumpkin GT, Covin JG (1997). Entrepreneurial Strategy Making and Firm Performance: Tests of Contingency and Configurational Models. Strat. Manage. J. 18(9):677-695.
Eisenhardt KM, Sull DN (2001). Strategy as simple rules. Harvard Bus. Rev. 79(1):107-116.
Field A (2013). Discovering statistics using IBM SPSS statistics. 4th Edition, SAGE Publication, Thousand Oaks: California.
Fraser DL, Stupak RJ (2002). A synthesis of the strategic planning process with the principles of learning, leading and linking. Int. J. Public Adm. 25(9):1199-1220.
Gerring J (2001). Social science methodology*:* A criterial framework. Cambridge University Press.
Glaser B, Strauss A (1967). The discovery of grounded theory. Weidenfield and Nicolson, London.
Gleick J (1987). Chaos: Making a New Science (Viking Press, New York, NY).
Goncalves H (2009). Proposal of a strategy model planning aligned to the balanced scorecard and the quality environments. TQM J. 21(5):462-472.
Gunther MR, Nerkar A (2004). Real options reasoning and a new look at the R&D investment strategies of pharmaceutical firms. Strat. Manage. J. 25(1):1-21.
Hamel G, Prahalad CK (1995). Thinking differently. Bus. Quart. 59(4):22-35.
Hamel G (1996). Strategy as revolution. Harvard Bus. Rev. pp. 69-71.
Hamel G, Prahalad CK (1989). To revitalize corporate performance, we need a whole new model of strategy. Harvard Bus. Rev. 67(3):63.
Hamel G (2000). Leading the Revolution. Harvard Business School Press: Boston, MA.
Hart SL (1992). An integrative framework for strategy-making processes. Acad. Manage. Rev. 17(2):327-351.
Hitt MA, Ireland RD, Camp SM, Sexton DL (2001). Strategic entrepreneurship: Entrepreneurial strategies for wealth creation. Strat. Manage. J. 22(6):479-492.
Hitt MA, Ireland RD, Sirmon DG, Trahms CA (2011). Strategic entrepreneurship: creating value for individuals, organizations, and society. The Acad. Manage. Perspect. 25(2):57-75.
Ireland RD, Hitt MA, Sirmon DG (2003). Strategic entrepreneurship: The construct and its dimensions. J. Manage. 29(6):963-989.
Johnson G, Scholes K, Whittington R (2006). Exploring Corporate Strategy: text and cases, 6th Edition, Prentice Hall
Johnson G, Scholes K, Whittington R (2008). Exploring Corporate Strategy: text and cases, 7th Edition, Prentice Hall.
Katila R, Chen EL, Piezunka H (2012). All the right moves: How entrepreneurial firms compete effectively. Strat. Entrepr. J. 6(2):116-132.
Knight FH (1921). Risk*,* uncertainty and profit. Washington, DC: Beard Books.
Kirzner IM (1973). Competition and entrepreneurship. Chicago: University of Chicago Press.
Kraus S, Reiche BS, Reschke CH (2007). Implications of strategic planning in SMES for international entrepreneurship research and practice (Published in M. Terziovski (Ed.), Energizing Management through Innovation and Entrepreneurship: Euro. Res. Pract. pp. 110-127.
Kogut B, Kulatilaka N (1994). Operating flexibility, global manufacturing, and the option value of a multinational network. Manage. Sci. 40(1):123-139.
Kuratko DF, Audretsch DB (2009). Strategic entrepreneurship: exploring different perspectives of an emerging concept. Entrepr. Theor. Pract. 33(1):1-17.
Kuratko DF (2014). Entrepreneurship: Theory, Process, Practice, 9th Edition, Cengage/South-western Publishers.
Larsen P, Tonge R, Ito M (1998). The strategic planning process in growing companies. J. Gen. Manage. 24(1):53-68.
Lewis P, Saunders M (2012). Doing research in business and management: An essential guide to planning your project. Financial Times/Prentice Hall.
Lumpkin GT, Dess GG (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. Acad. Manage. Rev. 21(1):135-172.
Markides CC (1999). A dynamic view of strategy. Sloan Manage. Rev. 40(3):55-63.
Mason RB (2007). The external environment's effect on management and strategy: a complexity theory approach. Manage. Decis. 45(1):10-28.
Mazzarol T, Rebound S, Soutar GN (2009). Strategic planning in growth oriented small firms. Int. J. Entrepr. Behav. Res. 15(4):320-345.
Mills J, Birks M (2014). Qualitative Methodology: A practical guide. SAGE Publications, Thousand Oaks: California.
Miller D (1983). The correlates of entrepreneurship in three types of firms. Manage. Sci. 29(7):770-791.
Miles MB, Huberman AM (1994). Qualitative data analysis: An expanded sourcebook. 2nd Edition, SAGE Publications, Thousand Oaks: London.
Mintzberg H (1994). 'The fall and rise of strategic planning', Harvard Business Review, January-February 1994. pp. 107-114.
Mintzberg H (1987). Crafting strategy, Harvard Business School Press.
Mintzberg H, Waters JA (1985). Of strategies, deliberate and emergent. Strat. Manage. J. 6(3):257-272.
Morris MH, Kuratko DF, Covin JG (2008). Corporate Entrepreneurship and Innovation, Entrepreneurial Development within Organizations, 2nd Edition' Thomson South-Western.
Mosakowski E (1998). Entrepreneurial resources, organizational choices, and competitive outcomes. Organ. Sci. 9(6):625-643.
Mullins LJ (2013). Management and Organisational Behaviour*,* 10th Edition, Pearson Education Ltd, Essex: London
Mullins LJ (2005). Management and Organisational Behaviour*,* 7th Edition, Pearson Education Ltd, Essex: London.
Normann R, Ramirez R (1993). From Value Chain to Value Constellation: Designing interactive strategy. Harvard Bus. Rev. pp. 65-77
Penrose E (1959). The Theory of the Growth of the Firm, Oxford University Press, Oxford.
Picken JC, Dess GG (1996). The Seven Traps of Strategic Planning November 1996. Inc.: pp. 99-103.
Piercy NF (2002). Research in marketing: teasing with trivia or risking relevance? Eur. J. Market. 36(3):350-363.
Prahalad CK, Hamel G (1989). "Strategic intent", Harvard Bus. Rev. pp. 63-76
Romer P (2007). 'Economic Growth', in David R. Henderson (ed.) Fortune Encyclopaedia of Economics. New York: Time Warner Books. Available at: http://www.stanford.edu/~promer/EconomicGrowth.pdf.
Sandada M, Pooe D, Dhurup M (2014). Strategic planning and its relationship with business performance among small and medium enterprises in South Africa, Int. Bus. Econ. Res. J. 13(3):659-670
Santos FM, Eisenhardt KM (2009). Constructing markets and shaping boundaries: Entrepreneurial power in nascent fields. Acad. Manage. J. 52(4):643-671.
Sarasvathy SD (2001). Effectual reasoning in Entrepreneurial decision making: Existence and Bounds. Acad. Manage. Proc. (1):D1-D6).
Scarborough NM (2014). Essentials of Entrepreneurship and Small

Business Management (7th ed.), Pearson Education, Inc.: Upper Saddle River, NJ.
Shane S (2000). Prior knowledge and the discovery of entrepreneurial opportunities. Organ. Sci. 11(4):448-469.
Shane S, Venkataraman S (2000). The promise of entrepreneurship as a field of research. Acad. Manage. Rev. 25(1):217-226.
Shumba V (2014). The journey towards productive entrepreneurship: A theoretical review of the entrepreneurial landscape in Zimbabwe. Int. J. Econ. Comm. Manage. 2(7):1-12.
Simba A (2013). 'The role of global R&D networks in generating social capital for born-global bio-tech firms: a multi-case approach,' Int. J. Entrepr. Small Bus. 20(3):342-362.
Smit HT, Trigeorgis L (2004). Quantifying the strategic option value of technology investments. Montreal: 8th Annual International Real Options Theory.
Singer S, Alpeza M, Balkic M (2009). Corporate Entrepreneurship: is entrepreneurial behaviour possible in a large company. In International Conference on Entrepreneurship and Innovation PODIM, March, 2009.
Stacey RD (1995). The science of complexity: An alternative perspective for strategic change processes. Strat. Manage. J. 16(6):477-495.
Teece DJ, Pisano G, Shuen A (1997). Dynamic capabilities and strategic management. Strat. Manage. J. 18(7):509-533.
Thompson JL (1999). A strategic perspective of entrepreneurship. Int. J. Entrepr. Behav. Res. 5(6):279-296.
Wiltbank R, Read S, Dew N, Sarasvathy SD (2009). Prediction and control under uncertainty: Outcomes in angel investing. J. Bus. Vent. 24(2):116-133.
Zahra SA, Covin JG (1995). Contextual influences on the corporate entrepreneurship-performance relationship: A longitudinal analysis. J. Bus. Vent. 10(1):43-58.

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