



Value creation in the African cement market: A model and validation

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ABSTRACT

Purpose of the study: This research sets out to develop a systems-thinking-based conceptual model that can be used by the cement service industry to market its products and services in Africa; to review the literature to identify available systems-thinking approaches that are used in the industry and to determine how they are used in the field of value engineering; and to identify the key challenges that prevent the diffusion of engineering products and services in Africa.

Design/methodology/approach: A descriptive narrative inquiry in the form of unstructured interviews with industry experts was conducted, together with a literature review, to validate and test the proposed model.

Findings: The research findings suggest that, in today's unforgiving economic climate and ever-changing business environment, characterised by globalisation and increased competitiveness, it is increasingly important for every cement manufacturer to streamline its processes, optimise its overall equipment effectiveness, and effectively implement tested cost-reduction methods to remain competitive in the market.

Recommendations: It is recommended for future research that this model be tested in a real market environment by a company operating in the African cement industry. The real market environment would test the model's stages for applicability, effectiveness, and reliability.

Managerial implications: The research in this study supports the use of the proposed model to penetrate the African market and to help managers who are servicing the cement industry to be successful in the region. As suggested by the findings from the literature review, the success of this model would ultimately be determined by management, who should communicate the clear goals and expectations of this model and supply employees with the resources needed to help the company to achieve its set goals.

Keywords

African cement market, Engineering services, Systems thinking, Value engineering.



JEL Classification: L21

1. INTRODUCTION

Concrete contributes up to 50 percent of all man-made goods produced globally, and the demand for cement is expected to increase substantially from 4.6 Gt/yr in 2015 to about 6 to 13.5 Gt/yr by 2050 (Schmidt *et al.*, 2018). The cement industry seems to be well-established in most regions of Africa, and the continent continually offers unexploited business opportunities for corporations, institutions, and entrepreneurs globally (Gekonge, 2013). The fast-growing population of Africa and its economies offer significant opportunities for organisations in a slowing global growth environment (Leke & Signe, 2019). Some of the world's fastest-growing economies are also found in Africa and are gaining interest from the economic community globally (Dana *et al.*, 2018). The economic outlook for the region is positive overall, as economic growth was expected to rise to 3.2 percent in 2019 and to 3.6 percent in 2020, according to date of the World Bank Group (Aykut & Blaszkiewicz-Schwartzman, 2018). The available literature indicated that businesses marketing engineering products and services in the African cement industry appear to lack a clear roadmap for developing their business in this region. Research by Meyer and Erasmus (2017) also indicated that these companies face a range of complex challenges when doing business in Africa. Each African region is unique, and so companies face different challenges depending on where they operate. Some of these challenges include the lack of a reliable energy supply, a lack of quality labour, unpredictable consumer behaviour, political instability, and increased market competition (Meyer & Erasmus, 2017).

Companies operating in the African region should not reinvent the wheel when doing business: this can waste valuable time and resources by deluding a company into thinking that it is moving forward when in reality, it is not. In 2019 alone, Africa faced major challenges, such as terrorism, flooding, the Ebola epidemic, conflicts in Libya and the DRC, rhino poaching, and tension between Uganda and Rwanda (Isilow, 2019). These challenges were unique to the continent, and so companies could not simply follow their European, American, or Asian sister companies but rather needed to adapt to their own environments. The lack of research in this field offers the opportunity to develop a process or model that could assist companies in operating in Africa without having to reinvent the wheel every time a new company opens its doors to the public.

The importance of cement in today's society – and especially in emerging markets such as Africa – makes this industry important for current and future research. Because each country

in Africa differs in economic size, growth rate, cement dependency, cement industry size, and challenges, companies end up reinventing the wheel when starting operations in the region. The unique and diverse nature of Africa raises the need for a systems model to assist businesses operating here. This research study intended to propose a model that an organisation operating in this region could use to market and sell its engineering products and services to companies in the cement industry.

The aim and purpose of this research study were to evaluate different systems-thinking approaches and to determine how they could add value to a company's engineering product and service offerings in the African cement market. The key objectives were:

1. To review the literature to identify available systems-thinking approaches that are used in the industry and to determine how they are used in the field of value engineering.
2. To develop a systems-thinking-based conceptual model that could be used by the industry to market its products and services in Africa.
3. To identify the key challenges that prevent the diffusion of engineering products and services in Africa.

These three primary research objectives yielded the following five subsidiary research questions:

1. How are systems thinking and value engineering described in the literature?
2. Is there a link between systems thinking and value engineering in the literature?
3. What engineering practices, as part of value engineering, are currently used in the industry?
4. In what ways is the diffusion of engineering products and services, as part of a systems-thinking approach, different in Africa when compared with other continents?
5. What challenges, as part of risk management planning in a systems-thinking approach, prevent the diffusion of engineering services in Africa?

After careful evaluation of the literature review and the interview findings through narrative inquiry, the authors summarised the three main new contributions of this research as follows:

1. A proposed new value-engineering-systems model has been developed for the African cement industry.

2. Narrative inquiry has been used to generate new data for the African cement industry. This new data includes the challenges associated with doing business in the African cement industry.
3. The African cement market is different in certain respects from the European and United States markets, as discovered from the literature review and the narrative inquiry.

2. LITERATURE REVIEW

A literature study was conducted to establish the current state of the cement market in Africa and to determine the market potential of the region. The literature study was also used to determine the linkage between systems thinking and value engineering in the literature.

As presented by Meyer and Pretorius (2021), systems thinking presents various viewpoints and concepts, many of which are very different from one another. Their research reviewed various literature sources and identified the following coherent definition that could be used. Systems thinking is, first, a perspective that recognises systems as a collection of various necessary and interrelated components in which the relationships between them are as important as the components themselves (Monat & Gannon, 2018). Second, systems thinking is a language that is centred on the iceberg model, which consists of system dynamics, emergence, causal loops, and unintended consequences (Monat & Gannon, 2015). Systems thinking is, last, a collection of tools comprising systemic root cause analysis, interpretive structural modelling, system dynamics/computer modelling, main chain infrastructures, behaviour-over-time graphs, stock and flow diagrams, causal loops with feedback, and delays and archetypes. With all these tools being available, it is apparent that systems thinking offers a great deal of value and power. Systems thinking can be used to solve complex problems that normally are not easily solved by the conventional approach of reductionist thinking, as systems thinking looks at the relationships between the system's components and the individual components. It creates a focus on the properties of the whole system, which are seen as being neither predictable nor attributable to the properties of each of its components. Systems thinking can be used to understand and explain dynamic non-linear behaviours such as inventory oscillations in the populations of predators and their prey and in supply chain management. It can also be used to understand complex socio-economic problems, predict behaviours, and identify leverage points. What makes systems thinking valuable for the model that is proposed in this study is that it can be used to understand and explain the illogical behaviours of countries, organisations, and individuals.

Value engineering is the process of improving the functionality of a project and creating cost savings throughout the complete product or service life cycle (Ibusuki & Kaminski, 2007).

While reassessing a project or design, a company ensures that all sensible alternatives have been identified. Scope statements and cost estimates are thoroughly checked, thus ensuring that nothing could have been underestimated or missed. Doing so ensures that the company obtains the best value over the life of the project or service. Value engineering creates quality and cost consciousness in the organisation and helps the company's employees to understand their functions better (Mandelbaum & Reed, 2006). Value engineering also assists management with the task-specific expenditure for the services and products under investigation. Quality is maintained at the required levels during value engineering: the quality will never be reduced as a result of cost reduction. Value engineering ultimately holds substantial potential for companies that are investigating the reduction of their service and product costs with a focus on targeting a unique market such as Africa.

The literature study revealed that there are very few or no linkages between systems thinking and value engineering in the literature. This distinct disconnect in the literature indicates that there could be an opportunity to combine both concepts. Doing so, and managing the risks through a good risk management tool, could have tremendous potential for an organisation that is focusing on expanding its business.

Meyer and Pretorius (2021) argued that the initial idea for this conceptual model came from the need for a process or model to assist with the diffusion of engineering products and services into the African cement industry. The authors of this research study found that there was no clear way to sell these market-specific products and services to the industry. Subsidiary research questions 1 and 2 formed the basis for the model, as described in Figure 1. The completed literature review indicated that there are very few or no links between systems thinking and value engineering in the available literature that looks at the African context. After completing a literature review in both fields, the realisation emerged that there were opportunities to combine models from both disciplines to benefit an organisation in respect of costs and marketing. Subsidiary research questions 3, 4, and 5 aimed to strengthen and defend the proposed model by using relevant market data gathered from interviews.

Given the unique market challenges and diverse market conditions in Africa, it is recommended that a micro-marketing strategy be implemented for individual markets. The considerable risks of doing business in Africa justified the use of a risk management tool in the proposed model. By implementing a causal loop policy structure diagram within the standard value engineering work plan, as displayed in Figure 1, an organisation could create a model with continuous feedback loops for information that could improve the product, service, logistical, and marketing costs when tailored to a specific market. Mapping the

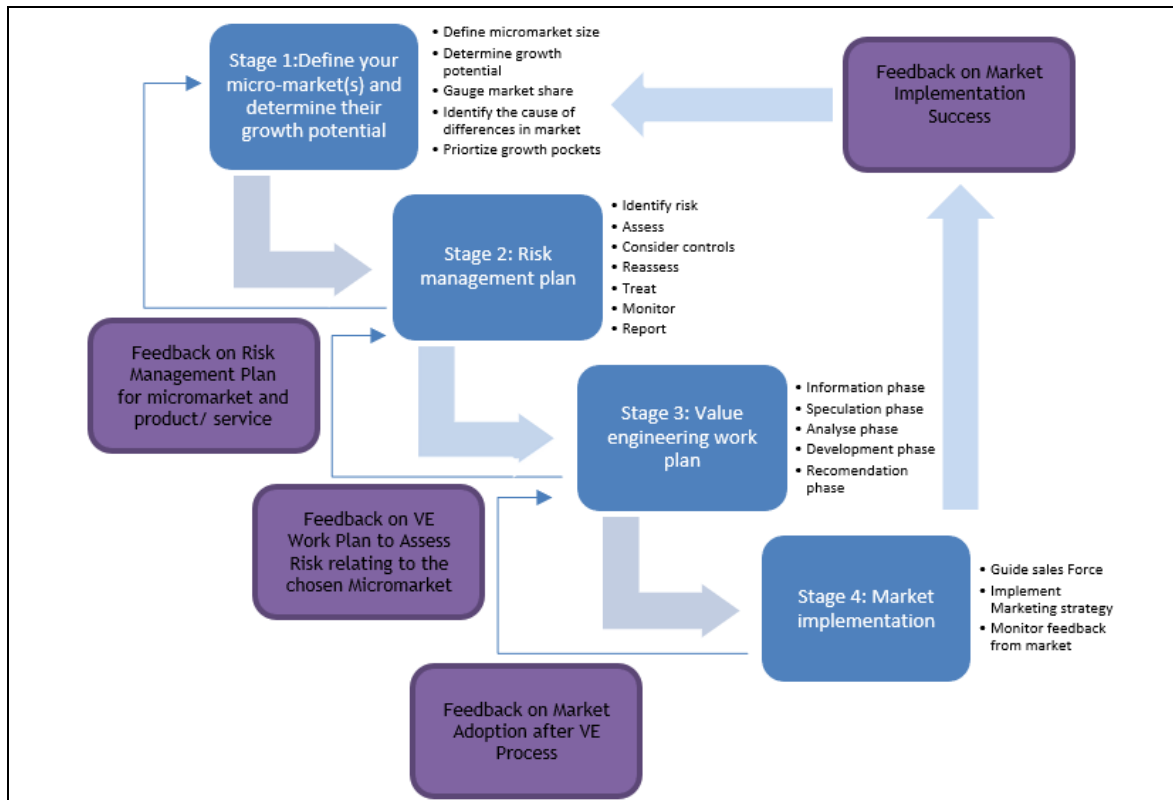
possible intended and unintended consequences of actions in the proposed causal loop diagrams could help users to anticipate and address various problems before they happen. This model would also take into account the unique challenges found in the African market.

This research identified the following benefits and advantages if the model were to be implemented:

- Adapting to market changes early on in the product/service life cycle.
- Reducing product and service costs, as the majority of African countries are cost-sensitive in respect of products and services.
- Cutting costs caused by rework, delays, and changes by using feedback loops.
- Reducing unproductive tension by reducing start-up delays and planning technical design and delivery.
- Providing guidance and practical advice from management to employees during the evaluation work plan process.
- Taking market factors into account during the value engineering process.
- Creating a more robust process owing to the real-world nature of the model.
- Producing a model for each unique product and service for selling into a specific market. This allows for tailored marketing strategies.
- Identifying market- and client-specific challenges early in the process, thus reducing organisational costs.
- Getting value for money by allocating the risks to a party that can manage them better.
- Providing an understanding of the target customers and markets.
- Reducing the risks associated with market uncertainty and complexity.
- Allowing for feedback monitoring from the market after business plan implementation.
- Using the process to take advantage of the proposed micro-market approach.
- Helping to identify markets that suit the organisation's objectives.

The unique nature of the proposed new value-engineering-systems model that focuses on the African market could have great benefits for the industry as a whole, and not just for the cement manufacturing industry. The proposed new value-engineering-systems model can be seen in Figure 1.

Figure 1: Proposed new value-engineering-systems model



Source: Author's own compilation

3. METHODOLOGY

This research used a descriptive narrative inquiry in the form of unstructured interviews as the method to validate the proposed model shown in Figure 1. A narrative inquiry is a form of qualitative research in which the stories themselves become the raw data (Butina, 2015). This research design is mainly used to investigate individuals or groups in an organisation, group, or community. This research type has the advantage that a detailed analysis of a few cases can be generated, and the interviewer has the freedom to choose what information is relevant and what can be presented. This research approach has been used in various disciplines to learn more about the lifestyle, identity, culture, and historical experiences of the narrator. A thesis completed by Long (2016) and Amaladas (2004) successfully used narrative inquiries as their primary research instruments. The current research paper used narrative inquiry to explore the experiences of people through personal narratives. Narrative inquiry is also the research approach of which Author 1 has the most knowledge and the most experience, which was another reason to select this approach.

All the interviews in this research were conducted with identified key cement manufacturers in the African market. The eight interview questions were uniquely constructed to identify the

potential needs of the cement manufacturers' customers and to identify the potential shortcomings of the suppliers servicing these customers. These questions were also constructed to assist with the validation of the proposed new value-engineering-systems model that would assist businesses in marketing their engineering products and services in the African cement market. Six open-ended interview questions were formulated to test the customers' needs, experiences, and challenges. All the interview questions are listed in Table 1, along with their reference to each subsidiary research question and the corresponding stage in the proposed new value-engineering-systems model.

Table 1: Subsidiary research questions linked to interview questions and to the proposed new value-engineering-systems model

Subsidiary research questions	Interview question	Proposed new value engineering systems model
1. How are systems thinking and value engineering described in the literature?	Literature review	Stages 1 – 4
2. Is there a link between systems thinking and value engineering in the literature?	Literature review	Stages 1 – 4
3. What engineering practices, as part of value engineering, are currently used in the industry?	1. How are your suppliers currently marketing their product and service offerings to you? Can you give me some examples?	Stage 1: Define your micro-markets and determine their growth potential. Stage 3: Value-engineering work plan Stage 4: Market implementation
3. What engineering practices, as part of value engineering, are currently used in the industry?	2. Do you see any way how your suppliers can improve the marketing of their product and service offerings to you? Can you give me some examples?	Stage 3: Value-engineering work plan Stage 4: Market implementation
4. In what ways is the diffusion of engineering products and services, as part of a systems-thinking approach, different in Africa when compared with other continents?	3. Have you worked in an industry in any country outside Africa? If yes, how do you see this market being different from Africa? How did the marketing practices used by suppliers operating in this country differ compared to the suppliers operating in Africa? Can you give me some examples?	Stage 4: Market implementation Feedback stages
3. What engineering practices, as part of value engineering, are currently used in the industry?	4. What key performance indicators do you use when evaluating the products and services of your suppliers? Please rank the performance indicators from most	Stage 3: Value-engineering work plan Stage 4: Market implementation

	important to least important.	
5. What challenges, as part of risk management planning in a systems approach, prevent the diffusion of engineering services in Africa?	5. What challenges do you think your suppliers face when delivering engineering products and services to your organisation? Please rank the perceived challenges from most important to least important.	Stage 2: Risk-management plan
5. What challenges, as part of risk-management planning in a systems approach, prevent the diffusion of engineering services in Africa?	6. What challenges do you face when doing business in your market area? Can you give me some examples?	Stage 2: Risk-management plan Stage 4: Market implementation
	7. Do you have any feedback or comments regarding this research study in general, or this questionnaire in particular?	
	8. In what industry are you operating (e.g., cement production, minerals processing...)?	

Source: Authors' own compilation

One employee was selected from each of the ten cement manufacturing companies operating in the five African regions. A study by Butina (2015) states that the sample size in qualitative research is not straightforward and that there are no rules for the correct sample size in such an inquiry. Butina (2015) also states that the sample size is ambiguous because it depends on the theoretical framework, the answers being sought, and the time, resources, and type of data to be collected. For this reason, the purpose of this study was to maximise the collection of information. The study also followed the approach of stopping the sampling once no new information was forthcoming. In this study, a minimum sample size was determined, and it was increased when necessary to reach redundancy.

It was decided to interview a minimum sample size of ten employees from the primary study industry of cement manufacturing companies and four from minerals processing plants operating in the same region. The minerals processing plant employees were interviewed as a control group to investigate the extent to which the cement and mineral industries differed in respect of their suppliers, needs, and challenges, with the purpose of adding overall value to this study. The cement manufacturing companies used in the interviews were all different in size, business strategy, and geographic location. They also had a very good coverage: 86 percent of the African continent. The author of this research strongly believed that this diversity would benefit this study, as it should appropriately represent a large portion of the cement manufacturing industry in Africa. It was intended to add value to the study by interviewing respondents who actively interact with external service providers and who

influence maintenance activities at the plants. The interviewed respondents were functioning in a management position with high-level roles of decision-making as part of their job description.

4. FINDINGS AND DISCUSSION

After the findings from the first interview question had been summarised narratively, it was decided to follow a more structured approach to analysing the data, owing to the volume of information collected from each respondent. To simplify the data analysis, identifying the codes was assigned to the interview findings, and ATLAS.ti was used to analyse the data through text analysis. ATLAS.ti is a workbench for the qualitative analysis of large bodies of textual, graphical, audio, and video data. It has a set of sophisticated tools to help arrange, reassemble, and manage the research material in creative yet structured ways. The software is also used to perform qualitative content and text analyses, which focus on using codes and developing a coding system (Kuckartz, 2019). The codes selected for the content or text analysis are of crucial importance for effective research, as the codes contain the substance of the investigation (Kuckartz, 2019). The ATLAS.ti software does not assist the researcher with choosing and naming the codes, as this is determined by the researchers' methodological knowledge and their thoughts on how they want to approach the analyses (ATLAS.ti, 2013). The codes are the objects used to label segments in the collected data and can be a theme, category, attribute, property, sub-code, or dimension. The method of analysis is discussed in more detail in the next section.

Text analysis is how a researcher gathers information about how humans make sense of the world. It is also a methodology or data-gathering process for researchers who seek to understand the ways in which members of different cultures make sense of who they are and how they fit into the world they live in (Alan, 2003).

The codes extracted from ATLAS.ti can be found in simplified Table 2. The raw data from the interviews was also extracted from ATLAS.ti and can be found in Appendix 6. The tabulated reports were analysed to see which codes were received most frequently and which were least frequently. Based on this information, the codes could be ranked according to code frequency and analysed to find the emerging patterns and establish the findings. For example, from analysing the findings from interview question 1, as shown in Table 2, it can be seen that four codes emerged with the greatest frequency:

- The 'face-to-face' interaction code frequency was 10 for cement producers and 4 for minerals customers.

- The 'e-mail correspondence' code frequency was 6 for cement producers and 1 for minerals customers.
- The 'give on-site product presentations' code frequency was 4 for cement producers and 3 for minerals customers.
- The 'share brochures, catalogues, and presentations via e-mail' code frequency was 4 for cement producers and 1 for minerals customers.

The first research question was then interpreted and summarised by using these top four codes, ranked according to importance. All of the other interview questions were answered in a similar way by using their unique ATLAS.ti tabulated data and then summarised it according to their observed ranked code frequency.

In addition, this research linked different concepts found in the proposed new model, seen in Figure 1, to the top-ranked codes. This was done to build confidence in the model and to link the research questions better to it. As shown in Table 2, this research linked the following codes to these model concepts:

- Face-to-face interaction as a market implementation tool was linked to market implementation in Stage 4.
- E-mail correspondence as a value-creating tool was linked to value engineering in Stage 3.
- On-site product presentation also creates value and so was linked to value engineering in Stage 3.
- Sharing brochures, catalogues, and presentations via e-mail helps to determine the growth potential for a market, and so this code was linked to micro-market analysis in Stage 1.

This text analysis and additional bibliometrics (which are discussed later) were used to give the qualitative analysis some confidence-building and triangulation support. An example of the analysed interview findings can be seen in Table 2.

Table 2: ATLAS.ti data for interview question 1

Question 1	Resp.A	Resp.B	Resp.C	Resp. cont.	Total cem.	Grand total	Model concept
Face-to-face interaction	1	1	1	...	10	14	Stage 4: Market implementation
E-mail correspondence	1	1	1	...	6	7	Stage 3: Value engineering
Give on-site presentation	0	1	1	...	4	7	Stage 3: Value engineering
Share brochures, catalogues, etc.	1	1	0	...	4	5	Stage 1: Micro-market analysis
Continued...	1	1	
Totals	3	7	4	4			

Source: Authors' own compilation

This research also used bibliometrics and some basic statistics as additional exploratory research to support the narrative results. The exploratory bibliometric research was intended to be qualitative in nature, not fully representative statistically. From the bibliometric study, this research found 15 additional articles for 'industrial organisations' with the codes 'performance' OR 'risk' OR 'value' counted in each paper; and, according to bibliometric assumptions, the word or code count is considered in some sense proportional to the impact that was considered by the authors of that paper. The code count for the three codes found in the 15 articles was then tabulated in Table 3.

Table 3: Code counts in articles

Time span	Case no.	Performance	Risk	Value
2019 to 2021	1	20	1	5
	2	2	97	4
	3	21	2	12
	4	1	15	7
	5	24	5	70
	6	2	1	20
	7	3	79	3

	8	6	2	9
	9	9	2	81
	10	98	0	19
	11	10	12	136
	12	98	3	39
	13	4	0	132
	14	14	15	11
	15	64	1	25

Source: Authors' own compilation

These code counts were then also converted into logarithmic scales in order to explore possible relationships between the variables in more detail. Table 4 shows the code counts converted to logarithmic scales.

Table 4: Logarithmic scales of code counts

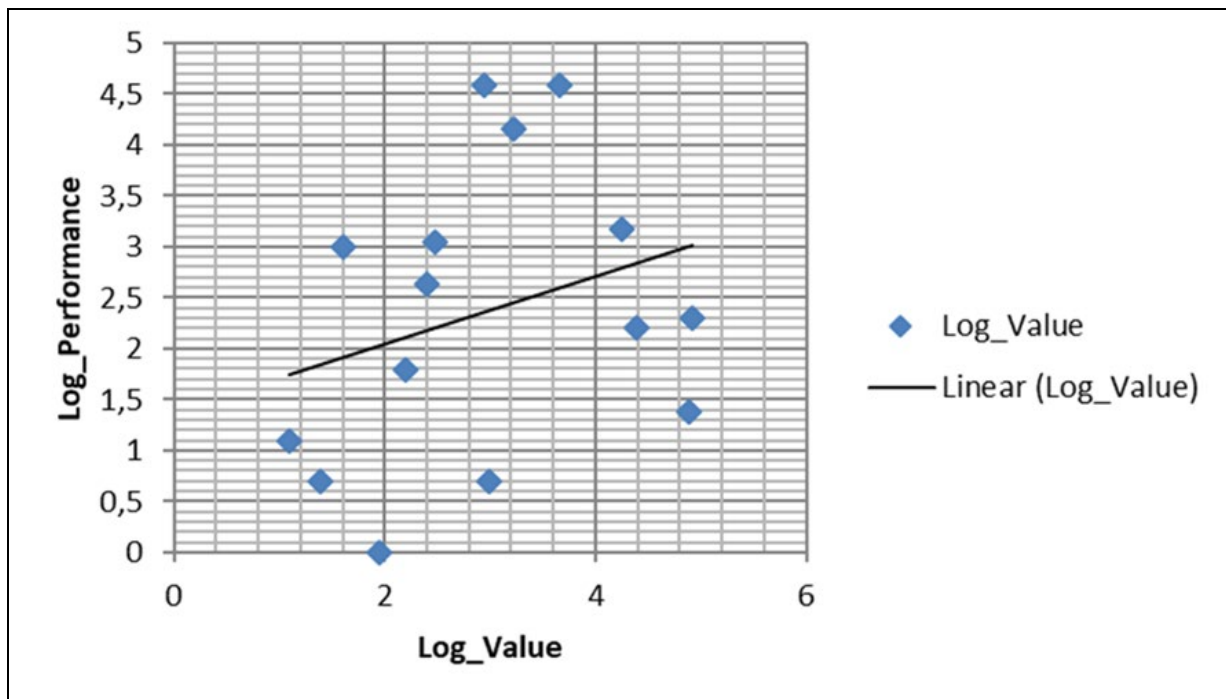
Time span	Case no.	Log_Performance	Log_Risk	Log_Value
2019 to 2021	1	2,995732274	0	1,609437912
	2	0,693147181	4,574710979	1,386294361
	3	3,044522438	0,693147181	2,48490665
	4	0	2,708050201	1,945910149
	5	3,17805383	1,609437912	4,248495242
	6	0,693147181	0	2,995732274
	7	1,098612289	4,369447852	1,098612289
	8	1,791759469	0,693147181	2,197224577
	9	2,197224577	0,693147181	4,394449155
	10	4,584967479	0	2,944438979
	11	2,302585093	2,48490665	4,912654886
	12	4,584967479	1,098612289	3,663561646
	13	1,386294361	0	4,882801923

	14	2,63905733	2,708050201	2,397895273
	15	4,158883083	0	3,218875825

Source: Authors' own compilation

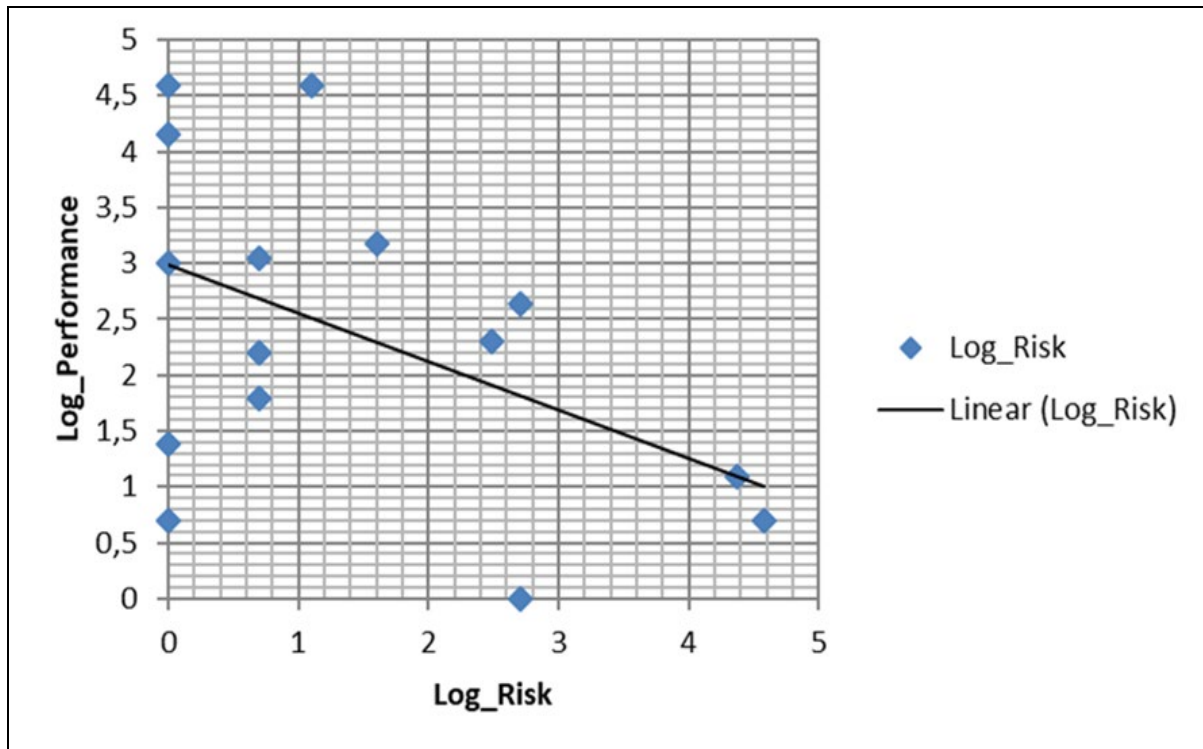
The logarithmic scales were used to construct three graphs to test whether there were any possible approximations to relationships between the codes' performance, value, and risk, as found in the 15 articles. The three resulting graphs are a Log_Performance vs Log_Value graph, a Log_Performance vs Log_Risk graph, and a Log_Value vs Log_Risk graph. This can be found in Figure 2 to Figure 4. A linear approximation in Excel was used to indicate possible relationships, and these are indicated by a line in each graph.

Figure 2: Log_Performance vs Log_Value graph



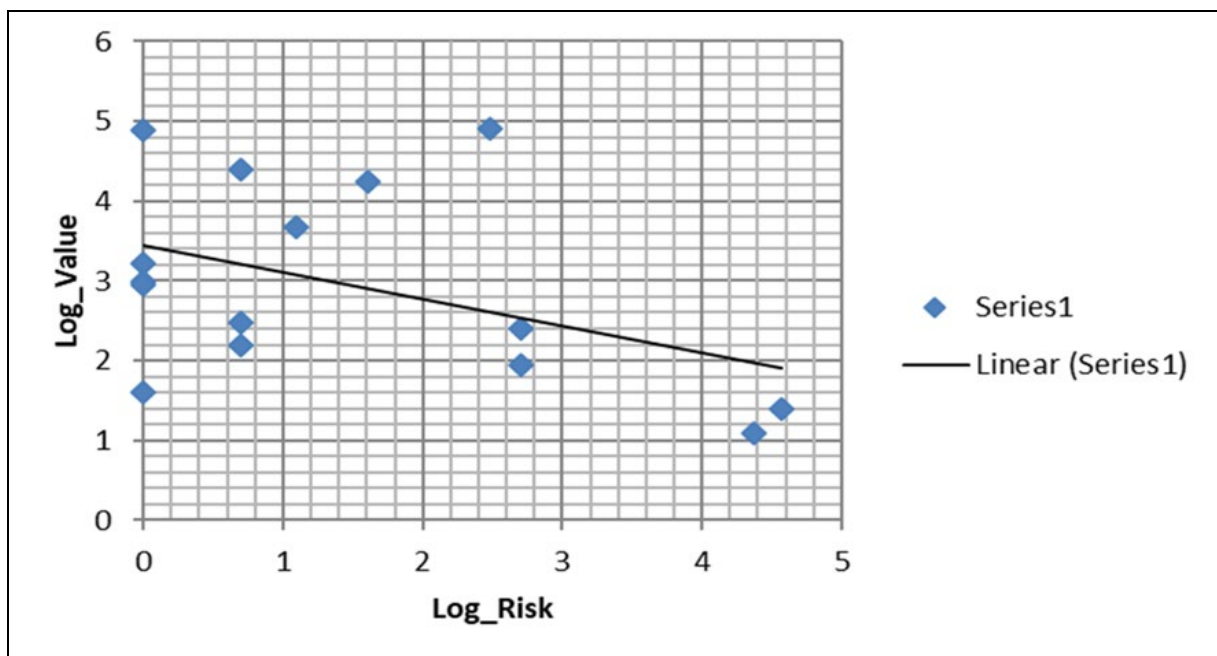
Source: Authors' own compilation

Figure 3: Log_Performance vs Log_Risk graph



Source: Authors' own compilation

Figure 4: Log_Value vs Log_Risk graph



Source: Authors' own compilation

The three graphs indicate that there is a possible (linear) approximation between performance, value, and risk, thus indicating some relationship between the variables. In

Figure 2, there is a direct relationship between performance and value; thus, as the performance of a product or service increases, the value also increases. For Figure 3, there is an inverse relationship between performance and risk: as the performance of the product or service decreases, so the associated risk increases. And finally, in Figure 4, there is also an inverse relationship between value and risk: as the value of a product or service decreases, so the associated risk increases. These are only approximations that indicate some relationship gained from the exploratory bibliometrics and – as indicated from the narrative enquiries – also support to some extent the relationships proposed in the new concept model.

In this paper, the researchers analysed the code frequencies for each interview question, linked the most important codes to stages in the proposed model, and conducted additional bibliometrics together with some basic statistics to support the narrative results. This research further established the interview findings, together with the similarities between the cement industry and the minerals industry in the African context. Some similarities were visible between these industries, as were some indications that each industry operates in its own unique way.

The researchers attempted as far as possible to use previous references on data quality so that the data collected for the interviews represented the investigated cement market well. It was especially important that the respondents were skilled individuals in management positions with sufficient working experience in the cement industry. The open-ended nature of the questions also helped to produce more diverse feedback from the respondents. Some interviews were concluded with a form of ‘small talk’, with a more relaxed mood than in the more formal interview process, which also helped with the conceptualisation of the respondents’ accounts.

The findings from the bibliometric analysis that were fed back into the research in a semi-quantitative manner reinforced what was found in the literature review and the interview data and built even more confidence in the proposed new qualitative model. The bibliometric research conducted for the three codes – performance, risk, and value – also supported the stages in the proposed model for risk management, value engineering, and market implementation.

This research study gives valuable insight into the current situation in the African cement industry and how it varies from available academic knowledge or research. The research fields of systems thinking and value engineering have been combined in a new proposed model to develop and assist organisational business operations in the African cement

industry. This model has been established from the industry experience and action research of the author of this research and from the opportunities presented in the literature. Qualitative research was conducted to create confidence in the new proposed model and to provide triangulation support for it.

5. CONCLUSION

This research set out to develop a systems-thinking conceptual model that could be used by the industry to market its products and services in Africa. This research has proposed that the new value-engineering-systems model be used to address the market challenges identified in the literature review and the interview findings. The literature review identified a knowledge gap in which systems thinking and value engineering are not used in combination to improve businesses operating in the African cement market. The unique and diverse nature of the African market motivates the need for a micro-market approach that targets regions individually with the aim of tailoring the company's business plan to that region's demographic. The theoretical model incorporates a risk-management plan to address the unique regional challenges identified in this study. A business plan is nothing if a company does not have a go-to-market approach, which was introduced in the final market implementation stage. The narrative inquiry findings were linked to various stages in the proposed model and strengthened its application in the real world. Finally, the text analysis and the bibliometrics were used to give confidence-building and triangulation support to the qualitative analysis and also supported the proposed model by validating the findings and supporting the model's stages.

The research in this study supports the use of the proposed model to penetrate the African market and to help managers who are servicing the cement industry to be successful in the region. Only through systemic thinking can one achieve sustainability and success in approaching the African market. The successful implementation of a sustainable strategy as has been proposed, requires a clear, stakeholder-oriented approach, followed by the proper planning and implementation of the model. As suggested by the findings from the literature review, the success of this model is ultimately determined by management, who should communicate the clear goals and expectations of this model and supply employees with the resources needed to help the company to achieve its set goals. Finally, the feedback from the respondents' interviews was that they believed that this was a valuable research subject, as it could give the industry valuable insights. The respondents said that they would like to be sent the findings of this research study, as they believed that it would be interesting for their businesses and give them valuable insights.

The additional research contributions, together with the answers to the research questions that were used to answer the five subsidiary research questions listed previously, are listed in Table 5.

Table 5: Summary of research findings

Subsidiary research questions	Summary of research findings
1. How are systems thinking and value engineering described in the literature?	<ol style="list-style-type: none"> 1. An abundant amount of literature is available for the fields of both systems thinking and value engineering, as discussed and interpreted in the cement context in the literature review. 2. Complex systems can exhibit intelligent behaviour by using interaction and feedback within the system; and this is the main building concept for the new proposed model, using systems thinking and concepts identified from the literature.
2. Is there a link between systems thinking and value engineering in the literature?	<ol style="list-style-type: none"> 1. Few or no links seem to be formally established between systems thinking and value engineering in the literature pertaining to organisations, especially in the African cement industry. 2. The literature review indicates that both systems thinking and value engineering hold benefits for organisations operating in the African cement industry. 3. This research indicates, through a narrative inquiry, that there could be a benefit for organisations by combining both fields of research – that is, systems thinking and value engineering. 4. This research combines both research fields with the aim of benefiting organisations serving the African cement industry. 5. This research develops a new proposed value-engineering-systems model that is validated to some extent and is designed to promote and strengthen the use and sales growth of engineering products and services in the African cement industry.
3. What engineering practices as part of value engineering are currently used in the industry?	<ol style="list-style-type: none"> 1. This research adds to the body of academic knowledge for the African cement industry as a whole. 2. The most popular marketing practices used in the cement industry are face-to-face customer interaction, e-mail correspondence between suppliers and customers, giving on-site customer presentations on products and services, and suppliers sharing brochures, catalogues, and presentations via e-mail, as verified through the narrative research. 3. The most appropriate areas in which suppliers could add value to the marketing of their products and services to the customer are to develop good quality websites, improve their pricing of products and services, get reference plants to showcase products and services, and demonstrate their products and services on-site in front of the customer, as verified through the narrative research. 4. The ranked key performance indicators from ‘most important’ to ‘least important’ that customers used to evaluate suppliers’ products and services include the cost, quality, delivery time, and reliability of products and services, as verified through the narrative research.
4. How are the	<ol style="list-style-type: none"> 1. The research indicates that, compared with the US and Europe, original equipment

<p>diffusion of engineering products and services as part of a systems-thinking approach different in Africa, compared with other continents?</p>	<p>manufacturers (OEMs) are not readily available in Africa; the OEM suppliers are also closer to plants in Europe and the US than in Africa. Skilled managers and artisans are available in the US or Europe, unlike in Africa, where these resources are not readily available.</p> <ol style="list-style-type: none"> 2. Europe also has a very strong and established cement manufacturing base compared with Africa; and this young supplier base in Africa makes it difficult to gain access to certain remote customers. 3. Europe focuses on giving free-of-charge services to clients, such as inspections, lubrication, and reporting, with the aim of getting to know the customers' equipment and gaining additional business. 4. The cement and minerals industries seem to be quite diverse, as they have very few challenges in common other than delivery times between suppliers and these two industries.
<p>5. What challenges as part of risk-management planning in a systems approach prevent the diffusion of engineering services in Africa?</p>	<ol style="list-style-type: none"> 1. Cement producers face the following challenges when doing business in their markets: the operational and selling costs of their products are too high; increased market competition is created by existing and new entrants into the market and by competition from 'grey' imported cement, as verified through the narrative research. 2. The findings indicate a wide range of challenges experienced by both cement and minerals markets, with only costs and increased market competition as common challenges. It seems that each industry has a unique set of challenges, as verified through the narrative research. 3. This research identified the challenges that cement manufacturers and product and service providers to this industry experience in the African cement industry, and so added to the available body of knowledge.

Source: Authors' own compilation

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