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Micro-economic drivers of the South African foundry industry

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Background: The foundry industry plays an important economic role in South Africa and all efforts should be made to sustain the industry. However, the problem is that many foundries are closing down due to economic factors.

Aim: The primary research objective was to identify from literature the micro-economic drivers applicable to the sustainable competitive advantage (SCA) of foundries in South Africa. The secondary objectives were to benchmark the perceptions of stakeholders in the most prominent micro-economic drivers identified from literature.

Setting: With micro-economic drivers identified, management can then compile a SCA strategy to retain the industry. Foundry representatives from foundries located in all nine provinces of South Africa were invited to participate in the study.

Method: An explanatory sequential mixed-methods approach was followed by first employing a quantitative approach, followed by a qualitative approach to identify the most prominent micro-economic drivers. Descriptive data analysis was utilised for the quantitative data and thematic analysis was utilised for the qualitative phase.

Results: It was found that the most prominent micro-economic drivers are product quality, the ability to innovate, employees' skills development, and investment in plant infrastructure.

Conclusion and contribution: The article contributes towards the deficiency in literature by presenting the most prominent micro-economic drivers for the South African foundry industry. The article also makes recommendations on SCA strategies for foundries in South Africa based on the four micro-economic drivers.

Keywords: South African foundry industry; sustainable competitive advantage; micro-economic drivers, explanatory sequential mixed-method, foundries closing down.

Background

The foundry industry operates on a globalised platform and offers numerous opportunities, but it also faces many challenges and associated risks, including price volatility and demand fluctuation (Ghadge et al. 2017). The problem, identified in a study reported on in this article, is the closing down of numerous foundries in South Africa. Literature states that the metal casting foundries in South Africa are closing because of circumstances on micro- and macro-economic levels (Andreoni, Kaziboni & Roberts 2021; Lochner et al. 2020; Mkansi, Nel & Marnewick 2018; South African Institute of Foundrymen [SAIF] 2020; The dtic 2021). The closing down of foundries threatens economic growth, direct and indirect employment and it also negatively affects raw material (casting) supply to original equipment manufacturers (OEMs) in South Africa.

The foundry industry in South Africa reduced from 450 foundries in the 1980s to 170 foundries in 2014 (Mulaba-Bafubiandi, Mageza & Varachia 2016). The industry shrank further from 167 foundries in 2018 (Mkansi et al. 2018) to 123 in 2020 (Lochner et al. 2020). The main reason for the closing down of foundries is the lack of competitiveness, compared to their international counterparts, and failure to overcome the macro- and micro-economic challenges facing the industry (The dtic 2021).

It is envisaged that a sustainable competitive advantage (SCA) could mitigate the risk of the closing down of foundries; however, in-depth research is still invited (Rohdin, Thollander & Solding 2007). Also, Haseeb et al. (2019) and Cicea et al. (2019) support the need for research on challenges on micro- and macro-levels to enhance organisations' ability to gain SCA. The study reported on in this article aims to address this problem by first identifying the key micro-economic drivers that enhance SCA. With micro-economic, or internal drivers identified, foundries would be able to enhance SCA and to prevent possible closures. As a delimitation, the macro-economic drivers will not be addressed in this article.

Hence, the primary research object is to identify from literature, the micro-economic drivers applicable to the SCA of foundries in South Africa. The secondary objectives are to benchmark the perceptions of stakeholders within the foundry industry on SCA against the most prominent micro-economic drivers identified from literature. Finally, recommendations will be made on SCA strategies for foundries in South Africa to possibly mitigate the closing down of foundry plants.

Literature review

The literature review provides background on the foundry industry, SCA and micro-economic drivers.

Foundry industry

According to Treyger (2005:1), the metal casting process 'involves the pouring of molten metal into a mould that contains a cavity of the desired shape'. The World Foundry Organisation (WFO) (2018) states that the foundry industry in South Africa comprises industries that deal with ferrous castings (steel and iron), non-ferrous castings (brass, aluminium and zinc), investment castings, as well as high pressure die castings. Three major sectors in South Africa consume the majority of the foundry output, namely the automotive, manufacturing and mining sectors (SAIF 2020; WFO 2018). The foundry industry in South Africa serves the following industries in the respective proportions: mining (32%), automotive (25%), manufacturing (24%), railways (9%), agriculture (3%), infrastructure (2%) and other (5%) (SAIF 2020; The dtic 2021). The foundry industry is of strategic importance as it creates employment to over 14 250 unskilled, semi-skilled and skilled people (SAIF 2020).

Over the past two decades (post 2000), the foundry industry had a significant influence on the development of many economies globally, while the metal casting industry is integral to all the world's manufacturing activities (Andreoni et al. 2021). As the foundry industry also plays an important role in the South African economy, contributing largely towards the country's gross domestic product (GDP) (SAIF 2020), it is important to sustain the industry (Lochner et al. 2020). Therefore, this article aims to shed light on the importance of the industry by the identification of micro-economic factors and how to achieve a SCA.

Sustainable competitive advantage

Sustainable competitive advantage is usually associated with profitability, efficiency and productivity (Trnkova & Kroupova 2021). Parola et al. (2017:4) argue that although the concepts of competitiveness and competitive advantage have been widely used, interchangeably, to refer to the ability of firms to outsmart rivals, the concepts have also been used to refer to 'rivalry among nations' (Porter 1985) and 'business ecosystems' (Mäntymäki & Salmela 2017). Sustainable competitive advantage relates to an organisation's ability to carry out the set of necessary steps for achieving lower costs than the competition, in an efficient and unique way, creating differentiated value for buyers (Porter 1985:20).

Since Porter's (1985) definition, many authors presented definitions of SCA, including Barney (1991:102); Hoffmann (2000) and Barney and Clark (2007:77). The authors of this article compiled a combined definition from literature as:

> [*A*] pro-business superiority strategy that allows a company to out-compete rivals by offering goods and/or services to customers in a manner that is difficult to replicate within the same window period of incessant advantage. (p. 36)

Since the introduction of Porter's viewpoint on SCA, contemporary theoretical views developed after 2000, namely the resource-based view (RBV), the market-based view (MBV), the knowledge-based view (KBV), the relational view (RV) and the capability-based view (CBV).

Resource-based view depicts an organisation as a collection of various resources put together for the benefit of the organisation (Wang 2014). These unique resources then provide the organisation with an advantage over rivals by means of knowledge, brand equity, cohesive leadership, strong patents, trade secrets, capabilities and innovation (Assensoh-Kodua 2019; Wang 2014).

The MBV states that an organisation's performance is primarily determined by the industry and external market factors (Wang 2014). Hence, the organisation's sources of market power play a crucial role in determining its relative performance within the industry. An organisation's competitive advantage can be attributed to how it is viewed by the market and industry in which it operates and also its ability to take advantage of entry barriers that keep other firms at bay and, therefore, protect profit margins (Kaningu, Warue & Munga 2017).

The KBV emphasises that organisational knowledge of strategy is the most important antecedent of the organisations' performance, innovativeness, and competitiveness (Cooper et al. 2020). Organisations that are able to create, capture and distribute knowledge more effectively than the competition, position themselves to outperform the rivals (Rezaee & Jafari 2016).

The RV, originally developed by Dyer and Singh (1998) states that the networking and strategic relationships between organisations is crucial in the creation of a SCA. These dynamic networks and relationships enable organisations to keep rivals from capitalising on existing profitable market shares.

The CBV emphasises that the capabilities of organisations provide their SCA. An organisation should identify its crucial capabilities and position these capabilities strategically to achieve market share. These capabilities might include marketing, innovation, human, financial and managerial capabilities (Gimez et al. 2019).

In order to achieve SCA, organisations should identify the most important micro-economic drivers. Management provides control over micro-economic drivers, and with these drivers identified, management can then achieve SCA.

Micro-economic drivers

Micro-drivers refer to the drivers within organisational control (Krajnakova, Navickas & Kontautiene 2018), while macro-drivers refer to those elements outside the control of organisations (Cepel et al. 2019). Hence, micro-economic factors relate to the factors internal to the organisation which determine its strengths, weaknesses and responses to threats and opportunities; and management has direct control over these factors (Krajnakova et al. 2018). Further, Porter et al. (2008) state that micro-drivers act directly in the firms, thereby affecting productivity and profitability levels. With micro-economic drivers identified, SCA strategies might be designed to take control of the drivers that might improve the sustainability of the foundry industry.

TABLE 1: Micro-economic drivers as identified in literature.

Number	Micro driver	Authors
1	Investment in plant infrastructure	(Pagone, Jolly & Salonitis 2016; Parola et al. 2017; Mkansi et al. 2018)
2	Cluster membership (e.g. South African Institute of Foundries)	(Osarenkhoe & Fjellström 2017)
3	Employees' skills development (human capital)	(Hamadamin & Atan 2019)
4	Product (service) differentiation	(Putra 2018)
5	Organisational culture	(Alina, Cerasela & Raluca-Andreea 2018)
6	Governance	(Madhani 2016)
7	Price competitiveness	(Porter 1985; Putra 2018)
8	Product quality	(Aiginger, Bärenthaler-Sieber & Vogel 2013; Brancati et al. 2018)
9	Ability to innovate (research and development)	(Pietrewicz 2019; Porter 1985)
10	Technology (equipment) upgrade	(Pietrewicz 2019; Putra 2018)
11	Production (raw material input) costs	(Brancati et al. 2018; Mohamed, Ndiya & Ogada 2019)
12	Firm capacity (size)	(Gimenez, Madrid-Guijarro & Durendez 2019; Kaleka & Morgan 2017)
13	Exposure to export market (degree of internationalisation)	(Hamadamin & Atan 2019; Mohamed et al. 2019)
14	Socio-cultural responsibility (corporate social investment)	(Areiqat et al. 2019; Jamali & Karam 2016; Zhao et al. 2019)
15	Certifications (ISO standards, product certifications)	(Kaleka & Morgan 2017; Su, Dhanorkar & Linderman 2015)
16	Possession of intellectual property	(Jamali & Karam 2016; Teixeira & Ferreira 2019)
17	Managerial choice (decision-making process)	(Putra 2018)
18	Bargaining power over suppliers	(Bruijl 2018; Porter 1985)
19	Possession of unique resources (inimitable to competition)	(Madhani 2016)
20	Value-added for the customer	(Aiginger et al. 2013; Brancati et al. 2018)

For the purpose of this article, an exercise of a systematic literature review (SLR) was undertaken to identify the micro-economic drivers affecting the organisation's business environment. A total of 20 micro-economic drivers were identified from literature (Table 1). Table 1 provides a summary of the micro-economic drivers affecting local and global foundries.

These micro-economic drivers cover a wide range of factors, ranging from employees' skills development, investment in infrastructure, organisational culture and governance, production, value to customer, bargaining power with suppliers and more (Table 1). It was deemed important by the researchers to classify these micro-economic drivers into categories for a more logical presentation that might possibly enhance SCA. An applicable classification approach was identified in literature from the study of Siudek and Zawojska (2014).

Siudek and Zawojska (2014) classify SCA drivers into five categories, namely: (1) assets (resources); (2) processes; (3) firm's performance; (4) supporting and related industries and clusters, as well as (5) institutions and government policies. The identified micro-economic drivers were then classified into five categories (Siudek & Zawojska 2014) (Table 2).

These five categories, with the applicable subsections (Table 2), were then tested through descriptive statistics in order to secure statistical validity and reliability. The research method is discussed in the next section.

TABLE 2: Sustainable competitive-advantage classification of micro-economic drivers.

SCA classification	Micro-economic drivers
Assets/resources	1. Employees' skills development (human capital)
	2. Embracing new technology
	3. Firm capacity (size)
	4. Investment in infrastructure
	5. Possession of intellectual property
	6. Possession of unique resources (inimitable to competition)
	7. Socio-cultural responsibility (corporate social investment)
Processes	8. Ability to innovate (research and development)
	9. Bargaining power over suppliers
	10. Managerial choice (decision-making process)
	11. Exposure to export market (degree of internationalisation)
	12. Product quality
Firm's performance	13. Organisational culture
	14. Governance
	15. Price competitiveness
	16. Production (raw material input) costs
	17. Product (service) differentiation
	18. Value-added for customer
Supporting and related industries and clusters	19. Cluster membership
Institutions and government policies	20. Certifications (ISO standards, product certification)

Source: Adapted from Siudek, T. & Zawojska, A., 2014, 'Competitiveness in the economic concepts, theories and empirical research', *Scientiarum Polonorum: Oeconomia* 13(1), 91–108
SCA, sustainable competitive advantage.

Assets and resources mainly refer to the assets of the organisation, especially human resources, technology, intellectual capacity, the organisation's capacity and the firms contribution to socio-cultural responsibilities (Table 2). Processes refer to the ability to innovate processes, bargaining power, managerial ability, the quality of products and access to markets (Table 2). The organisation's performance refers to the organisational culture, good governance, price competitiveness and product services, as well as value-added services to the customer. Support and related industries and clusters refer to cluster membership that enhances networking potential and finally, institutions and government policies refer to the certification such as ISO accreditation and product certification (Table 2).

Research method

The research reported on in this article aims to primarily contribute towards the body of knowledge through the identification of micro-drivers from literature that can be used to enhance the SCA of the foundry industry in South Africa. These micro-drivers were then tested (descriptive statistics and thematic analysis) in order to identify the most prominent micro-drivers as identified by industry experts. Finally, recommendations are made on how to mitigate the challenge of foundry closures through SCA recommendations.

An explanatory sequential mixed methods approach was followed (Creswell & Creswell 2018). The explanatory sequential mixed-methods design employs an initial quantitative phase of data collection and analysis, which is followed by a qualitative data collection and analysis phase, with the aim of integrating or linking the data from the two separate strands of data. Through the explanatory sequential mixed-method design, the qualitative data can be utilised to obtain explanations from the quantitative phase in order to better understand the phenomenon (Creswell & Creswell 2018).

The mixed-method approach enables researchers to produce a more significant contribution towards the field of study and to secure more validity (Bowen, Rose & Pilkington 2017). Further, the mixed-method approach was followed because of five justifications for combining both qualitative and quantitative methods which include (1) triangulation; (2) complementarity; (3) development; (4) initiation; and (5) expansion (Bryman & Cramer, 2012). Triangulation refers to the use of different approaches to provide a better understanding of a given phenomenon (Turner, Cardinal & Burton 2015); thereby enhancing the mutual corroboration of the findings (Schoonenboom & Johnson 2017) and increasing the credibility of the study.

First a quantitative phase was introduced, followed by a qualitative phase. The research method followed the steps proposed by Bordeianu and Morosan-Danila (2013), that include the following:

Step 1: Determination of the purpose of the study

The first step determined the limitation and delimitation of the study, as well as the target population. The study aimed to determine the micro-economic factors for the closing down of foundries in South Africa. This was followed by the prioritisation of these micro-economic factors.

Step 2: Reviewing existing literature

Secondly, a comprehensive literature review, followed by evaluating existing literature, regarding the micro-economic drivers of SCA in the foundry industry, was carried out. In this phase the research instruments to be utilised for testing the micro-economic drivers in the foundry industry were evaluated. A theoretical framework followed that and depicted the micro-economic drivers in the South African foundry industry (Table 1 followed by Table 2).

Step 3: Generating the research instrument

The third step considered the instrumental items, sequencing, format and method of administration for the research to be suitable for the research population. The population comprised the employees of foundry companies in South Africa and therefore questions were framed in a language and terminology understood by the industry representatives.

Step 4: Content validity evaluation

The opinion of industry experts was sought for the validation of the research instrument, and to confirm whether the instrument addressed the specific research objectives (Malmqvist et al. 2019). Hence, the items in the questionnaire were guided by the drivers identified in literature, as well as discussions conducted with industry experts.

Step 5: Pilot testing of the research instrument

The questionnaire comprised six areas, including the respondents' demographic variables; ratings on the importance of micro-drivers; the identification of three critical micro-drivers; the ranking of the impact of competitive forces on SCA; the ranking of business competitiveness approaches to SCA; and suggestions on measures to improve SCA. The pilot test according to Kumar (2011) helps streamline processes and procedures in preparation for the main study.

Step 6: Construct validity evaluation

The sixth step comprised construct validity and evaluation which, according to Slavec and Drnovsek (2012), relate to the scale's ability to measure correctly. To achieve validity, the researcher uses alternative measures of a concept and correlates them with a summated scale in order to determine whether the scale measures the concept as intended (Hair et al. 2014). According to Hair et al. (2014:3), a summated scale is a 'method of combining several variables that measure the same concept into a single variable in an attempt to increase the reliability of the measurement through multivariate measurement'. Hair et al. (2014) state that discriminant validity is tested by confirming the correlation among measures.

Step 7: Reliability testing of the instrument

Bordeianu and Morosan-Danila (2013) posit that if the research instrument gives the same results when used on a group of respondents after a short period of time and when no changes are foreseen, then the instrument has a high level of reliability. The calculation of the correlation coefficient precedes this process, with high correlations signifying similarities of the two sets of answers and consequently demonstrating that the chance of errors is less (Bordeianu & Morosan-Danila 2013). Cronbach's alpha coefficient, which further represents another method of determining the reliability of the research instrument, was also calculated. Data were collected by the researchers alone to ensure accuracy and uniformity of the data collection process and the respondents were all comfortable reading and writing in English (Singh et al. 2018).

Approach

The contact details of the prospective participants were obtained from the foundry industry database of the National Foundry and Technology Network. The contact details of 196 representatives from 95 foundries were available on the NFTN list. Questionnaires were e-mailed to all 196 respondents (Table 3).

This forms part of step 1 of the research method in which the limitations and delimitations were considered. For the qualitative phase, and practical reasons, an interview sheet was compiled in order to obtain in-depth information from 12 industry experts within the foundry industry. Amongst the questions, experts were asked to identify the most prominent micro-economic drivers and also motivate why they have chosen these drivers.

Step 2 (of the research method discussed above) entailed the identification of micro-economic drivers from literature (Table 1). After the identification of applicable micro-economic drivers the research instrument (Table 4) was compiled as step 3. For step 4 the content validity was tested with industry experts during the pilot study. The pilot study (step 5) was undertaken with seven (7) participants before the actual study was conducted in order to establish if there was clarity regarding the proposed interview questions (Majid et al. 2017). The participants in the pilot study all have and represent extended experience in the foundry industry (Table 5).

TABLE 3: Sample for the research.

Province	Population of foundries operational in South Africa (2020)	Population of respondents available to distribute questionnaires to (contact details available on foundry database)
Gauteng	84	151
KwaZulu-Natal	16	24
Western Cape	10	7
Eastern Cape	4	3
Free State	4	8
North West	1	1
Northern Cape	3	0
Mpumalanga	1	2
Total	**123****	**196**

Note: **The total number of foundries (123) excluded foundry companies that were confirmed to be in the processes of finalising the modalities of company closure when the study by Lochner et al. (2020) was conducted.

The construct validity (step 6) and the instrument reliability (step 7) will be addressed in the findings section.

Ethical considerations

Ethical clearance was obtained from UNISA (University of South Africa) (2020_CEMS_BM_100; 23 July 2020).

Findings

The first section of the findings indicates the demographical information of the respondents. The second section depicts the data obtained during the quantitative phase, followed by the qualitative findings.

Demographics

The response rate for this study was 88% (Table 6) based on 108 usable individual responses received out of 123 survey invites sent (Table 6).

The responses in general represented a good spread (Table 6). Regarding the role in the organisation, the respondents were classified into five categories: top (9.3%; n = 10); senior (13.9%, n = 15); middle (13%, n = 14); junior management (25%, n = 27); as well as non-management employees (38.9%, n = 42).

The different areas of focus were well represented in the study with employees in finance and administration contributing 22.2% (n = 24), operations or manufacturing contributing 18.5% (n = 20), and the sales and marketing divisions constituting 17.6% (n = 19) of the sample. Employees involved in strategic management and project management each represented 14.8% (n = 16) of the sample, while those in procurement, buying and tendering constituted 12.0% (n = 13).

Finally, Table 5 illustrates that 18.5% (n = 20) of the respondents have worked for their current organisations for less than a year, while the majority of the respondents (34.3%, n = 37) reported that they had been with their company for between 1 and 5 years. A proportion of 24.1% (n = 26) have worked for their current organisation for between 6 and 10 years, while 23.1% (n = 25) of the respondents indicated that they had worked for their current organisation for more than 10 years.

TABLE 4: Measurement instrument with references from literature (validation).

Number	Micro driver items	Scale					Source
		Not important at all	Slightly important	Moderately important	Very important	Extremely important	
1	Investment in plant infrastructure	-	-	-	-	-	(Mkansi et al. 2018; Pagone et al. 2016; Parola et al. 2017)
2	Cluster membership (e.g. South African Institute of Foundries)	-	-	-	-	-	(Osarenkhoe & Fjellström 2017)
3	Employees' skills development (human capital)	-	-	-	-	-	(Hamadamin & Atan 2019)
4	Product (service) differentiation	-	-	-	-	-	(Putra 2018)
5	Organisational culture	-	-	-	-	-	(Alina, Cerasela & Raluca-Andreea 2018; Sengottuvel & Aktharsha 2016)
6	Governance	-	-	-	-	-	(Madhani 2016)
7	Price competitiveness	-	-	-	-	-	(Porter 1985; Putra 2018)
8	Product quality	-	-	-	-	-	(Aiginger et al. 2013; Brancati et al. 2018)
9	Ability to innovate (research and development)	-	-	-	-	-	(Pietrewicz 2019; Porter 1985)
10	Technology (equipment) upgrade	-	-	-	-	-	(Pietrewicz 2019; Putra 2018)
11	Production (raw material input) costs	-	-	-	-	-	(Brancati et al. 2018; Mohamed et al. 2019)
12	Firm capacity (size)	-	-	-	-	-	(Gimenez et al. 2019; Kaleka & Morgan 2017)
13	Exposure to export market (degree of internationalisation)	-	-	-	-	-	(Hamadamin & Atan 2019; Mohamed et al. 2019)
14	Socio-cultural responsibility (corporate social investment)	-	-	-	-	-	(Areiqat et al. 2019; Zhao et al. 2019)
15	Certifications (ISO standards, product certifications)	-	-	-	-	-	(Kaleka & Morgan 2017; Su et al. 2015)
16	Possession of intellectual property	-	-	-	-	-	(Teixeira & Ferreira 2019)
17	Managerial choice (decision-making process)	-	-	-	-	-	(Putra 2018)
18	Bargaining power over suppliers	-	-	-	-	-	(Bruijl 2018; Porter 1985)
19	Possession of unique resources (inimitable to competition)	-	-	-	-	-	(Madhani 2016)
20	Value-added for the customer	-	-	-	-	-	(Aiginger et al. 2013; Brancati et al. 2018

TABLE 5: Demographics of participants in the pilot study.

Participants	Period of experience in the foundry industry (rounded off)	Position in organisation	Province
Pilot interview participant 1	11 years	Chief Operations Officer	North West
Pilot interview participant 2	6 years	Marketing Manager	Gauteng
Pilot interview participant 3	7 years	Procurement Manager	Gauteng
Pilot interview participant 4	2 years	Former NFTN Projects Leader	Gauteng
Pilot interview participant 5	6 years	Managing Director	Northern Cape
Pilot interview participant 6	3 years	Director	KwaZulu-Natal
Pilot interview participant 7	14 years	Managing Member (Co-Owner)	Gauteng

Data analysis: Quantitative phase

Twenty micro-economic drivers were tested through descriptive statistics that included (1) investment in plant infrastructure; (2) cluster membership; (3) employees' skills development; (4) product or service differentiation; (5) organisational culture; (6) governance; (7) price competitiveness; (8) product quality; (9) ability to innovate; (10) technology or equipment upgrade; (11) production or raw material costs; (12) firm capacity; (13) exposure to export market; (14) socio-cultural responsibility; (15) certifications; (16) possession of intellectual property; (17) managerial choice; (18) bargaining power over suppliers; (19) possession of unique resources; and (20) value-add for the customer.

TABLE 6: Demographics.

Demographic	Level	*n*	%
Role within your organisation	Top management	10	9.3
	Senior management	15	13.9
	Middle management	14	13.0
	Junior management	27	25.0
	Non-management	42	38.9
	Total	108	100.0
Area of focus within your organisation	Strategic management	16	14.8
	Finance and administration	24	22.2
	Operations/manufacturing	20	18.5
	Projects management	16	14.8
	Sales and marketing	19	17.6
	Procurement/buying/tendering	13	12.0
	Total	108	100.0
Period of employment within the foundry industry	1. Less than 1 year	9	8.3
	2. Between 1 and 5 years	25	23.1
	3. Between 6 and 10 years	30	27.8
	4. More than 10 years	44	40.7
	Total	108	100.0

The statistical data on the respondents' feedback are presented in Table 7.

For the quantitative phase, the respondents expressed the following perceptions: They were of the opinion that product quality was the most important micro-economic driver (mean = 4.66; SD = 0.60), followed by the ability to innovate (mean = 4.51; SD = 0.63), employees' skills development (mean = 4.45; SD = 0.86), investment in plant infrastructure

TABLE 7: Statistical data (quantitative research).

Item	N	Min	Max	Mean	SD	Ranking
Product quality	108	3	5	4.66	0.60	1
Ability to innovate (research and development)	108	3	5	4.51	0.63	2
Employees' skills development (human capital)	108	1	5	4.45	0.86	3
Investment in plant infrastructure	108	2	5	4.35	0.75	4
Price competitiveness	108	2	5	4.31	0.79	5
Possession of unique resources (inimitable to competition)	108	2	5	4.27	0.78	6
Embracing new technology	108	1	5	4.23	0.92	7
Product (service) differentiation	108	2	5	4.22	0.85	8
Production (raw material input) costs	108	2	5	4.21	0.90	9
Managerial choice (decision-making process)	108	1	5	4.21	0.80	10
Bargaining power over suppliers	108	1	5	4.18	0.85	11
Value-added for customer	108	1	5	3.94	1.08	12
Governance	108	1	5	3.92	1.07	13
Certifications (ISO standards, product certifications)	108	1	5	3.90	1.22	14
Possession of intellectual property	108	1	5	3.86	1.01	15
Exposure to export market (degree of internationalisation)	108	1	5	3.82	0.96	16
Organisational culture	108	1	5	3.67	1.23	17
Cluster membership	108	1	5	3.57	1.02	18
Socio-cultural responsibility (corporate social investment)	108	1	5	3.51	1.20	19
Firm capacity (size)	108	1	5	3.37	1.09	20

SD, standard deviation.

TABLE 8: Demographics of interviewees: Qualitative phase.

Participants	Year experience	Position in organisation	Province
Interview participant 1	16	CEO	Gauteng
Interview participant 2	7	Managing director	Mpumalanga
Interview participant 3	12	Managing director	KwaZulu-Natal
Interview participant 4	5	CEO and SAIF* president	Gauteng
Interview participant 5	23	Financial director	Western Cape
Interview participant 6	27	Owner	Mpumalanga
Interview participant 7	7	Owner	KwaZulu-Natal
Interview participant 8	13	Technical director	Free State
Interview participant 9	36	Former managing director and SAIF* president (retired)	Gauteng
Interview participant 10	22	Foundry consultant	Gauteng
Interview participant 11	8	Managing director	Limpopo
Interview participant 12	30	Former director (retired)	Gauteng

(mean = 4.35; SD; 0.75), and price competitiveness (mean = 4.31; SD = 0.79) (Table 7).

Data analysis: Qualitative phase

The qualitative research phase followed the quantitative phase through thematic analysis. The top management of foundries were targeted with the aim to undertake an in-depth interview process, as well as guidance from literature. The interviewees were asked to identify the most critical micro-drivers and motivate why. The qualitative phase maximises the understanding and insights of the research phenomenon (Onwuegbuzie & Leech 2007). The researchers employed a strategy of the combination of 'prolonged engagement and richness of data' to ensure improved credibility of the data collection process (Babbie 2010).

TABLE 9: Summary of findings: Qualitative phase.

Number	Micro-economic drivers – qualitative phase
1.1.1	Investment in plant and infrastructure (1*), interest rates and cheap imports
1.1.2	Employees' skills development (3*), insufficient artisans and skills to deliver quality products
1.1.3	Product: service differentiation, product range (4*), and setting yourself apart
1.1.4	Organisational culture (5*), rigid organisational culture leads to a lack of flexibility and innovation
1.1.5	Governance (6*), good governance is the foundation of a successful organisation
1.1.6	Price competitiveness (7*), price versus quality *Alternative view*, stick to your process and know what you are doing
1.1.7	Product quality (8*) quality products that can be exported
1.1.8	Ability to innovate (9*) research, improve and adapt to render the best quality at the lowest cost
1.1.9	Technology upgrade (10*) the need to upgrade equipment
1.1.10	Production raw material input costs (11*) knowing and monitoring your overhead costs, metal ratios
1.1.11	Exposure to the export market (13*), market exposure, the export market included
1.1.12	Certification ISO standards and product certifications lack time, seeing the need and compliance
1.1.13	Possession of intellectual property, owning the intellectual property, versus owning the foundry
1.1.14	Managerial choice (decision-making process) (17*)
1.1.15	Value-added for customers (20*); if you have a product, you also need a customer to use it

Note: *Refer to the micro-drivers in Table 1.

Firstly, a pilot study was conducted with seven participants to clarify the questions (Majid et al. 2017), after which 12 participants were considered in sample selection. These 12 participants were randomly selected to obtain representation from different provinces and different designations and experiences (Table 8). The four criteria for establishing trustworthiness in qualitative research were considered for validity. These include credibility, dependability, transferability and confirmability (Anney 2014). The interviewees were asked about the importance of micro-economic drivers and to prioritise the importance of these drivers.

For the qualitative analysis, coding was utilised to identify certain themes in line with the framework proposed by Braun, Clarke and Weate (2016). After the transcription process, qualitative data were reviewed several times to ensure understanding of the content, followed by the coding process, and succinct labels were generated to identify the most important features of the data (Braun & Clarke 2006). Then the codes were collated in preparation for theme generation and interpretation. Dependability was thereafter addressed through the utilisation of a code-recode approach in which the data were coded twice (Anney 2014). The two sets of coded data were then compared to determine whether there were any differences or not (Anney 2014).

The demographical information of the interviewees is presented in Table 8.

In line with the quantitative phase findings, the respondents mentioned that quality (Table 7; rank 1) is of high importance (Table 9 – 1.1.1; 1.1.6; 1.1.7; 1.1.8). The respondents further supported research in innovation (Table 7; rank 2) when

TABLE 10: Ranking of critical micro-economic drivers (qualitative phase).

Drivers	Participants (qualitative interviews)												Frequency	Rank
	1	2	3	4	5	6	7	8	9	10	11	12		
Micro-drivers for sustainable competitive advantage														
Employees' skills development (human capital)	x	x	x	x	x	x	-	-	x	x	x	x	10	1
Investment in plant infrastructure	-	-	-	x	x	x	x	-	x	-	x	-	6	2
Product quality	x	x	-	-	x	-	-	x	-	-	x	x	6	2
Ability to innovate (research and development)	-	x	-	x	-	-	x	-	x	-	x	x	6	2
Technology (equipment) upgrade	-	x	x	-	x	-	x	x	-	x	-	-	6	2

Employees' skills development ranked first (Table 9; rank 1), which was also rated high during the quantitative phase (Table 7; rank 3). Investment in plant infrastructure was also ranked high (Table 9; rank 2); and this was ranked high during the quantitative phase (Table 7; rank 4). Product quality was ranked high (Table 9; Table 7: rank 1), which corresponds with the finding during the quantitative phase. The ability to innovate was ranked high in the qualitative and quantitative phase (Table 7; rank 2; Table 9; rank 2). Technology ranked high during the qualitative phase (Table 9; rank 2) but not so high during the quantitative phase (Table 7; rank 7).

TABLE 11: Feedback from respondents (qualitative phase).

Micro-drivers	Responses during qualitative phase
Employees' skills development (Human capital)	'… not just in the field of, let's call it metal casting, but also in the field of, you know, fitters and turners and electricians and mechanicians. So, a lot of technical skills that were developed, basically it just dried up for about ten years. And then it sort of tried to start up again, but I think, there was a lot of momentum lost. So, a lot of skills development potential was lost in the country.' (Participant 2)
Investment in plant infrastructure	'… I think, in my opinion, the main reasons, there are a number of, obviously a lot of reasons, but one of the bigger is almost total lack of investment. You know, if you look at the number of foundries that are running equipment which is 30 to 50 years old. Now, there's no way you can compete against anybody, whether it's your local competitor or whether it's international, on outdated equipment.' (Participant 4)
Product quality	'… product quality in an open economy, particularly when you're servicing automotive-type companies, you have to, and not only them, but all in the main, all customers want quality … so, you've got to be able to produce a quality product. That's a definite prime requirement.' (Participant 5)
Ability to innovate (research and development)	'… then, you know, ability to innovate is certainly also a key … definitely in my opinion the ability to innovate and to, you know, constantly improve and adapt to make sure that we, you know, do not just, we don't fall behind. We constantly improve and innovate and, you know, like I said we're busy with certain ways of moulding, you know, new innovative ways to mould.' (participant 12)
Technology (equipment upgrade)	'… the market is changing so quickly, with technology these days, if you don't invest, that is a problem.' (Participant 7)

interviewed (Table 9 – 1.1.8; 1.1.9; 1.1.13). Finally, employees' skills development (Table 7; rank 3) was also supported during the interviews (Table 9 – 1.1.2).

During the qualitative phase, the respondents were also asked to rank the most critical micro-economic drivers for SCA in order of importance. The responses to the highest ranks are indicated in Table 10.

Some of the feedback from the interviewees to motivate the most critical micro-economic drivers are depicted in Table 11.

When the top five findings of the qualitative and quantitative phases were combined, the critical micro-economic drivers for foundries seem to be: (1) product quality; (2) employees' skills development; (3) the ability to innovate (research and development); (4) investment in plant infrastructure; and (5) technology (equipment) upgrade (Table 10).

Two constructs, namely product quality (1) and (3) the ability to innovate, form part of SCA processes (Table 2), while (2) employees' skills development and (4) investment in plant infrastructure form part of assets/resources (Table 2). The firms' performance, supporting and related industries and clusters, as well as institutions and government policies (Table 2) did not feature as SCA classifications for the micro-economic drivers during both the qualitative and quantitative phases.

The four most prominent micro-economic drivers identified from the qualitative and quantitative phases include: (1) product quality; (2) ability to innovate; (3) employees' skills development; and (4) investment in plant infrastructure (Figure 1).

Price competitiveness (rank 5) and technology (equipment) upgrade (rank 2) did not overlap from the qualitative and quantitative phases as highest priority (Table 10). According to the classification of Siudek and Zawojska (2014) (Table 2), product quality and the ability to innovate fall under the SCA processes, and employees'skills development and investment in plant infrastructure are classified under assets/resources (Table 12).

Discussion

The problem addressed in this article is that the foundry industries in South Africa are closing down due to various economic circumstances. The aim was to determine the most prominent SCA micro-economic drivers in the South African foundry industry. Organisations have control over micro-economic drivers, and with these drivers identified, management could address these issues to enhance sustainability in the foundry industry.

The study applied an explanatory sequential mixed method to determine the most prominent SCA micro-economic drivers in South African foundries. From the five SCA classifications recommended by Siudek and Zawojska (2014) (Table 2), processes (inclusive of product quality and ability to innovate) and assets/resources (inclusive of employees' skills development and investment in plant infrastructure) were identified as critical. It seems as if the following SCA strategies were viewed as less critical, namely: (1) firms' performance; (2) supporting and related industries and clusters; and (3) institutions and government policies (Figure 2).

Two of the SCA micro-economic drivers, according to the classification of Siudek and Zawojska (2014) (Table 11)

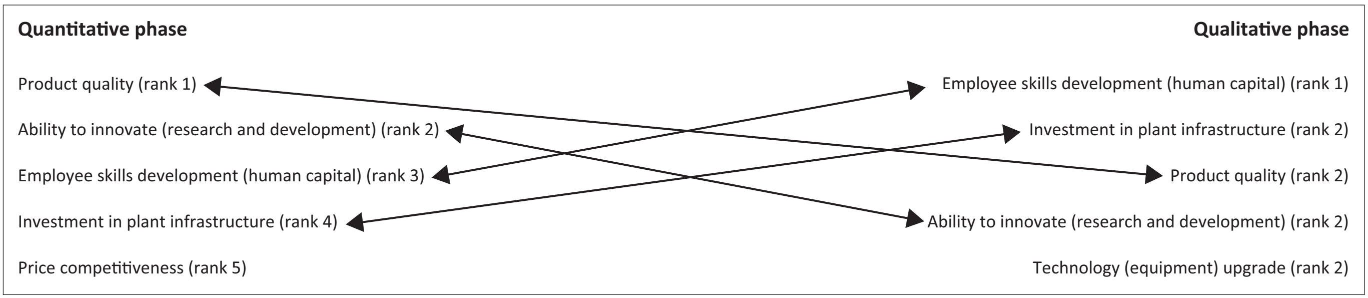


FIGURE 1: Combination of micro-economic drivers (qualitative and quantitative phases).

TABLE 12: Sustainable competitive-advantage classification (post-quantitative and qualitative phases).

Processes	Assets/resources
SCA classification	
Product quality	Employees' skills development
Ability to innovate	Investment in plant infrastructure

SCA, sustainable competitive advantage.

identified under processes, are product quality and the ability to innovate.

Firstly, product quality was viewed by the respondents as a critical driver enhancing SCA. This is in line with the findings of Sitanggang, Sinulingga and Fachruddin (2019) and they recommend the dimensions to be addressed for quality which include performance, features, reliability, conformance to specifications, durability, serviceability, aesthetics and perceived quality. In order to obtain and maintain a SCA, it is recommended that foundries introduce strategies to obtain and maintain product quality. Alghamdi and Bach (2013) and Chigbata and Christian (2018) point out that firms worldwide must utilise product quality as a 'strategic means' for gaining a SCA.

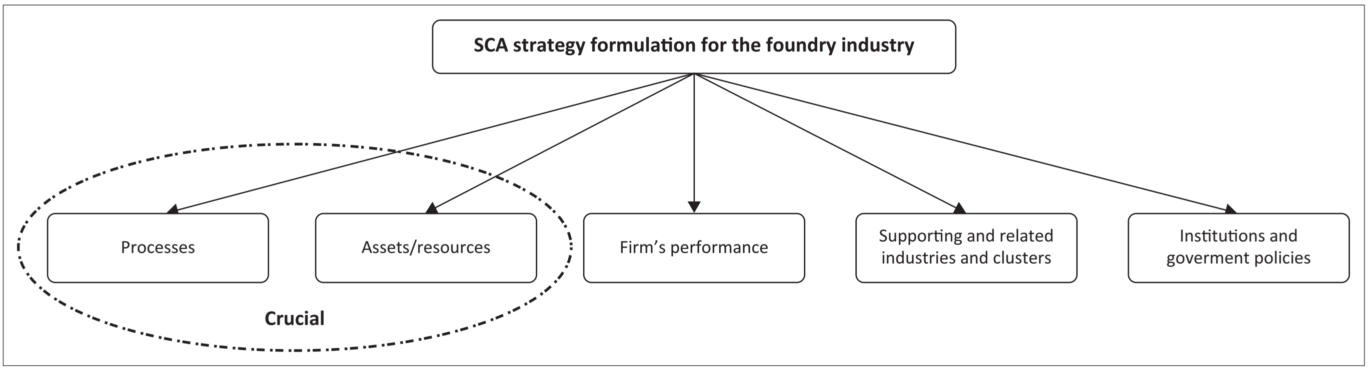
The second, processes SCA (Table 11) identified, is the ability to innovate (research and development). Innovation enables and empowers firms to develop new products and establish new ways of cost-effective manufacturing. Literature also states that there is a significant and positive relationship between innovation and the ability of a firm to remain competitive (Hermundsdottir & Aspelund 2020), which should be embraced by the foundry industry. Banganayi, Nel and Nyembwe (2019) point out that innovation technology not only relates to mechanical upgrades but also to information and communication technology (ICT), software applications in line with the fourth industrial revolution (4IR). Through innovation, foundries will be able to manufacture castings better, quicker and cost-effectively. It is recommended that an organisational culture be cultivated that promotes new ideas and encourages innovation to enable local foundries to compete within the global landscape.

Further, two of the SCA micro-economic drivers, according to the classification of Siudek and Zawojska (2014) (Table 11), identified under the assets/resources category (Table 11), are employees' skills development and investment in plant infrastructure.

Firstly, employees' skills development (human capital) was seen as a SCA. This is in line with Hamadamin and Atan (2019:1) who state that SCA is no longer defined by the physical assets of the business but more on the skills set; that is, skills possessed by employees, they also add that employees stand out as a major source of gaining SCA in any business. This is further supported by Rodriguez and Walters (2019) who state that the SCA of an organisation is dependent on the competency and quality of the employees. It is recommended that management of foundries in South Africa formulate a comprehensive training programme for employees. The training should not only focus on technical (hard) skills, but also on softer skills in order to ensure that there is an all-round appreciation of the administration, manufacturing, financial and quality processes, as well as service provision within the industry. Organisational practices are also important to promote employees' knowledge and skills development, while concurrently strengthening the organisation's SCA (Grobler & De Bruyn 2018).

Secondly, plant infrastructure (Table 11) refers to the investment in the foundry plant infrastructure in order to enhance SCA and to align the local foundry industry with the global expectations regarding performance, technology and delivery. The absence of plant infrastructure investment significantly impacts on the growth, profitability and performance of businesses (Momoh & Ezike 2018). However, the investment in plant infrastructure also encapsulates computer-aided technology and processes. Barney (1991:114) states that 'an information processing system that is deeply embedded in a firm's management decision making process may hold the potential of sustained competitive advantage'. This view is supported by Hoffman (2000) and Salisu and Julienti (2019) who point out that the ability of firms to adapt to a changing technological environment is key to enhancing firm SCA.

In conclusion, it is deemed important for the South African foundry industry to design and comply with a designated SCA strategy with the associated processes to support the strategy. It is especially important to incorporate processes (product quality and the ability to innovate) and assets/resources (employees' skills development and investment in plant infrastructure) in the SCA strategy.



SCA, sustainable competitive advantage.

FIGURE 2: Sustainable competitive-advantage strategy focus for micro-economic drivers.

Conclusion

The article provides valuable insight into the micro-economic drivers of the South African foundry industry in order to enhance SCA. The micro-economic drivers were identified from literature (Table 1) and a measurement instrument was then designed in order to test perceptions regarding the most prominent micro-economic drivers (Table 3). It was determined, after the quantitative and qualitative phases, that the critical micro-economic drivers for the South African foundry industry are product quality, employees' skills development, the ability to innovate (research and development), and investment in plant infrastructure.

The article makes a contribution on three levels, namely, a theoretical contribution (Table 1), a managerial contribution (recommendations in the previous section) and a methodological contribution (Table 3). In addition, the research also expands on the SCA body of knowledge (as proposed by Siudek and Zawojska 2014) by identifying processes (inclusive of product quality and ability to innovate) and assets/resources (inclusive of employee skills development and investment in plant infrastructure) as critical factors for sustainability in the foundry industry in South Africa.

Taking cognisance of the identified contributions of the study, limitations do exist. The study only included foundries in South Africa and although the results might be applicable to other emerging countries, the results might not necessarily be generalised to the global foundry platform.

The article provides many opportunities for further research to expand insight into the SCA of the foundry industry. The study could be duplicated in other countries (emerging and developed) in order to determine the deviation or duplication of results. Further studies may include the macro-economic drivers and the inclusion of more stakeholders, such as government policy makers, might also provide a more holistic view. Finally, a longitudinal study might provide more insight as it will be undertaken over a longer period to equalise industry fluctuations.

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Authors' contributions

L.P.: Conceptualisation, methodology, formal analysis, writing original draft, visualisation, validation, writing, review and editing. A.S.T.: Conceptualisation, methodology, formal analysis, validation, writing, review and editing, supervision. R.D.v.S.: Conceptualisation, methodology, formal analysis, validation, writing, review and editing, supervision.

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Data availability

The data that support the findings of this study are available on request from the corresponding author, A.T.

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