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A generic balanced scorecard for small and medium manufacturing enterprises in South Africa

Authors:
Arthur Reynolds[1]
Houdini Fourie[1]
Lourens Erasmus[2]

Affiliations:
[1]School of Accounting, Nelson Mandela University, South Africa

[2]Department of Financial Governance, University of South Africa, South Africa

Corresponding author:
Arthur Reynolds,
arthur83415@gmail.com

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Background: Prior research confirmed that the balanced scorecard (BSC) can be used successfully at manufacturing small and medium enterprises (SMEs), to assist with sustainability. South African SMEs have a low survival rate despite being a significant contributor to the local economy with the manufacturing sector in particular hampered by negative growth.

Aim: The objective of this study was to develop a BSC for manufacturing SMEs in South Africa with measurable key performance indicators (KPIs).

Setting: We conducted a Delphi study with cost accounting specialists in different industries.

Methods: The development of the generic BSC was facilitated with a Delphi survey and analytical hierarchy process (AHP).

Results: The research presents a generic yet flexible BSC for manufacturing SMEs. A total number of 12 generic and 104 specific KPIs were identified. The results revealed a greater emphasis on the financial and customer perspectives that may be conducive to SME sustainability and success.

Conclusion: A generic BSC that can be adapted to specific organisational and industry requirements has the potential to enhance SME sustainability and success.

Introduction

South African small and medium enterprises (SMEs) contribute up to 22% of gross domestic product in the economy (Bureau for Economic Research 2016:31). Yet the survival rate of South African SMEs is very low, with nearly 80% of all SMEs failing over the long term (Brink, Cant & Ligthelm 2003:1; Olawale & Garwe 2010:729). The manufacturing sector is particularly vulnerable because of higher labour costs in comparison to other sectors, which results in a declined prevalence of manufacturing SMEs (Bureau for Economic Research 2016:20). The high labour costs are further exacerbated by South African labour laws, which render the lay-off of unproductive and redundant staff cumbersome at best (Bureau for Economic Research 2016:8). In addition, the high crime rate in South Africa could hamper the development of manufacturing SMEs, probably as a result of increased security costs (Sesep 2016:44). Difficulties obtaining financing and inexperienced entrepreneurs are additional contributing factors to the demise of manufacturing SMEs (Brink et al. 2003:18; Olawale & Garwe 2010:735). To facilitate the development of SMEs in South Africa, the National Development Plan (NDP) was introduced by the South African National Planning Commission (Ingle 2014:37). Ingle opines that, although the NDP acknowledges the high labour costs and social problems, there may be other factors limiting the growth of SMEs (Ingle 2014:38).

As an important contributor to the South African economy, how can SMEs' sustainability be improved? The balanced scorecard (BSC) is a measurement tool that may be used by an organisation to measure its financial and non-financial performance (Kaplan & Norton 1992:71). The BSC could enable an organisation to achieve its long-term strategic goals by managing the short-term targets (Okongwu, Brulhart & Moncef 2015:698). Furthermore, it may allow organisations to focus their attention only on those activities that are beneficial to the achievement of its strategic goals (Andersen, Cobbold & Lawrie 2001:7). As a result, the BSC is considered a useful management tool for SMEs, although its implementation may differ from that of larger organisations (Andersen et al. 2001:9; Fernandes, Raja & Whalley 2006:633).

Critical success factors (CSFs) are those factors contributing to an organisation's long-term survival (Rockart 1979:85). Extant literature identifies different CSFs for SMEs in developing countries. Two primary CSFs associated with SMEs in developing countries are operating costs and access to financial resources (Nuntsu, Tassiopoulos & Haydam 2004:521; Sesep 2016:57). It is considered important for SMEs to identify and address their CSFs to ensure sustained growth (Brink et al. 2003:19; Ng & Kee 2012:685; Temtime & Pansiri 2004:19). In order to address these CSFs, the BSC can thus be useful to owners and managers of SMEs (Ayvaz & Pehlivanl 2011:146), because the BSC aligns the organisation with its strategic goals (Andersen et al. 2001:9). Measurements that can be quantified and used to track the CSFs of an organisation, are key performance indicators (KPIs) (Fernandes et al. 2006:624). Fernandes et al. (2006:631) suggest that SMEs should only focus on the essential KPIs when implementing the BSC, that is on the quality of KPIs rather than increasing the number of KPIs. It is thus imperative that CSFs for SMEs be investigated.

It is evident from the literature consulted that the high failure rate of SMEs in South Africa has an adverse effect on economic growth (Bureau for Economic Research 2016; Ingle 2014; Sesep 2016). This may partly be attributable to two key aspects. Firstly, the generic CSFs for the sustained survival of manufacturing SMEs in South Africa are not clearly outlined in published literature; and secondly, it is not clear how these CSFs should be considered in a generic BSC for manufacturing SMEs' sustainability.

The research objective of this article is to propose measurable KPIs that should be considered in a generic BSC for manufacturing SMEs. In doing so, this article defines the context of the manufacturing SME and its generic functions; identifies the CSFs necessary for manufacturing SMEs to gain a competitive advantage; determines how the CSFs can be considered in the BSC; and outlines the KPIs to be included in the generic BSC for manufacturing SMEs.

The manufacturing small or medium enterprise and generic critical success factors

The modern manufacturing industry likely originated during the British Industrial Revolution in the 18th century as described by Kelly, Mokyr and O'Grada (2014). The process of manufacturing includes people, machinery and tools in a facility such as a factory to produce a product for a customer (Obi 2013:3–4; Rajput 2007:1). Manufacturing organisations in the SME category in South Africa are defined as manufacturing organisations with an annual turnover of less than R163 million, with some factories having a turnover of less than R2 million (Statistics South Africa 2017:30).

Literature revealed that six generic functions or activities (or departments) could be identified at a manufacturing SME, namely production and product development; sales and distribution; customer service; purchasing; marketing; and management and administration (Jespersen & Skjøtt-Larsen 2005:18; Kahn 2015:46; Obi 2013:12). It is likely that CSFs can be attributed to specific activities. Production was found to be essential and useful to measure performance (Bhagwat & Sharma 2007:48; Gunasekaran, Patel & McGaughey 2004:337; Khan & Tidke 2013:1; Kumar et al. 2016:1300). Product development is considered an important function because of its focus on innovation and reduction of costs (Dhurup & Makhitha 2014:232; Mendis & Ganga 2013:93). The supply chain management (SCM) function consists of the sales and distribution function, customer service and the purchasing function (Jespersen & Skjøtt-Larsen 2005:13). Measuring the performance of the SCM functions allows managers to direct their focus at areas of improvement (Afonso & Cabrita 2015:279; Callado & Jack 2015:288; Okongwu et al. 2015:698). Measuring the CSFs within the BSC could improve the effectiveness of the marketing function (Engle 2005:135), which may have a significant influence on the overall performance of a manufacturing SME (Mokhtar, Yusoff & Ahmad 2009:80; Mokhtar, Yusoff & Arshad 2014:57). It is plausible that measuring the six activities within the BSC could enhance the effectiveness of the BSC. The performance of the six activities incorporated in a BSC is affected by the CSFs, which is addressed next.

Owners of SMEs in South Africa often have limited business acumen and the potential failure of SMEs can likely be attributed to this lack of skill (Kirsten, Vermaak & Wolmarans 2015:32). The competence of the owner and manager of the manufacturing SME can be considered as a CSF necessary for its sustainability (Asare et al. 2015:32; Nkosi, Bounds & Goldman 2013:9; Okpara & Kabongo 2009:16; Okpara & Wynn 2007:33). It can thus be argued that the performance measurement of the management and administration function is important for manufacturing SMEs' sustainability.

Another CSF at manufacturing SMEs that may be of importance to ensure suppliers are paid and production lines are running, is cash flow management (Sebone & Barry 2009:193). A lack of cash flow may be attributed to the lack of access to financing, which is a common barrier for manufacturing SMEs (Asare et al. 2015:32; Ghosh et al. 2001:209; Moyo 2003:169; Okpara & Kabongo 2009:15; Okpara & Wynn 2007:31; Yusuf 1995:72). Because of the challenge of obtaining low-cost loans, SMEs are left with no choice but to opt for more expensive financing options (Okpara & Wynn 2007:31). The relationship between cash flow and the cost of financing suggests that measurement within a BSC may have to be conducted in parallel.

Government support can also be regarded as necessary for the sustainability of manufacturing SMEs, because a lack of government support could contribute to failure to increase their revenues (Moyo 2003:169; Onaolapo & Oladejo 2011:318). Failure to increase revenue because of a lack of government support can likely be attributed to a lack of funding to grow the customer base of manufacturing SMEs.

Apart from increasing revenues, manufacturing SMEs can also reduce operating costs to increase profits (Hung, Hung & Lin 2015:200). This suggests that owners could counter a limited revenue base by managing their operating cost. The measurement of revenue, as well as cost, could therefore be regarded as generic CSFs for manufacturing SMEs.

To produce a high-quality product, it is vital to ensure the basic elements of total quality management (TQM) (Charantimath 2011:76) are adhered to. Measuring the effectiveness of TQM can enhance the financial performance of an organisation (Mehralian et al. 2017:120). A high-quality product may form a basis for fostering customer relationships that is considered essential for organisational success (Ghosh et al. 2001:209; Moyo 2003:168). The customer relationship of the manufacturing SME needs to be maintained by a good product and at a competitive price, as well as with an effective aftersales service (Benzing, Chu & Kara 2009:63; Ghosh et al. 2001:211; Temtime & Pansiri 2004:23). Customer relationships can also be influenced by the on-time delivery performance of the SME (Belekoukias, Garza-Reyes & Kumar 2014:5361; Hung et al. 2015:198). There may also be a relationship between customer service delivery and the effectiveness of TQM (Mehralian et al. 2017:120). It is plausible that customer requirements such as value for money, quality and acceptable service delivery have to be monitored from the customer's viewpoint and internally to ensure that the cause and effect of these measures are addressed. These customer requirements could, therefore, be regarded as CSFs for manufacturing SMEs.

There may be an argument that resources such as 'people and machinery necessary for customer satisfaction' and 'internal management' must be managed and monitored. The development of people in the workplace was shown to be a CSF for SMEs (Avcikurt, Altay & Ilban 2011:161; Sebone & Barry 2009:192). By training people, it is possible to improve labour productivity, which is considered vital for manufacturing SME success (Santos-Requejo & González-Benito 2000:216). Labour productivity, customer satisfaction and the organisational performance, in general, can also be improved if employees are satisfied in the working environment (Antoncic & Antoncic 2011:600; Jeon & Choi 2012:341). It is likely that non-measurement of people and machinery could have an impact on the CSFs mentioned earlier and it may, therefore, have to be considered as a generic CSF for manufacturing SMEs.

Information and communications technology (ICT) is another critical contributing factor to manufacturing SMEs' success. The effective implementation and use of ICT at manufacturing SMEs can influence the financial success and market growth of the organisation (Dhurup & Makhitha 2014:246; Gono, Harindranath & Özcan 2014:14). In addition to ICT, the status and relevance of production technology may also be necessary for manufacturing SMEs to prosper (Santos-Requejo & González-Benito 2000:215).

Balanced scorecard and development techniques

As mentioned earlier, the BSC is used by organisations to review non-financial and financial measures (Kaplan & Norton 1992:71). The BSC consists of four perspectives (Kaplan & Norton 1992:71), namely financial, customer, internal, as well as learning and growth, in which several metrics could be evaluated. The financial perspective represents metrics from the shareholders' point of view and is typically measured in monetary terms. The customer perspective relates to the metrics that could indicate in what manner customer requirements are satisfied. The internal perspective provides an overview of the metrics that evaluate the internal performance of an organisation. The learning and growth perspective reviews the metrics that measure internal growth and development. Lin (2015:1239) has suggested that there is a relationship between the results from the non-financial perspectives and profitability. The development of a generic BSC could be an effective tool for manufacturing SMEs to increase profits by managing the important metrics.

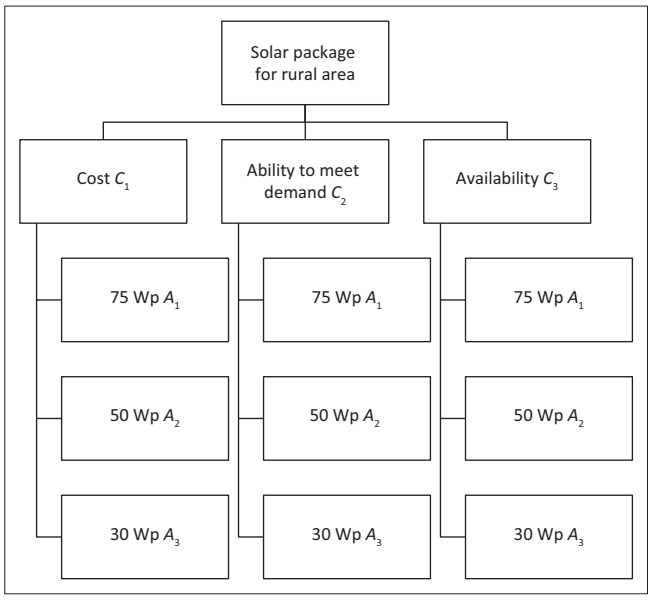
The development of the BSC is often used in conjunction with Delphi studies and the analytical hierarchy process (AHP). Delphi studies, using multiple surveys, are conducted when consensus is required on specific elements (Hasson, Keeney & McKenna 2000:1008; Remenyi 2013:70). A panel of experts is assembled to conduct a Delphi study (Shelton & Creghan 2015:376). The AHP is used for decision making and involves the use of pairwise comparisons (Saaty 2008:85). It is suggested that the AHP allows the relative importance of BSC perspectives and metrics to be established (Varma, Wadhwa & Deshmukh 2008:353). A scale of 1–9 is typically used to compare the elements (Table 1).

Once a problem is identified for which the AHP can be used, it is necessary to create a hierarchy design (Saaty 2008:85). As an example, in the study of Ahammed and Azeem (2013: 6–11), it was required to establish the most suitable solar power system for a rural area. The solar power systems had different power outputs (75 Wp, 50 Wp, 30 Wp), and each of the solar power systems had relative positives with respect to cost, ability and availability (Figure 1). These attributes were considered for the decision criteria.

TABLE 1: Scale of numbers for analytical hierarchy process elements.

Importance	Description
1	Equally important
2	Slight importance
3	Moderate importance
4	Moderate to strong importance
5	Strong importance
6	Strong to very strong importance
7	Very strong importance
8	Very strong to extreme importance
9	Extreme importance

Source: Adapted from Saaty, T.L., 2008, 'Decision making with the analytic hierarchy process', *International Journal of Services Sciences* 1(1), 83–98. https://doi.org/10.1504/IJSSCI.2008.017590



Source: Adapted from Ahammed, F. & Azeem, A., 2013, 'Selection of the most appropriate package of solar home system using analytic hierarchy process model in rural areas of Bangladesh', *Renewable Energy* 55(1), 6–11. https://doi.org/10.1016/j.renene.2012.12.020

FIGURE 1: Hierarchy design for decision making.

After the pairwise comparisons are conducted, it is possible to commence the AHP analysis. The first step is to calculate the relative weights for each solar power alternative (A_x). A comparison matrix (Eqn 1) is created for the relative weights. In addition, a relative weight calculation into a normalised matrix (Eqn 2) is conducted for each A_x by dividing column elements with column averages (Ahammed & Azeem 2013:8).

Comparison matrix: $$A_x = \begin{bmatrix} 1 & p & q \\ 1/p & 1 & r \\ 1/q & 1/r & 1 \end{bmatrix} \quad \text{[Eqn 1]}$$

Normalised matrix: $$M_x = \begin{bmatrix} 1 & s & t \\ 1/s & 1 & u \\ 1/t & 1/u & 1 \end{bmatrix} \quad \text{[Eqn 2]}$$

According to Mu and Pereyra-Rojas (2017:11), the activity of normalising the comparison matrix (relative weight calculation) refers to the approximate AHP method, a simpler form of AHP. The overall priorities as selected by a decision-maker can be calculated by using the average of each row in the normalised matrix. A consideration for pairwise comparisons is the consistency of the selections made by expert panels. The expectation is that selections are reasonably consistent and that perfect consistency is not normal (Ahammed & Azeem 2013:8). Consistency in selections in the AHP process is measured by calculating a consistency index (CI / Eqn 3) and a consistency ratio (CR / Eqn 4). The variable λ_{max} is calculated by using the priorities calculated for each row and multiplied with the comparison matrix. To calculate λ_{max} the weighted total for each row is divided by the priority for each row (Mu & Pereyra-Rojas 2017:13–14). Random consistency (RC / Eqn 5) is dependent on the number of alternatives (in the example of Ahammed and Azeem there are three). The RC increases proportionally with the number of alternatives (Ahammed & Azeem 2013:9). For example, for $n = 3$ the value for RC = 0.58, and for $n = 5$ the value for RC = 1.12 (Ahammed & Azeem 2013:9).

$$CI = \frac{\lambda_{max} - n}{n-1} \quad \text{[Eqn 3]}$$

$$CR = \frac{CI}{RC} \quad \text{[Eqn 4]}$$

$$n, RC = (1,0;\ 2,0;\ 3,0.58;\ 4,\ 0.90;\ 5,\ 1.12;\ 6,\ 1.24) \quad \text{[Eqn 5]}$$

It is acceptable to have CR ≤ 0.10 and to review (or reject) selections where CR > 0.10 (Ahammed & Azeem 2013:8). However, in practice it is not uncommon to accept CR > 0.10 and CR < 0.20, which is still considered reasonable (Pauer et al. 2016:5). After review, the final decision matrix that represents the basis for relative weights for the alternatives can be calculated. The calculation of the relative weights for the illustrated example is also presented (Ahammed & Azeem 2013:9), where:

- $A - C_x$= Alternatives for selection criteria cost (x)
- $A - C_y$= Alternatives for selection criteria demand (y)
- $A - C_z$= Alternatives for selection criteria availability (z)

In the example of Ahammed and Azeem, the relative weights for the alternatives were calculated by multiplying the decision matrix with the weighting of each selection criteria (Eqn 6 & 7):

$$\text{Relative weight} = \begin{bmatrix} A_x & A_y & A_z \\ B_x & B_y & B_z \\ C_x & C_y & C_z \end{bmatrix} \times \begin{bmatrix} x \\ y \\ z \end{bmatrix} \quad \text{[Eqn 6]}$$

$$\begin{bmatrix} 75\ Wp \\ 50\ Wp \\ 30\ Wp \end{bmatrix} = \begin{bmatrix} 0.0796 & 0.7118 & 0.2310 \\ 0.2648 & 0.2169 & 0.6651 \\ 0.6556 & 0.0712 & 0.1039 \end{bmatrix} \times \begin{bmatrix} CP & 0.5940 \\ HEN & 0.2967 \\ AP & 0.1093 \end{bmatrix} = \begin{bmatrix} 0.2837 \\ 0.2943 \\ 0.4219 \end{bmatrix} \quad \text{[Eqn 7]}$$

In the example from Ahammed and Azeem (the solar power system), 30 Wp is calculated to be the most desirable option because of the relative importance of low price (CP = 0.5940). The same principle can be applied to the BSC where the relative importance of each of the perspectives and KPIs can be related to the underlying weighting for each BSC metric.

The findings of this research could provide manufacturing SME managers and owners with little or no accounting knowledge, with a generic BSC template that could serve as a management tool. Furthermore, it would contribute to existing literature by providing a framework to develop generic BSCs in any context. The research method followed is explained next, followed by the results of the Delphi study, the findings and the conclusion.

Research method and design

Methodology

The research was conducted in a mixed-method research paradigm using a Delphi study over a period of 10 months. According to Bryman (2016:635), a mixed-method approach uses the principles of both quantitative and qualitative research techniques. In this study, qualitative data (open-ended responses), as well as quantitative data (close-ended responses) were collected. Furthermore, the data were analysed using qualitative techniques (thematic coding) and quantitative techniques such as AHP and descriptive statistics. The research therefore adopted a pragmatic stance that included significant interpretivist interaction with Delphi panel members. A comprehensive literature review was first conducted. Purposive, heterogeneous sampling was used to identify the 27 panel members for the Delphi study. The 27 panel members represented cost accounting experts from academia and practice, representing a range of industries. Holloway and Galvin (2016:146) describe heterogeneous sampling as when individual members can be differentiated from each other by a distinct characteristic. In this case, the panel members could be divided into two distinct groups: cost accounting academics and cost accounting industry experts. The sample of participants was sourced from previously established networks, social networks and universities. The study used descriptive statistics, content analysis and the AHP to analyse the feedback from the panel members.

Validity and reliability

The concepts used for the data analysis such as descriptive statistics, content analysis and AHP were adequately understood by the authors as demonstrated in the development of the generic BSC to ensure the validity of the statistical analysis. To ensure the reliability of the content analysis in Round 2, the final analysis was reviewed by an independent accounting expert. Furthermore, the Microsoft Excel for Mac template, developed for the AHP analysis conducted after the conclusion of Round 3, was reviewed and confirmed as applicable by an independent academic with expertise on the concepts of AHP. Causal reliability was demonstrated by the literature review that illustrated that AHP can be effectively used to develop the BSC because of its hierarchical structure. External validity is addressed by the use of a heterogeneous expert panel from different industries, as well as academics. As a result, the development of the research instruments (surveys) was based on past literature and the feedback from a Delphi panel made up of people who can be considered experts in the field of cost accounting.

Development of the generic balanced scorecard

The surveys used as part of the Delphi study were conducted on an online survey platform (SurveyMonkey) over three rounds, after which it was possible to present the generic BSC for manufacturing SMEs. The development of the generic BSC commenced with the identification of the 27 expert panel members and proceeded with an iterative process of research instrument design, surveys and data analysis. The process concluded with the development of the generic BSC after the completion of Round 3. The development of the generic BSC is outlined in Figure 2.

Delphi study Round 1: Measurability of critical success factors within activities

As mentioned previously, the generic CSFs and activities for manufacturing SMEs as identified in literature were adopted as a starting point for the Delphi study (Figure 3). As depicted in Figure 3, the five generic CSFs were allocated to each of the four BSC perspectives for a total of 20 potential KPIs. However, if the six generic manufacturing SME activities are considered for the generic BSC and there is a possibility to assign a KPI for each BSC perspective, generic CSF and activity combination,

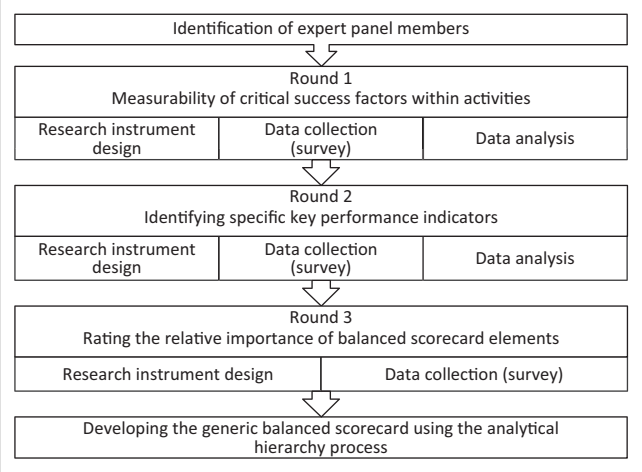


FIGURE 2: Delphi process used to develop the generic balanced scorecard.

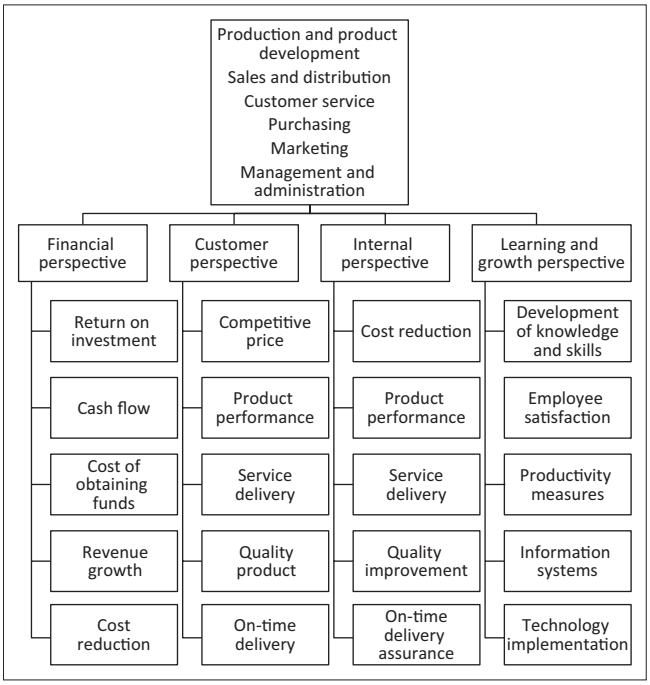


FIGURE 3: Generic critical success factors for manufacturing small and medium enterprises.

the total number of KPIs can potentially total 120 (excluding KPIs not reserved for any activity). This number of KPIs would not be practical for a manufacturing SME and it was therefore decided to use Round 1 to eliminate the number of KPIs that could be measured within activities.

Expert panel members were asked to assign the degree of measurability of each perspective, CSF and activity combination using a Likert-type scale (1 = not measurable at all; 2 = slightly measureable; 3 = moderately measurable; 4 = fully measurable; and 5 = extremely measurable). Of the 27 panel members, 23 participated in the survey (85% response rate). The response rate was considered more than sufficient for the purpose of the study. To establish which activity metric combination should be included in the generic BSC it was decided to only consider responses of 4 (fully measurable) or 5 (extremely measurable) as representing consensus. Activity metric combinations with an overall consensus of less than 70% were excluded from the generic BSC. An additional qualification criterion (mean ≥ 4) was included. Therefore, a combination of perspective and measurement category was only considered if it satisfied both the criteria of consensus and mean. An overview of the analysis and the results is provided in Appendix 1.

Delphi study Round 2: Identifying specific key performance indicators

In Round 1 expert panel members were requested to select the degree of measurability for each perspective–KPI category–activity combination. On conclusion of the survey, the number of potential measurement categories at activity level was reduced from 120 to 9. The next step was to consider the specific KPIs that can be measured in the generic BSC. Although the purpose of the study was to develop a generic BSC, it was considered that some flexibility must be available for manufacturing SME entrepreneurs and managers to adapt the BSC to their specific circumstances. The survey was divided into the four perspectives with the five KPI categories assigned to each metric. Each perspective was further divided into two sections: factory-level metrics and activity-level metrics. Expert panel members were requested to identify at least one KPI per metric category.

Round 2 had a significantly lower response rate than Round 1. Only 11 of the 27 panel members that were approached responded (41% response rate). Despite the lower response rate, a total number of 104 KPIs could be identified from the responses of the panel members. Because of the nature of the open-ended responses, the individual responses from the panel members were analysed using content analysis (available on request). An additional column was created where each specific KPI identified from the responses was entered. A further 11 columns were then created to capture responses. A corresponding response from a respondent was entered next to a specific KPI where it is found to be similar or identical. Any response was considered if it was judged to be specific and measurable; for example, 'quality control report' could not be included as it cannot be measured. The 104 specific KPIs identified from the content analysis were divided into 16 homogeneous metric groups representing generic KPIs (Appendices 2 and 3). The purpose of the generic KPIs was to provide the option of selecting appropriate specific KPIs to owners and managers of manufacturing SMEs.

Delphi study Round 3: Rating the relative importance of balanced scorecard elements

In Round 2, expert panel members were requested to identify specific and measurable KPIs that were grouped into 32 homogeneous metric groups (16 general KPIs identified from Round 2 on factory and activity levels). The purpose of Round 3 was to further reduce the number of general KPIs and to determine the number of KPIs that should be included in the BSC for the manufacturing SME. The first question on the survey requested panel members to identify the number of KPIs to be included in the BSC for manufacturing SMEs. A drop-down list was used for this purpose. The remainder of the survey used pairwise comparisons to enable panel members to decide on the relative importance of BSC perspectives and general KPIs within the categories (factory or activity level). The pairwise comparisons were scaled using the following terms: 1 – equal importance; 3 – moderately more important; 5 – essentially more important; 7 – very strong importance (over another KPI); and 9 – absolute importance (over another KPI). Of the 27 panel members, a total of 17 completed the survey (63% response rate). The improved response rate from Round 2 can be attributed to the use of questions requiring closed-ended responses in Round 3 instead of the open-ended responses used in Round 2.

Developing the generic balanced scorecard

The generic BSC for manufacturing SMEs was developed using the following general steps:

- **Step 1:** Calculate the number of KPIs suitable for manufacturing SMEs from the responses received from the panel members.
- **Step 2:** Apply the AHP to calculate the relative weights of the BSC perspectives, categories and KPIs.
- **Step 3:** Allocate the correct number of KPIs to each perspective and category.
- **Step 4:** Rank each KPI by its overall weighting, as well as the maximum weighting achieved for a single segment (combination of perspective and category).
- **Step 5:** Calculate a combined ranking for the overall weighting and the maximum segment weighting.
- **Step 6:** Assign the KPIs to the BSC individually by starting with the highest ranking KPI and assigning it to the segment with the highest relative weight that is still available.

To calculate the number of general KPIs, the median (M = 12) was deemed appropriate because of the high standard deviation (s = 7.09) in the sample. The mean ($\bar{x}$ = 14.76) was affected by three outliers as extremely high values (30; 25; 25).

The total number of general KPIs to be included in the generic BSC for manufacturing SMEs is therefore 12.

The next step was to use the AHP to calculate the weighting for the BSC perspectives and categories (factory or activity). At first, the data collected from the decision-makers were organised in a comparison matrix and a total was calculated for each column (Table 2 upper section). The relative weight for element in the comparison matrix was then calculated for the normalised matrix by dividing each element by the relevant total from the comparison matrix (Table 2 lower section). This process was repeated for each decision-maker as a basis for the priority weight calculations.

The priority weights for each criterion were calculated from the average of each row in the normalised matrix. For example, the priority weight for the financial perspective was calculated as (0.192 + 0.318 + 0.313 + 0.125) / 4 = 0.237. To calculate λ_{max}, the priority weights are transferred to a weighted comparison matrix where it is multiplied with the comparison matrix (Table 3). The row total is then divided by the average to determine a consistency measure that is used to calculate λ_{max}. Ultimately the average value of four consistency measures were used. For example, the consistency value for customer is calculated as 0.331 (priority weight) divided into 1.407 (sum of row weighted comparison) = 4.25. The 4.30 that was calculated for λ_{max} could also be calculated by using the matrix product function (MMULT) in Microsoft Excel for Mac using the parameters (comparison row and priority column) and then dividing by the average.

The next step was to calculate the consistency index and consistency ratio using the formulae as identified in literature (Eqn 8 – 10):

$$\text{CI} = \frac{\lambda_{max} - n}{n-1} = \frac{4.30 - 4}{4-1} = 0.10 \quad \text{[Eqn 8]}$$

$$\text{RC} = 0.90 \text{ (based on } n = 4) \quad \text{[Eqn 9]}$$

TABLE 2: Comparison and normalised matrix.

Matrix	Criteria	Financial	Customer	Internal	Learning
Comparison	Financial	1.000	1.000	5.000	0.333
	Customer	1.000	1.000	7.000	1.000
	Internal	0.200	0.143	1.000	0.333
	Learning	3.000	1.000	3.000	1.000
	Total	**5.200**	**3.143**	**16.000**	**2.667**
Normalised	Financial	0.192	0.318	0.313	0.125
	Customer	0.192	0.318	0.438	0.375
	Internal	0.038	0.045	0.063	0.125
	Learning	0.577	0.318	0.188	0.375
	Total	**1.000**	**1.000**	**1.000**	**1.000**

TABLE 3: Weighted comparison matrix with $\lambda_{max.}$

Perspectives	Financial	Customer	Internal	Learning	Total	λ_{max}
Average	0.24	0.33	0.07	0.36	1.00	4.30
Financial	0.24	0.33	0.34	0.12	1.03	4.34
Customer	0.24	0.33	0.47	0.36	1.41	4.25
Internal	0.05	0.05	0.07	0.12	0.28	4.19
Learning	0.71	0.33	0.20	0.36	1.61	4.42

$$\text{CR} = \frac{CI}{RC} = \frac{0.10}{0.90} = 0.111 \quad \text{[Eqn 10]}$$

It was established from literature that selections with CR < 0.10 should be accepted but that CR < 0.20 can also be considered as appropriate in some cases. It was calculated from the AHP calculation that if different CR criteria are applied (between < 0.10 and < 0.20) that the results only differ marginally across a range of criteria (Table 4). The overall results were calculated by using the arithmetic mean for qualifying responses. The financial and customer perspective were preferred over the internal perspective ranging from 63% combined for CR < 0.20 to 72% combined for CR < 0.10 as qualifying criteria. The number of qualifying responses increased from 6 to 9 (out of 15 selections) if CR inclusion rate is relaxed from < 0.100 to < 0.125 and only increased again by another 2 when CR < 0.20 is applied. It appears that adequate consistent and sufficient data collection may be applicable if CR is set between < 0.125 and < 0.175. Based on this premise and the relative consistency of the results across the different inclusion criteria, the remainder of the AHP discussion will be based on the result from CR < 0.150.

From the AHP calculation based on CR < 0.15, it was possible to calculate the overall weights and segment weights for each general KPI. The next step was to assign the 12 generic KPIs to each perspective and segment (factory and activity level). It was already established that the financial and customer perspectives (of relative equal stature) are preferred by decision-makers in a ratio of approximately 2:1. Therefore, a total number of 8 general KPIs (out of 12) were assigned to the financial and customer perspectives in equal measure. The remaining four general KPIs were assigned in equal measure to each of the four segments for the internal and learning perspectives. Because only one general KPI was available for the learning activity-level segment and it was considered more important than the other three segments, it was considered the only appropriate strategy. The preceding approach is outlined in Figure 4.

The next step was to divide the eight generic KPIs assigned to the financial and customer perspectives to the four activity segments (Figure 5). The expert panel preferred 66.06% of KPIs in the financial perspective to be assigned to the

TABLE 4: Perspective overall weighting for different acceptance criteria of consistency ratio.

Consistency ratio	< 0.100	< 0.125	< 0.150	< 0.175	< 0.200
Financial perspective	0.324	0.352	0.352	0.352	0.308
Customer perspective	0.397	0.346	0.346	0.346	0.320
Internal perspective	0.100	0.102	0.102	0.102	0.138
Financial perspective	0.179	0.200	0.200	0.200	0.233
Qualifying responses	6	9	9	9	11
Non-qualifying responses	9	6	6	6	4
Total responses	15	15	15	15	15
% qualifying responses	40%	60%	60%	60%	73%
No selection made	2	2	2	2	2
Overall survey response	17	17	17	17	17

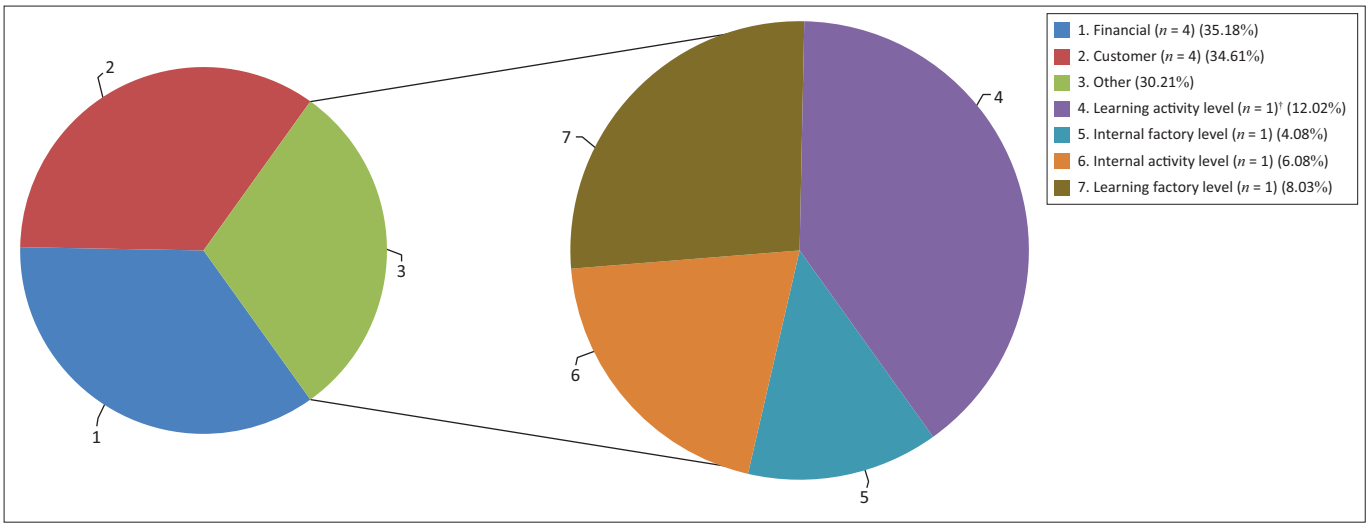
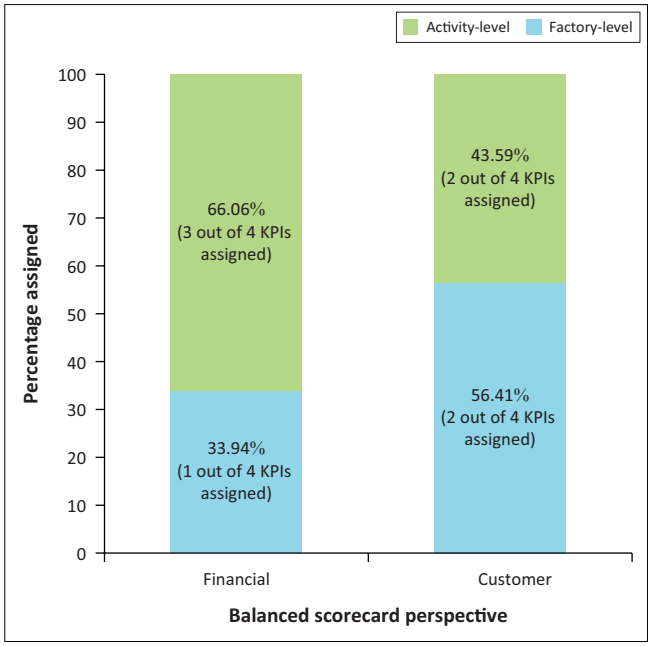


FIGURE 4: Number of key performance indicators for balanced scorecard with CR < 0.15. †Learning and growth activity level only has one generic key performance indicator available.



KPI, key performance indicator.

FIGURE 5: Number of key performance indicators to financial and customer perspectives.

activity level. Three generic KPIs were assigned to the activity level and the remaining KPI were assigned to the factory level. The result for the customer perspective was closer and the KPIs were therefore equally assigned to the factory level and the activity level. The generic BSC were therefore established to include four financial perspective KPIs (one factory and three activity), four customer perspective KPIs (two each for factory and activity), two internal perspective KPIs (one each for factory and activity) and two learning perspective KPIs (one each for factory and activity).

To establish a priority ranking for the general KPIs it was considered that an important general KPI within a lowly weighted perspective might be eliminated by a general KPI within a highly weighted perspective. The general KPIs were ranked by means of a combination ranking, which is a combination of overall ranking and highest segment weighting. The next step was to assign the general KPIs individually to the BSC in order of combined ranking by its highest available segment weight (Table 5). In this case, the first general KPI that could be assigned is manufacturing performance. It was assigned to the learning and growth perspective in the production activity, with a segment weighting of 1.000 as it was the only element in this context. Using this approach, it was possible to assign 12 general KPIs (out of 16) to the generic BSC. Three generic KPIs in the learning and growth perspective on factory level (employee education, information technology and employee satisfaction) would not be assigned as only one general KPI was required in the segment, which in this case was production technology; it had an average ranking of eight, and an overall ranking of seven. Furthermore, the general KPI cost of obtaining funds was ranked last (16) in all measures and was therefore not included.

Ethical consideration

Ethical clearance was obtained prior to the commencement of the research from the Nelson Mandela University (Ref: H-15-BES-ACC-020). The cost accounting experts were supplied with an information booklet outlining the purpose and scope of the study. A section where the participant was required to provide informed consent was provided for at the beginning of each survey. The surveys did not require the participants to divulge their names or any personal details. Furthermore, the Internet Protocol (IP) addresses of the participants were not tracked during the process of conducting the surveys to maintain their anonymity.

Results

In Round 1, the expert panel only assigned nine perspective and generic CSF combinations to activities constituting a small proportion (7.5%) of all combinations (Table 6). In the financial perspective, revenue growth was paired with the sales and distribution function, which is consistent with

TABLE 5: Ranking of general key performance indicators for the generic balanced scorecard with consistency ratio < 0.15.

KPI category	Max segment weighting	BSC weighting	Rank segment	Rank BSC	Combined ranking	Rank overall
Turnover	0.176	0.061	13	5	9	8
Cash flow	0.464	0.055	3	7	5	3
Earnings	0.257	0.123	7	3	5	3
Cost of obtaining funds	0.103	0.012	16	16	16	16
Cost savings	0.205	0.057	9	6	8	6
Inventory turnover	0.179	0.048	12	8	10	10
On-time delivery	0.265	0.098	6	4	5	3
Selling price	0.180	0.035	11	9	10	10
Market share	0.136	0.026	15	11	13	15
Customer satisfaction	0.623	0.184	2	2	2	2
Manufacturing performance	1.000	0.189	1	1	1	1
Material rework and scrapping	0.149	0.031	14	10	12	13
Employee education	0.245	0.020	8	14	11	12
Information technology	0.188	0.015	10	15	13	14
Production technology	0.286	0.023	4	12	8	7
Employee satisfaction	0.280	0.023	5	13	9	8

KPI, key performance indicator; BSC, balanced scorecard.

TABLE 6: Combinations selected in Round 1.

Perspective	Generic CSF	Activity
Financial	Revenue growth	Sales and distribution
Financial	Cost reduction	Purchasing
Customer	Service delivery	Customer service
Customer	Quality product	Production and product development
Customer	On-time delivery	Sales and distribution
Internal	Cost reduction	Production and product development
Internal	Cost reduction	Purchasing
Internal	Quality improvement	Production and product development
Learning and growth	Productivity measures	Production and product development

CSF, critical success factor.

the functionality of this activity (Jespersen & Skjøtt-Larsen 2005:138). The purchasing function was associated with cost savings by expert panel members. It confirms the importance of the purchasing function for a manufacturing SME to ensure that profit margins are maximised (Hung et al. 2015:199). The customer perspective and the internal perspective each found three activities associated with performance measurement. Service delivery was associated with the customer service function, which is described as a core activity in the SCM function (Jespersen & Skjøtt-Larsen 2005:18). Delivering a quality product was considered significant in the context of the production and product development function. Although quality is relevant across an organisation (Benzing et al. 2009:63; Ghosh et al. 2001:211), the expert panel may have wanted to focus scarce resources on the primary activities. Cost reduction (as an internal activity, as opposed to monetary result) was considered important in the production activity as well as in the purchasing function. Furthermore, on-time delivery was considered relevant for the sales and distribution function. In the learning and growth perspective, only production measure could be associated with an activity. In this case, it was associated with production and product development.

The expert panel identified 104 specific KPIs for manufacturing SMEs in Round 2. It was necessary to group the specific KPIs into 16 categories (general KPIs) for further evaluation (Appendix 2 and 3). It was found that the expert panel identified specific KPIs that were fundamentally similar but could be used in different settings. It is likely that various manufacturing SMEs may have slightly different preferences with regards to the selection of specific KPIs. Therefore, it was established that a generic BSC should have sufficient flexibility within a formal structure. It was found that the BSC implementation may fail if a structured approach is not followed for the design of the BSC (Andersen et al. 2001:6; Fernandes et al. 2006:627).

The generic BSC (Figure 6) conforms to this belief by only including 12 metrics for manufacturing SMEs' performance measurement, yet it still allows the entrepreneurs the flexibility of selecting appropriate KPIs for their industry. It is suggested that the effectiveness of the generic BSC for manufacturing SMEs should be empirically tested to determine the suitability in different manufacturing industries. It is possible that an empirical study of this nature could adapt and improve the generic BSC even further. Furthermore, it is recommended that a similar study be conducted with alternative development techniques not used in this research.

The results from the AHP calculation enabled the 12 general KPIs to be included in the generic BSC for manufacturing SMEs to be allocated according to the preference from the expert panel. In Round 3 it was found that the financial and customer perspectives were considered more important to the expert panel compared to the internal and learning perspectives (Table 4).

The rationale behind the generic BSC is that owners and entrepreneurs of manufacturing SMEs select a specific KPI relevant to their organisation from the data collected in Round 2, for example, cash flow is required to be measured once in the generic BSC. However, manufacturing SMEs can also select one of the following KPIs, namely cash availability, cash conversion cycle, inventory value, creditors versus debtor's days, number of days with positive cash flow, cash flow from operations or availability of overdraft facility. The generic BSC is presented in Figure 6, listing the specific KPIs that manufacturing SMEs can select for each of the 12 generic KPIs.

Conclusion

The primary purpose of the research was to develop and present a generic BSC for manufacturing SMEs in South Africa.

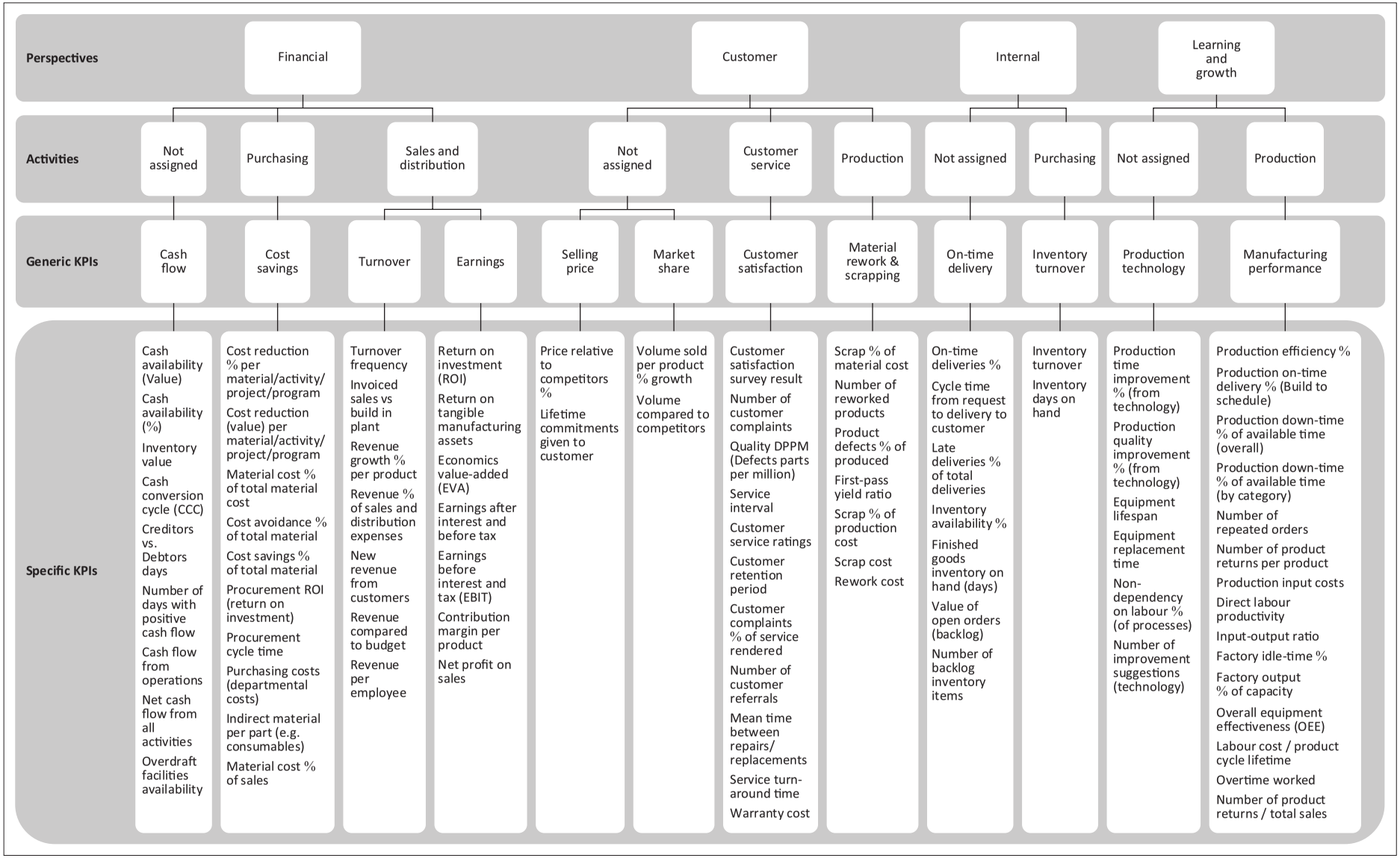


FIGURE 6: The generic balanced scorecard for small and medium manufacturing enterprises in South Africa. KPI, key performance indicator.

The basis for the development of the generic BSC was the generic CSFs identified in the literature review. The generic CSFs were classified in broadly the same categories as the four BSC perspectives. Furthermore, the generic BSC was developed to allow flexibility for manufacturing SMEs that may have slightly different requirements. This was achieved by including the 12 general KPIs in the generic BSC that each includes numerous specific KPIs, as identified by the expert panel.

In general, the findings from the expert panel during development of the generic BSC confirmed the premise that the BSC for manufacturing SMEs should be uncomplicated and easy to use. The ability to adapt the generic BSC to the needs of the manufacturing SMEs, by incorporating sufficient flexibility, represents a management tool that could be adapted to many settings. Furthermore, using cost accounting experts to develop the generic BSC ensures that the final instrument has a sound development basis and can be reliably used in practice. The researchers are therefore confident that an appropriate performance measurement system has been developed for manufacturing SMEs, representing a significant contribution to existing literature.

Recommendations and suggestions for future research

It is recommended that owners and management of manufacturing SMEs adapt the generic BSC with due consideration of the specific KPIs applicable to their organisations. It is also advised that easily measurable KPIs be selected that do not require additional resources. Furthermore, it is suggested that future research attempt to measure the suitability of the generic BSC by means of an implementation case study. It is proposed that a case study be performed for a period of time and the suitability of integrating with costing systems be established.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article. The views expressed in the submitted article are the authors' own and do not necessarily reflect the official position of the listed institutions.

Authors' contribution

A.R. constructed the article from the research conducted during the PhD study; H.F. was responsible for academic insight and review; and L.E. was responsible for academic insight and review.

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Appendices start on the next page →

Appendix 1

TABLE 1-A1: Activity metric evaluation Round 1.

Perspective	Category	Production				Customer service				Marketing				Purchasing				Sales and distribution				Administration			
		Mean	Median	SD	≥4 (%)	Mean	Median	SD	≥4 (%)	Mean	Median	SD	≥4 (%)	Mean	Median	SD	≥4 (%)	Mean	Median	SD	≥4 (%)	Mean	Median	SD	≥4 (%)
Financial	Cash flow	3.304	3.000	1.195	43	2.348	2.000	1.165	22	3.087	3.000	0.928	35	3.478	3.000	1.175	48	3.826	4.000	1.049	74	3.609	4.000	1.170	57
	Cost of obtaining funds	3.130	4.000	1.483	57	1.913	2.000	0.974	9	2.348	2.000	1.165	17	3.087	4.000	1.248	52	2.609	3.000	1.310	35	3.261	3.000	1.358	48
	Cost reduction	3.652	4.000	0.914	65	2.478	3.000	1.058	17	3.043	3.000	0.999	30	4.087	4.000	0.775	74	3.304	3.000	1.081	43	3.522	3.000	1.016	48
	Return on investment	3.652	4.000	1.237	57	2.217	2.000	0.930	13	3.000	3.000	0.885	30	3.174	3.000	1.239	48	3.435	4.000	1.173	57	2.652	3.000	1.202	17
	Revenue growth	2.870	3.000	1.296	35	2.522	2.000	1.058	22	3.304	3.000	1.081	39	2.174	2.000	1.434	22	4.217	5.000	0.930	74	3.087	3.000	1.282	39
Customer	Competitive price	3.174	3.000	1.307	48	2.565	3.000	1.346	35	3.435	4.000	1.135	57	3.348	4.000	1.339	57	3.826	4.000	0.916	78	2.522	3.000	1.347	30
	On-time delivery	3.478	4.000	1.247	52	3.913	4.000	1.139	70	2.261	2.000	1.188	22	3.261	3.000	1.390	48	4.304	4.000	0.748	83	2.217	2.000	1.317	22
	Product performance	3.522	4.000	1.175	65	3.261	4.000	1.150	57	3.174	3.000	1.307	43	2.652	3.000	1.339	39	3.609	4.000	1.052	65	2.217	2.000	1.214	22
	Quality product	4.261	4.000	0.792	87	3.478	4.000	1.247	57	2.522	2.000	1.281	30	3.261	4.000	1.112	52	3.522	4.000	1.347	70	2.217	2.000	1.214	22
	Service delivery	3.217	3.000	1.102	48	4.087	4.000	1.018	83	2.696	3.000	1.120	26	2.652	3.000	1.433	39	3.696	4.000	0.906	61	2.652	3.000	1.306	30
Internal	Cost reduction	4.130	4.000	0.797	74	2.826	3.000	1.403	39	2.957	3.000	1.367	39	4.261	4.000	0.792	78	3.652	4.000	1.047	52	3.304	4.000	1.300	57
	On-time delivery assurance	3.652	4.000	1.005	57	3.652	4.000	0.914	57	2.565	3.000	1.378	30	3.348	3.000	1.272	48	3.913	4.000	1.060	78	2.826	3.000	1.372	35
	Product performance	3.478	4.000	1.410	57	3.304	3.000	1.120	48	2.957	3.000	1.233	30	3.087	3.000	1.248	48	3.304	4.000	1.159	52	2.435	2.000	1.346	30
	Quality improvement	4.217	4.000	0.778	78	3.130	3.000	1.034	35	2.478	2.000	1.347	26	3.304	3.000	1.120	39	3.043	3.000	1.334	39	2.565	2.000	1.313	30
	Service delivery	3.304	3.000	1.231	48	3.739	4.000	0.988	61	2.870	3.000	1.154	35	3.174	3.000	1.090	43	3.478	4.000	1.137	57	2.913	3.000	1.213	35
Learning and growth	Development of knowledge and skills	3.435	3.000	0.970	48	2.739	3.000	0.943	22	2.609	3.000	1.132	22	2.913	3.000	0.974	30	2.957	3.000	0.751	26	3.087	3.000	0.974	39
	Employee satisfaction	3.174	3.000	1.129	39	2.739	3.000	1.188	26	3.087	3.000	1.176	43	2.957	3.000	1.160	39	2.870	3.000	1.076	30	3.348	3.000	1.127	43
	Information systems	3.522	4.000	1.098	52	3.000	3.000	1.103	35	2.826	3.000	1.090	22	3.217	3.000	1.284	48	3.261	3.000	1.150	48	3.391	3.000	1.093	48
	Productivity measures	4.174	4.000	0.816	83	3.130	3.000	1.034	39	2.739	3.000	1.150	26	3.130	3.000	1.191	39	3.174	3.000	1.049	39	3.087	3.000	1.100	39
	Technology implementation	3.739	4.000	1.072	65	3.174	3.000	1.007	39	3.000	3.000	1.103	35	3.174	3.000	1.167	43	3.174	3.000	1.129	43	3.304	4.000	1.231	52

Appendix 2

TABLE 1-A2: Specific metrics identified in Round 2 (Part 1).

Number	Generic KPI	Specific KPI	BSC perspective	Activities
1	Turnover	Turnover frequency	F	Fa
2	Turnover	Invoiced sales versus build in plant	F	Fa
3	Turnover	Revenue growth % per product	F	Fa Sa
4	Turnover	Revenue % of sales and distribution expenses	F	Sa
5	Turnover	New revenue from customers	F	Sa
6	Turnover	Revenue compared to budget	F	Sa
7	Turnover	Revenue per employee	F	Fa
8	Cash flow	Cash availability (Value)	F	Fa
9	Cash flow	Cash availability (%)	F	Fa
10	Cash flow	Inventory value	F	Fa
11	Cash flow	Cash conversion cycle (CCC)	F	Fa
12	Cash flow	Creditors vs. Debtors days	F	Fa
13	Cash flow	Number of days with positive cash flow	F	Fa
14	Cash flow	Cash flow from operations	F	Fa
15	Cash flow	Net cash flow from all activities	F	Fa
16	Cash flow	Overdraft facilities availability	F	Fa
17	Earnings	Return on investment (ROI)	F	Fa
18	Earnings	Return on tangible manufacturing assets	F	Fa
19	Earnings	Economics value-added (EVA)	F	Fa
20	Earnings	Earnings after interest and before tax	F	Fa
21	Earnings	Earnings before interest and tax (EBIT)	F	Sa
22	Earnings	Contribution margin per product	F C	Fa Sa
23	Earnings	Net profit on sales	F	Fa
24	Cost of obtaining funds	Weighted average cost of capital (WACC)	F	Fa
25	Cost of obtaining funds	Market value	F	Fa
26	Cost of obtaining funds	Interest paid %	F	Fa
27	Cost savings	Cost reduction % per material/activity/project/programme	F	Pu
28	Cost savings	Cost reduction (value) per material/activity/project/programme	F	Pu
29	Cost savings	Material cost % of total material cost	F	Pu
30	Cost savings	Cost avoidance % of total material	I	Pu
31	Cost savings	Cost savings % of total material	I	Pu
32	Cost savings	Procurement ROI (return on investment)	I	Pu
33	Cost savings	Procurement cycle time	I	Pu
34	Cost savings	Purchasing costs (departmental costs)	I	Pu
35	Cost savings	Indirect material per part (e.g. consumables)	I	Pu
36	Cost savings	Material cost % of sales	F	Pu
37	Inventory turnover	Inventory turnover	F	Pu
38	Inventory turnover	Inventory days on hand	F I	Pu
39	On-time delivery	On-time deliveries %	F C I	Fa Sa
40	On-time delivery	Cycle time from request to delivery to customer	C	Sa
41	On-time delivery	Late deliveries % of total deliveries	C I	Fa Sa
42	On-time delivery	Inventory availability %	I	Fa
43	On-time delivery	Finished goods inventory on hand (days)	I	Fa
44	On-time delivery	Value of open orders (backlog)	C	Sa
45	On-time delivery	Number of backlog inventory items	I	Fa
46	Selling price	Price relative to competitors %	C	Fa
47	Selling price	Lifetime commitments given to customer	C	Fa
48	Market share	Volume sold per product % growth	C	Fa
49	Market share	Volume compared to competitors	C	Fa
50	Customer satisfaction	Customer satisfaction survey result	C I	Fa
51	Customer satisfaction	Number of customer complaints	C I	Fa Sa Cu Pr
52	Customer satisfaction	Quality DPPM (Defects parts per million)	C	Fa

KPI, key performance indicator; BSC, balanced scorecard; F, financial perspective; C, customer perspective; I, internal perspective; L, learning perspective; Fa, factory-level activity; Cu, customer service activity; Pu, purchasing activity; Sa, sales activity; Pr, production activity.

Appendix 3

TABLE 1-A3: Specific metrics identified in Round 2 (Part 2).

Number	Generic KPI	Measurable KPI	BSC perspective	Activities
53	Customer satisfaction	Service interval	C	Fa
54	Customer satisfaction	Customer service ratings	C	Cu
55	Customer satisfaction	Customer retention period	C	Cu
56	Customer satisfaction	Customer complaints % of service rendered	C	Cu
57	Customer satisfaction	Number of customer referrals	C	Cu
58	Customer satisfaction	Mean time between repairs or replacements	C	Pr
59	Customer satisfaction	Service turnaround time	I	Fa
60	Customer satisfaction	Warranty cost	C	Fa
61	Material rework and scrapping	Scrap % of material cost	C	Pr
62	Material rework and scrapping	Number of reworked products	C I	Pr
63	Material rework and scrapping	Product defects % of produced	I	Pr
64	Material rework and scrapping	First-pass yield ratio	I	Pr
65	Material rework and scrapping	Scrap % of production cost	I	Pr
66	Material rework and scrapping	Scrap cost	I	Pr
67	Material rework and scrapping	Rework cost	I	Pr
68	Manufacturing performance	Production efficiency %	C I L	Fa Pr
69	Manufacturing performance	Production on-time delivery % (build to schedule)	I	Fa
70	Manufacturing performance	Production downtime % of available time (overall)	I	Fa
71	Manufacturing performance	Production downtime % of available time (by category)	I	Fa
72	Manufacturing performance	Number of repeated orders	I	Fa
73	Manufacturing performance	Number of product returns per product	I	Fa
74	Manufacturing performance	Production input costs	I	Pr
75	Manufacturing performance	Direct labour productivity	L	Pr
76	Manufacturing performance	Input–output ratio	L	Pr
77	Manufacturing performance	Factory idle time %	L	Pr
78	Manufacturing performance	Factory output % of capacity	L	Pr
79	Manufacturing performance	Overall equipment effectiveness	L	Pr
80	Manufacturing performance	Labour cost / product cycle lifetime	I	Pr
81	Manufacturing performance	Overtime worked	I	Pr
82	Manufacturing performance	Number of product returns / total sales	I	Fa
83	Employee education	Training hours (total)	L	Fa
84	Employee education	Training hours (per employee)	L	Fa
85	Employee education	Apprentice/learnerships % of workforce	L	Fa
86	Employee education	Learning progression (% passing from one standard to next)	L	Fa
87	Employee education	Number of employees with tertiary education	L	Fa
88	Employee education	Number of courses attended and completed	L	Fa
89	Information technology	Number of IT updates	L	Fa
90	Information technology	Number of logged IT calls	L	Fa
91	Information technology	Number of repeat IT calls	L	Fa
92	Information technology	Processes with real-time feedback %	L	Fa
93	Information technology	System unavailability %	L	Fa
94	Production technology	Production time improvement % (from technology)	L	Fa
95	Production technology	Production quality improvement % (from technology)	L	Fa
96	Production technology	Equipment lifespan	L	Fa
97	Production technology	Equipment replacement time	L	Fa
98	Production technology	Non-dependency on labour % (of processes)	L	Fa
99	Production technology	Number of improvement suggestions (technology)	L	Fa
100	Employee satisfaction	Trade survey employee scoring	L	Fa
101	Employee satisfaction	Employee satisfaction survey ratio	L	Fa
102	Employee satisfaction	Number of grievances submitted	L	Fa
103	Employee satisfaction	Absenteeism %	L	Fa
104	Employee satisfaction	Employee turnover rate	L	Fa

KPI, key performance indicator; BSC, balanced scorecard; F, financial perspective; C, customer perspective; I, internal perspective; L, learning perspective; Fa, factory-level activity; Cu, customer service activity; Pu, purchasing activity; Sa, sales activity; Pr, production activity.