Development of a Conceptual Framework and Management Guide for Sustainable Contract Manufacturing Companies in South Africa

T.T. Mahove[1*] & S. Motope[2]

ARTICLE INFO

Article details
Submitted by authors 26 May 2025
Accepted for publication 2 Oct 2025
Available online 12 Dec 2025

Contact details
* Corresponding author
25331744@sun.ac.za

Author affiliations
1 Department of Industrial Engineering, Stellenbosch University, Stellenbosch, South Africa

ORCID® identifiers
T.T. Mahove
https://orcid.org/0009-0009-7787-210X

S. Matope
https://orcid.org/0000-0001-5598-1027

DOI
http://dx.doi.org//10.7166/36-4-3256

ABSTRACT

Articles on manufacturing outsourcing focus largely on providing guidance to brand owners on how to select the manufacturing partner, on the benefits of outsourcing manufacturing, and how to manage the contract manufacturing relationship. However, there is a lack of frameworks that offer guidance to contract manufacturing companies to help them to set up and run manufacturing organisations that achieve sustainable success as strategic supply chain partners to the brand owners. In this study, informed by the design science research methodology, an artefact, a critical success factors conceptual framework and management guide for contract manufacturing companies to achieve sustainable success is introduced.

OPSOMMING

Artikels oor vervaardigingsuitkontraktering fokus grootliks op die verskaffing van leiding aan handelsmerkeienaars oor hoe om die vervaardigingsvennoot te kies, oor die voordele van uitkontraktering van vervaardiging, en hoe om die kontrakvervaardigingsverhouding te bestuur. Daar is egter 'n gebrek aan raamwerke wat leiding bied aan kontrakvervaardigingsmaatskappye om hulle te help om vervaardigingsorganisasies op te rig en te bedryf wat volhoubare sukses behaal as strategiese voorsieningskettingvennote vir die handelsmerkeienaars. In hierdie studie, ingelig deur die ontwerpwetenskapnavorsingsmetodologie, word 'n artefak, 'n konseptuele raamwerk vir kritieke suksesfaktore en 'n bestuursgids vir kontrakvervaardigingsmaatskappye om volhoubare sukses te behaal, bekendgestel.

1. INTRODUCTION

Outsourcing manufacturing services by brand owners to contract manufacturing companies (CMCs) is a growing practice that has many problems; in most cases it does not achieve its intended objectives, with a number of CMCs in South Africa failing and going out of business [1]. However, limited research focuses on CMCs. According to [2], there are essentially two research strands on contract manufacturing (CM). The first is concerned with the factors that influence the choice of CM, and includes outsourcing frameworks for guiding brand owners [3]; [4]; [5]. The second strand studies the benefits and impact of CM on the operational and financial performance of the brand owner, which include cost reduction, improved delivery, access to technology, improved quality, and improved productivity [6]; [7]; [8]; [9]; [10]; [2]. Other published research on CM focuses on highlighting the risks of CM to brand owners, with proposals and strategies to manage the risks [11]; [6]; [12]; [13]; [14]; [15]. Other researchers have published articles on CM relationships [16]. Fewer articles have been written on the supplier side of CM relationships, the CMC. Relatively few studies focus explicitly on the unique difficulties faced by CMCs and the critical success factors (CSFs) for CMCs to achieve sustainable success. [17] conducted research on the supplier side of CM relationships, and found that most of the literature on outsourcing focuses only on the buying (outsourcing) company. Their paper highlighted the supplier's side from a relational perspective, and stressed the importance of business relationships between suppliers of outsourced activities and their customers [17]. [18] concluded that in outsourcing research there has been much less discussion of the strategic issues for outsourcing service providers, although in reality there are major issues to be considered. They discussed the different types of outsourcing decisions and the drivers for both the brand owner and the outsourcing service provider. None of them proposed frameworks to provide guidance to the management of CMCs on how to build sustainable CMCs that can become strategic partners in the brand owners' supply chain [19]. In essence, the research on CM mainly studies and provides guidance on CM to the brand owners, with no guidance provided to the CMCs. [20] stated that ISO accreditation, good manufacturing practice (GMP), and adherence to guidelines are all crucial to running a successful CM business. However, they did not provide any guidance or framework on the steps to follow to achieve this and to become a sustainable CMC. The aim of this study is to close this gap by proposing a critical success factors (CSFs) conceptual framework to guide CMCs to implement these factors effectively and to build businesses that achieve sustainable success as strategic supply chain partners to brand owners. This work is situated in the industrial engineering discipline, where the problem is to design frameworks that help organisations to improve their efficiency, integration, and sustainability. The focus here is on CMCs, which play a critical role in modern supply chains but often face pressures to do with performance, coordination, and long-term competitiveness. The proposed framework is designed to guide their transformation by improving system performance, strengthening supply chain integration, and embedding operational sustainability in their practices.

The article progresses from the research methodology (Section 2) and literature-derived CSFs (Section 3) to the proposed framework (Section 4) and its implementation guide (Section 5), followed by an updated discussion of sustainable CMCs (Section 6), and concludes with final insights and next steps (Section 7).

2. RESEARCH METHODOLOGY FOR FRAMEWORK DEVELOPMENT

In this study, design science research (DSR) [21]; [22]; [23]; [24] was used as the methodological guideline to develop the critical success factors framework for sustainable CMCs. This paper describes step (iii) of the DSR process (Figure 1), the design and development of the artefact, the CSFs' conceptual framework, and a management guide for sustainable CMCs that have the potential to be strategic and long-term partners with their brand owner partners.

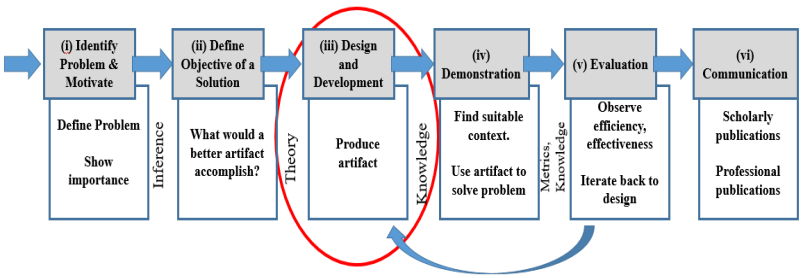

Figure 1: Design science research methodology (adapted from [24])

The main inputs into the framework design are the critical success factors identified in the Delphi study by [19] and those identified from the literature.

3. CRITICAL SUCCESS FACTORS

3.1. Critical success factors from Delphi study

[19] empirically identified the CSFs for sustainable CMCs through a two-round Delphi study of 14 experts in CM who had experience of working with CMCs in various areas, including quality, supply chain, procurement, and operations [19]. These CSFs were grouped into eight pillars [19], as shown in Figure 2.

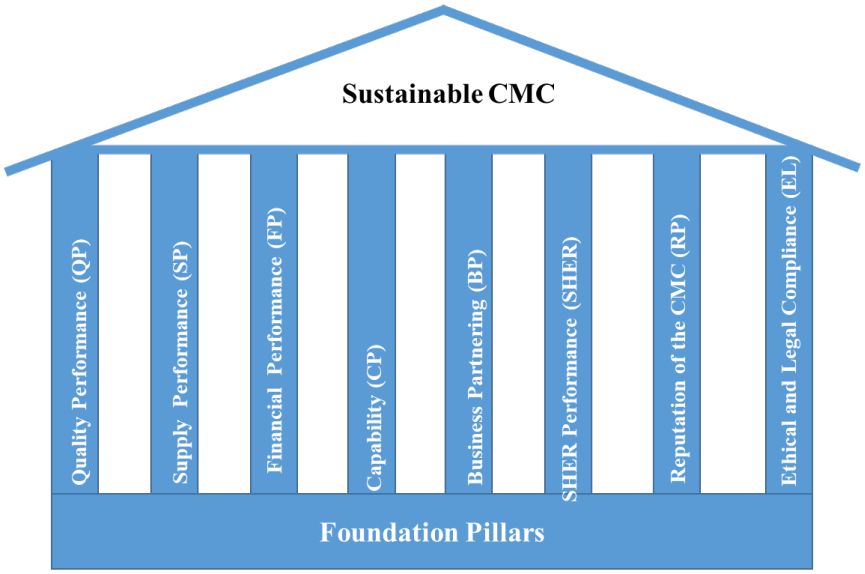

Figure 2: House of sustainable contract manufacturing companies [19]

The foundation pillars are discussed later in this article. The CSFs under each pillar were categorised into three different categories, based on their level of consensus in the second round of the Delphi study [1] They categorised those factors that fully met the predetermined consensus criteria as "**A**"; those that partially met the consensus criteria were categorised as "**B**"; and those that did not meet the predetermined criteria but were not discarded, but that nevertheless were also taken into consideration in the final framework, were categorised as "**C**" [1].

3.2. Critical success factors from the literature review

To identify the CSFs for CM from the literature, a review was conducted using academic search websites (Scopus, Google Scholar, and the Stellenbosch University library). The search words were "manufacturing outsourcing", "contract manufacturing", "selection of contract manufacturing partner", "manufacturing outsourcing partner selection", "frameworks for contract manufacturing", "critical success factors for manufacturing outsourcing and contract manufacturing", and "manufacturing SMEs". The search range for articles was from 2000 to 2024.

3.2.1. Reasons for selecting contract manufacturing companies

From the literature review, the reasons for selecting the CMCs that were cited by several authors are summarised in Table 1.

Table 1: Reasons for outsourcing to contract manufacturing companies (Authors' own work)

Reasons	Authors
Cost reduction/cost saving	[5]; [6]; [7]; [9]; [10]; [15]; [25]; [26]; [27]; [28]; [29]; [30]; [31]; [32]
Access to extra capacity	[6]; [9]; [26]; [32]; [33]; [34]; [35]
Access to expertise, capability, and technology not available in-house	[2]; [5]; [6]; [9]; [16]; [34]; [35]; [36]; [37];[38]
Improved quality standards	[9]; [10]; [15]; [25]; [26]; [28]; [30]; [32]
Flexibility/agility	[7]; [9]; [16]; [28]; [30]; [31]; [32] [33]; [34]; [35]; [36]; [37]; [38]
Asset reduction/no capital expenditure	[2]; [7]; [16]; [26]; [30];[31]; [32]; [35]; [38]
Focus on core competencies	[9]; [16]; [26]; [28]; [32]
Location/close to final markets	[7]; [9]; [29]; [35]
Achieve organisational performance	[9]; [10]; [24]; [28]
Transforming fixed costs into variable costs	[9]; [16]; [32]
Optimum resource use	[9]; [32]
Improved financial and business performance	[9]; [31]; [34]
Improved speed to market	[9]; [15]; [16]
Promote competition between suppliers	[9]

These reasons were taken into account in determining the CSFs and developing the framework.

3.2.2. Selecting a contract manufacturing company

To identify other CSFs for CMCs, the researchers also examined the selection criteria for suppliers identified by brand owners. Supplier selection is one of the critical decisions for any organisation owing to its direct impact on profitability and organisational competitive position maintenance [40]. [41]) reviewed the literature on manufacturing outsourcing decisions and partner selection criteria from 2010-2021, and summarised his findings on key criteria for selecting a supplier under the following classifications:

- Operational performance – Production and process capacity, product quality, on-time delivery.
- Agile performance – Service levels, flexibility, collaboration with partners, lead-time skills.
- Economic performance – Product price, resource consumption, financial stability
- Environmental performance – Green product, green manufacturing process, green research and development.
- Social performance – Employee welfare, organisational culture, leadership, occupational health and safety.

[30] concurred with [41]. The results of their research showed that green packaging and labelling, the relationship with the manufacturing brand, order flexibility, and product traceability are the most important criteria in retail private-label supplier selection.

[42] and [43] identified the followed factors as critical for strategic supplier selection: quality, pollution prevention, delivery/service, cost, occupational health and safety practices, and resource consumption. [43] added employment practices and waste management.

These are the success factors that were also taken into consideration in the design of the framework and management guide.

3.2.3. Risks and difficulties of outsourcing to a contract manufacturing company

The researchers also reviewed the literature on the risk of outsourcing manufacturing to a CMC in order to identify additional success factors to be incorporated into the framework design. Knowledge of the risks was valuable for CMCs and brand owners to be aware of so that the correct actions could be taken to mitigate them. Outsourcing comes with potential risks [44]; [45]: it could expose brand owners to significant risks that would need to be mitigated in order to reap collaborative benefits effectively [46]. The major risks that were identified are discussed below.

Encroachment - Encroachment was cited by several authors as a major risk from outsourcing manufacturing to a CMC [47]; [48]; [49]. Encroachment is the practice in which a CMC introduces their own products and competes with the brand owner [49]; [50]; [52]; [54]. In such a situation, the role of the CMC changes from just being an upstream partner to being both upstream partner and downstream competitor; and this could damage the CM's relationship with the brand owner [52].

Loss of control - Brand owners could lose control over the quality of purchased materials, which could in turn damage their brand name and market share [48]. This could be as a result of buying inferior quality materials to save costs. According to [11], in order to ensure that the supplier can produce products that meet the requirements of the manufacturer, the manufacturer needs to share their knowledge about product design. In manufacturing outsourcing among supply chain enterprises, the supplier could misappropriate the knowledge shared by the manufacturer [11]. Once CMs have built their reputation as reliable manufacturers, many of them start to enter the market with their own brands and compete directly with the original equipment manufacturers [11]. [13] added loss of flexibility and diminishing outsourcing advantages as risks of outsourcing to CMCs.

Quality non-compliance - CMCs could fail to comply consistently with the quality requirements of the brand owner [5]; [6]; [15]; [29]; [53]; [54]; [55], putting brand consumers and the brand owner's reputation at risk [28].

Dependence on the CMC - Brand owners run the risk of total dependence on the CMC [15]; [26]; [28] to the point where they risk losing their intellectual property and skills [13]; [31].

Hidden costs/cost increases - CMCs could incur additional costs that were not originally known or budgeted for, putting the brand owner's profitability at risk [5]; [13]; [26]; [28].

Unethical practices - CMCs could engage in unethical practices, including collusion with the brand owner's competitors [31], poaching the brand owner's customers or intellectual property [14]), and misappropriating knowledge [11]; [13]. When a supplier is involved in an issue that society deems unethical, not only that company but the whole supply chain could be affected [10], which could cause reputational damage.

Poor performance - The CMC could fail to deliver the expected performance, resulting in poor brand owner performance [56], thus putting the brand owner's supply chain at risk [13]; [29].

Other risks and difficulties

[57] highlighted several major causes for outsourcing failures:

- having an ambiguous contract;
- ignoring personnel, cultural, custom, and language issues;
- neglecting hidden costs;
- failure to have an exit strategy in place.

3.2.4. Critical success factors from frameworks and models

After outlining the key risks in outsourcing to CMCs in section 3.2.3, the review examined the CSFs in existing frameworks and models, highlighting the factors that support effective transformation in manufacturing. According to [58], in order to develop a new framework, a better understanding of existing frameworks is required. In order to identify other success factors not identified in the review above, and

because we could not find any frameworks and management guides for CMCs, we reviewed the literature on frameworks, models, or guides for manufacturing SMEs, manufacturing excellence, and manufacturing in general to identify other CSFs for manufacturing companies that would be relevant to this research. The results are shown below, with the framework/model name and the selected factors:

- [59] Wilgor framework for manufacturing excellence: People involvement, leadership, culture, knowledge, and skills.
- [58] Manufacturing excellence: environment, flexibility, delivery, customer relations, quality, reliability, and leadership.
- [60] Framework for identifying CSFs for quality in manufacturing SMEs: customer focus, employee focus, quality strategy, supplier relationships, and employee involvement.
- [61] Successful outsourcing companies: strong relationships with suppliers, high level strategic reviews, and culture.
- [62] 12 principles of manufacturing excellence: good housekeeping, safety, maintenance, capability, and training.
- [63] Integrated manufacturing business excellence system (IMBES): customer focus, leadership, culture, and suppler quality management.
- [64] CSFs for manufacturing industries in India: management commitment, human resources, culture, and quality.
- [11] Outsourcing partner selection model: Process quality and manufacturing time.
- [65] Operational excellence assessment framework for manufacturing companies: culture, continuous improvement, enterprise alignment, and results.
- [66] Lean manufacturing framework for manufacturing companies: Shopfloor management and quality management

Most of the frameworks and models reviewed above focus on manufacturing organisations in general, with a particular emphasis on SMEs and manufacturing excellence initiatives. While these contributions might be valuable, they do not directly address the unique transformation difficulties of CMCs. CMCs operate under distinct conditions, such as limited control over product design, dependence on clients' specifications, and the need to balance efficiency with flexibility, all of which require a tailored approach. This paper responds to that gap by presenting a framework specifically developed for the transformation of CMCs. The frameworks above do provide valuable insights into success factors for manufacturing companies, which were useful input in the development of our CMC framework. However, they do not provide a guide to management of CMCs about the process to follow to implement the framework for sustainable success effectively.

3.2.5. Success factors from literature review

The success factors that were identified from the literature review are grouped under common themes and summarised in Table 2**.**

Table 2: Success factors identified from literature (Authors' own work)

Theme	Factors
Quality	Quality meeting specifications and requirements
Supply	Supply on time, in full
Cost/ Finance	Cost saving, reduced capital expenditure, financial stability
Location	Close to final markets
Capacity	Flexibility, agility
Safety and health	Safe and health focus, compliance with regulations
Environment	Green manufacturing practices, environmental management, waste management, compliance with regulations
Culture and people	Employee involvement, continuous improvement, employment practices, employee welfare

Theme	Factors
Capability	Technology, skills development, visionary leadership, manufacturing systems and practices, process management
Collaboration	Customer service, supplier management, stakeholder relationships
Innovation	Decreasing time to market, increased investment in research and development
Ethical practices	Honesty, protection of confidential information, integrity

4. PROPOSED FRAMEWORK

The CSFs identified in the Delphi study and in the literature review were incorporated into the development of the artefact, the framework for sustainable CM. The classification of success factors used by [1] was adopted. Figure 3 shows the graphical representation of the success factors. The framework provides guidance for the leaders of CMCs to transform their companies into sustainable CMCs that are strategic supply chain partners with their brand-owner customers.

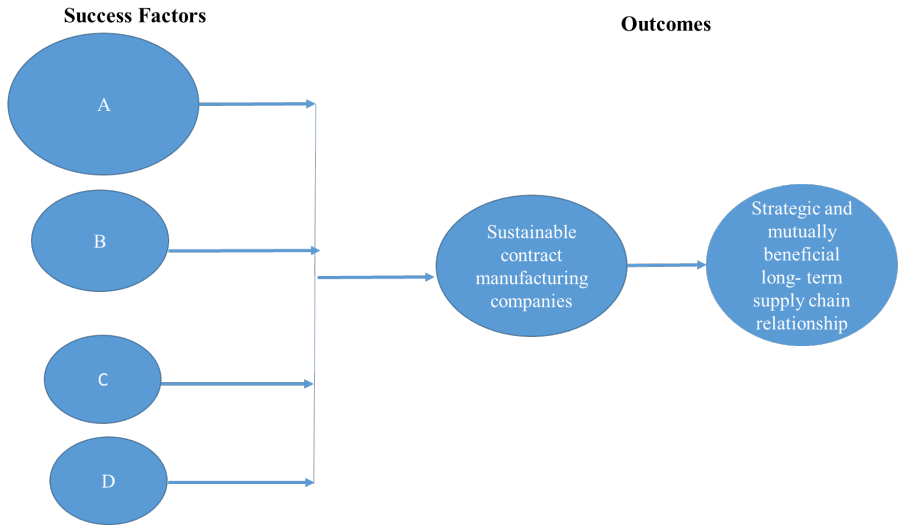

Figure 3: Graphical representation of sustainable CMC factors (Authors' own work)

The **A** factors are the most critical, and are considered mandatory for sustainable CM. Successful implementation of these factors would therefore be a necessity for CMCs. **B** factors are the second-most critical, with the **C** factors also considered part of the implementation. **D** factors did not emerge from the Delphi survey or the literature review. These are additional factors that would emerge when the framework was tested and refined in different CMCs; but this was not in the scope of this article.

There is a need for methods to support CMCs in operationalising the implementation of the success factors to achieve their sustainability goals [66]. According to [67], in order to propose a new model it is usually not sufficient simply to define its content and a structure to frame it. To ensure their applicability and benefits, they have also to be tested – for instance, by proof of concept or by real life applications [66]. For them to be tested, they need to be implemented. A popular implementation method in the literature is the maturity model (MM) [68]; [69]; [70]. For this research, a five stage/level maturity model was proposed as the implementation method, taking guidance gleaned from the literature reviews on MM from [68]; [71]; [73]; [74] and [72], that five levels are the most common.

The dimensions of the proposed MM were made up of the eight pillars (dimensions) and the **A** and **B** factors (sub-dimensions) that emerged from the Delphi survey and the literature review. The reseachers named this framework the Mahove-Matope Sustainable Contract Manufacturing Company Maturity Model (SCMC-MM). Each pillar is assessed using a structured maturity assessment tool to assist the management team to identify performance gaps, prioritise interventions, and track progress through defined maturity levels

The proposed CMC maturity levels, including a description of each level and its performance criteria, are shown in Table 3.

Table 3: CMC maturity levels (Authors' own work)

Level	Level descriptor	Activities
1	Starting out	No or very few success factors in place, no implementation plans.
2	Foundation building	Some success factors being implemented or in place. Performance on key performance indicators (KPIs) below target.
3	On solid ground	Majority of success factors in place. Performances on some but not all KPIs on target.
4	Towards sustainability	Majority of success factors in place. Performances on all KPIs on target.
5	Sustainable CMC	All success factors in place. Performance on KPIs on target, and improvements demonstrated.

A CMC at level 5 is considered to be at the highest level of the maturity model, and is classified as a sustainable CMC with which brand owners could partner with a high degree of confidence.

To assess the maturity level, the SMCM-Assessment checklist is used. This is shown in Figure 4, with the first two pillar assessments as examples.

		Please insert the assessed value in the applicable box					
		1	2	3	4	5	
Pillar	Factors	Starting out	Foundation building	On solid ground	Towards sustainability	Sustainable CMC	Average
Quality Performance	Factory housekeeping standards.	1					
	Documented QMS in place.		2				
	QMS compliance to board cover quality standards.		2				
	Qualified Quality personnel.			3			
	Certification to standard bodies, e.g. ISO.				4		2.2
Supply Performance	On-site supply control testing capability.	1					
	Product supply on time and in full.		2				
	CMC has a continuous improvement culture.	1					
	Capacity availability.			3			
	Operations management system in place.	1					1.8

Figure 4: SCMC-MM assessment checklist (Authors' own work).

The assessment results can be visualised on a radar chart.

In this study, the analytical hierarchy process (AHP) was used to rank the identified success factors and to advise the management of CMCs about which pillars to focus attention on and to prioritise during implementation, based on the ratings of the experts. These priority pillars are the foundation pillars mentioned in section 3. The AHP was developed by Thomas L. Saaty in 1971, is a theory of measurement through pairwise comparisons, and relies on the judgements of experts to derive priority scales [75].

From the results of the AHP, the highest priority pillars for implementation are quality performance, financial performance and business partnering. The second-highest priority pillars are safety, health, environmental and risk (SHER) and ethical/ legal compliance, followed by supply performance and reputation. Capability emerged as the final pillar in this analysis.

The consistency ratio (CR) was calculated as 0.02, which represents acceptable consistency, being less than 0.1 (Table 4). This means that the pairwise comparisons were done consistently.

Table 4: Eigenvalue and consistency index calculation (Authors' own work)

	QP	SP	CP	FP	RP	BP	SHER	EL	SUM	WEIGHT	SUM/ WEIGHT (SW)
QP	0.23	0.23	0.17	0.23	0.23	0.23	0.30	0.30	1.90	0.23	8.32
SP	0.05	0.05	0.07	0.05	0.05	0.05	0.03	0.03	0.37	0.05	8.05
CP	0.03	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.19	0.02	8.06
FP	0.23	0.23	0.17	0.23	0.23	0.23	0.30	0.30	1.90	0.23	8.32
RP	0.05	0.05	0.07	0.05	0.05	0.05	0.03	0.03	0.37	0.05	8.05
BP	0.23	0.23	0.17	0.23	0.23	0.23	0.30	0.30	1.90	0.23	8.32
SHER	0.08	0.14	0.12	0.08	0.14	0.08	0.10	0.10	0.82	0.10	8.24
EL	0.08	0.14	0.12	0.08	0.14	0.08	0.10	0.10	0.82	0.10	8.24

Total (T) = (ΣSW)	=	65.61
Count (n)	=	8
Eigenvalue, Ev (T/n)	=	8.2
CI (Ev-n)/(n-1)	=	0.029
RI (For n = 8)	=	1.41
CR (CI/RI)	=	0.02

5. UPDATED HOUSE OF SUSTAINABLE CONTRACT MANUFACTURING COMPANIES, AND DISCUSSION

Based on the ranking process discussed above that highlighted the priority pillars, the "house of sustainable CMCs" figure is updated to reflect the priority pillars as the foundations of the house (Figure 5). Pillars C and D are added. The factors in the D pillar are those that emerged from the testing, validation, and refinement of the framework at selected CMCs.

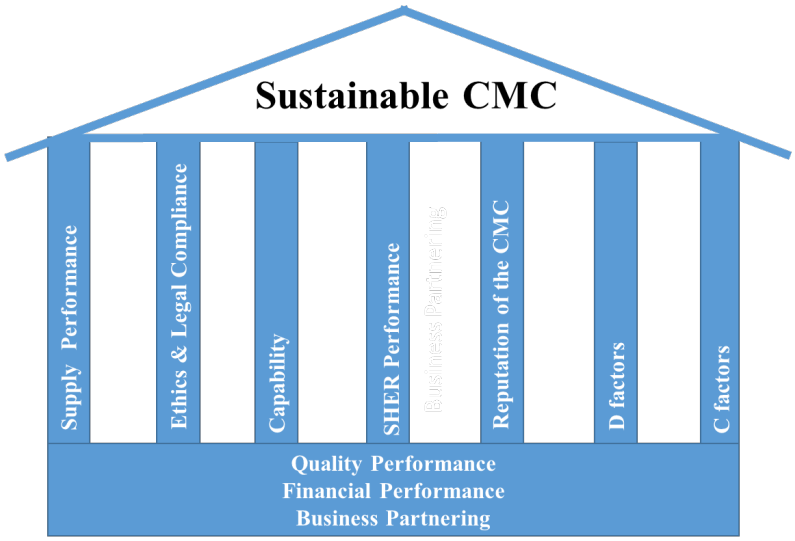

Figure 5: Updated house of sustainable contract manufacturing companies (Authors' own work)

The house shows that brand owners are more likely to work with a CMC that can demonstrate a strong compliance with their quality requirements, can show strong financial performance, and can operate at a strategic partnership level. A CMC that demonstrates strong performance for each of these pillars at level 5 creates a strong base to attract the top brand owners as partners. To deliver the expected quality performance, the CMC must ensure that it fully understands the requirements of the brand owner, and is able consistently to deliver to expectations. Financial performance includes factors such as cashflow management, cost saving, and the ability to maintain contract costs. Brand owners would prefer not to work with a CMC that fails to deliver a product because of material shortages or that is at risk of closing

down because of cashflow problems. A CMC that could maintain the contract cost or even offer a price reduction would have greater opportunities to attract more customers. Having cost-saving programmes also improves the CMC's profitability and sustainability. Business partnering includes success factors such as openness and transparency, joint problem-solving, regular performance reviews, and ownership. CMCs that position themselves as an extension of the brand owner, share the brand owner's vision, and treat the brand owner's products as their own have a better chance of attracting more business and reducing the risk of failure.

6. CONCLUSION, NEXT STEPS

In this article the design and development of the initial artefact, the CSFs conceptual framework for sustainable CMCs, was completed. A management guide was proposed for CMCs to implement the framework, and the AHP method was used to identify the priority pillars for implementation. The framework and management guide is a five-level and eight-dimension maturity model, named the Mahove-Matope Sustainable CMC Maturity Model (SCMC-MM), that should enable CMCs to assess their current level on the sustainability journey and to identify the areas that require improvement solutions to be able to move up to the sustainable CMC level as the CMC improves.

In conclusion, the proposed framework underscores the relevance of industrial engineering in enabling CFCs to enhance their system efficiency, strengthen supply chain integration, and embed operational sustainability. Much of the literature and its associated models focus on manufacturing more broadly – often with reference to SMEs or manufacturing excellence programmes – but do not adequately account for the structural and operational realities of CMCs. This framework addresses that gap by responding to the distinct constraints that CMCs face, including limited authority over product design, dependence on clients' specifications, and the need to remain both efficient and flexible. The framework and management guide should contribute to research and to the literature on manufacturing outsourcing and CM, and should provide a novel tool that researchers, brand owners, consultants, and managers of CMCs could apply to transform CMCs into sustainable and strategic partners in their brand owner customers' supply chains.

Beyond its immediate application, the SCMC-MM could also have relevance for South African industrial development and SMME policy: by strengthening the role of CMCs, it supports more competitive, resilient, and sustainable local and global supply chains, thus being aligned with national objectives for industrial growth, localisation, and enterprise development.

Future research could validate the SMCM-MM by engaging a sample of CMCs, applying the model to their transformation initiatives, and evaluating the outcomes through performance indicators, stakeholder insights, and longitudinal analysis, thereby testing its robustness and refining it further. Future research could also explore the impact of 4IR technologies on CMCs. While many of the CSFs identified by [19] build on earlier manufacturing excellence approaches, [76] noted that AI is actively reshaping South African manufacturing, reinforcing the need for a sustainability framework that integrates digital capabilities with traditional CSFs.

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