

A Sustainability Model for a Municipality

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Abstract

Sustainability is crucial for ensuring the well-being of both current and future generations by promoting a balanced approach to economic growth, social equity, and environmental protection. With increasing pressure from customers, investors, and international organisations such as the United Nations, municipalities are urged to adopt sustainable practices. This study aims to provide a structured approach for municipalities to meet these growing demands by integrating sustainability into their operations and strategies. A survey was conducted among 395 respondents to identify the key components of a municipal sustainability model, with the data analysed using confirmatory factor analysis, Spearman's correlation test, chi-square test, and Structural Equation Modelling (SEM). The findings revealed critical elements of the proposed sustainability model, where confirmatory factor analysis identified significant variables for each construct, and SEM validated the overall model. The results suggest that sustainability initiatives should align with legislative requirements, be incorporated into business strategies, and involve active stakeholder engagement. The model highlights the importance of embedding sustainability into service delivery and promoting continuous improvement through feedback and lessons learned. Recommendations include fostering a culture of sustainability within the municipality, enhancing stakeholder participation, and ensuring strict compliance with sustainability legislation and guidelines. Managerial implications suggest that leadership should prioritise sustainability in strategic planning, promote awareness and training programmes, and establish multidisciplinary structures to support sustainability initiatives.

Keywords: Sustainability Model, Municipality, Pillars of Sustainability, Public Sector

1. Introduction

Sustainability, as defined by the Brundtland Commission of the United Nations, is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. This concept underscores the importance of making decisions and implementing practices that ensure the long-term health and viability of social, economic, and environmental systems. It involves considering the impact of current actions on the future and making choices that foster the continued well-being of both people and the planet [1].

The nature of sustainability is often described through its three interconnected pillars: economic growth, environmental protection, and social quality of life. These pillars form the foundation of sustainable development, necessitating a balance between them to ensure the successful implementation of sustainability principles. Economic growth focuses on generating wealth and improving living standards, environmental protection aims to preserve natural resources and ecosystems, and social quality of life ensures that all individuals have access to basic needs, opportunities, and a fair distribution of benefits [1]. Other approaches to sustainability include systemic reform and the integration of sustainability into all areas of governance and decision-making, which are essential for fostering a sustainable

society [2].

In the public sector, sustainability is of paramount importance as it directly influences the ability of governments to deliver services that meet the needs of their communities while safeguarding future resources. Public sector perspectives on sustainability emphasise the critical role of governance frameworks, which include public policies supporting green governance, stakeholder coordination, and the promotion of a circular economy [3-5]. The implementation of Environmental Management Systems (EMS) and effective stakeholder engagement are crucial for managing and reducing environmental impacts within public organisations [6]. Additionally, the public sector's transformative capacity is essential in driving sustainability transitions through mission-oriented innovation policies that address societal challenges [7,8]. Integrating these perspectives into public sector operations is vital for embedding sustainability into the core functions of municipalities, thereby contributing to long-term sustainable development.

2. Literature Review

2.1 Theories Relevant to Sustainability

Sustainability models serve as essential frameworks guiding the development and implementation of sustainable practices

by balancing economic, environmental, and social dimensions. The concept of sustainability, popularised by the Brundtland Commission, emphasises the need to meet present needs without compromising the ability of future generations to meet theirs. This idea is encapsulated in the Three Pillar Basic Model, which underlines the interdependence of the economy, environment, and society [1].

Other models, such as the Prism of Sustainability and the Doughnut Model, offer expanded or alternative perspectives by introducing additional dimensions like governance or focusing on the balance between human needs and planetary boundaries. These theories collectively highlight the necessity for systemic reform and the integration of sustainability into all areas of governance and decision-making processes [2].

2.2 Models of Sustainability

2.2.1 Three Pillar Basic Model

The Three Pillar Basic Model is foundational in sustainability discourse, emphasising the interdependence of economic, environmental, and social dimensions. This model has been critiqued for potentially fostering compartmentalised approaches that may favour the economic dimension over others. However, it remains a critical framework for understanding the integrated nature of sustainable development [1].

The Three Pillar Basic Model is particularly applicable to the public sector because it aligns with the core functions of government, balancing economic growth, environmental stewardship, and social welfare. Public sector entities, such as municipalities, are inherently tasked with managing these three dimensions, making this model a natural fit. However, the challenge lies in ensuring that the economic dimension does not overshadow environmental and social considerations, which can happen if not properly managed.

2.2.2 The Prism of Sustainability

Developed by the Wuppertal Institute, the Prism of Sustainability adds an institutional dimension to the basic three pillars, highlighting the importance of governance and policy interlinkages. This model addresses the need for comprehensive public policies that support green governance and the coordination of stakeholders to tackle environmental challenges [9].

The addition of the institutional dimension in the Prism of Sustainability makes it especially pertinent for the public sector. Governance and policy interlinkages are at the heart of public sector operations, and this model provides a framework for integrating sustainability into these processes. By incorporating governance structures and policy-making into sustainability efforts, public sector organisations can more effectively coordinate actions across different sectors and levels of government, ensuring that sustainability is embedded into the legislative and regulatory framework.

2.2.3 The Doughnut Model

Introduced by economist Kate Raworth, the Doughnut Model

visualises sustainability as a balance between fulfilling human needs and respecting planetary boundaries. This model advocates for economies to operate within a "safe and just space" for humanity, emphasising the need to prevent environmental degradation while ensuring social equity [10].

The Doughnut Model's emphasis on staying within planetary boundaries while meeting social needs is highly relevant to public sector roles, particularly in urban planning, infrastructure development, and social services. Governments are responsible for ensuring that development does not exceed environmental limits, and this model provides a clear visualisation and guiding principle for policymakers. In the context of municipalities, this model can help planners design cities and communities that are sustainable, resilient, and equitable.

2.2.4 Atkisson's Pyramid Model

Atkisson's Pyramid Model offers a step-by-step approach to achieving sustainability, beginning with the measurement of indicators and progressing towards forming actionable agreements and strategies. This model is particularly valuable for its structured methodology, which helps organisations systematically integrate sustainability into their operations, ensuring that all actions are aligned with overarching sustainability goals [11].

Atkisson's Pyramid Model, with its structured and step-by-step approach to sustainability, is highly applicable to the public sector, where bureaucratic processes often require clear, systematic methodologies. This model is particularly useful in guiding public sector entities through the complexities of integrating sustainability into their operations. By providing a framework for measuring progress and forming actionable agreements, this model helps ensure that sustainability initiatives are implemented effectively and aligned with broader governmental objectives.

To maximise the applicability of these models within the public sector, it is crucial to adapt them to the unique challenges and contexts of public sector operations. Public entities often operate under different constraints compared to private organisations, such as budget limitations, regulatory requirements, and the need for public accountability. Therefore, successful implementation of sustainability models in the public sector requires a strong focus on stakeholder engagement, transparency, and adaptability.

Additionally, leadership within the public sector must prioritise sustainability in strategic planning and policy development, ensuring that sustainability goals are integrated into the broader governance framework. This includes fostering a culture of continuous learning and improvement, as well as establishing multidisciplinary teams that can drive sustainability initiatives across various sectors.

While the foundational principles of these sustainability models are universally applicable, their successful integration into the public sector hinges on adapting them to fit the specific governance structures, stakeholder needs, and operational

realities of government entities. Through thoughtful adaptation and strong leadership, these models can help the public sector effectively navigate the complexities of sustainable development, ultimately contributing to the creation of resilient, thriving communities.

2.3 Sustainability Strategy and Planning

Strategic integration of sustainability into management procedures can provide a competitive edge and open new opportunities for organisations. Sustainability frameworks advocate for the alignment of sustainability indicators with overall organisational goals across strategic, tactical, and operational levels. This approach ensures that sustainability is not treated as a standalone initiative but is embedded in the core business strategy [12].

2.4 Operationalising Sustainability

Operationalising sustainability involves translating sustainability concepts into actionable practices within organisations. This process often involves aligning corporate social responsibility (CSR) with sustainability initiatives and ensuring that both internal and external stakeholders are engaged. By operationalising sustainability, organisations can address the economic, environmental, and social impacts of their actions and align stakeholder interests with sustainability goals [13,12].

2.5 Social and Environmental Measures

Effective sustainability metrics must balance community, environmental, and business needs. This involves more than just being environmentally friendly; it encompasses a holistic approach to measuring sustainability performance, including the entire value chain. As the criteria for measuring sustainability evolve, organisations must continuously adapt their strategies to ensure that they are meeting the latest standards for economic, environmental, and social performance [14,15].

2.6 Sustainability Reporting

Sustainability reporting involves presenting both financial and non-financial results to stakeholders, showcasing the economic, environmental, and social outcomes of business activities. These reports are essential for managing risks related to social and environmental events and for communicating an organisation's impact on sustainability. Effective sustainability reporting requires a clear presentation of the positive and negative effects of corporate activities and how they align with broader sustainability goals [16,17].

While these sustainability models and frameworks offer diverse approaches, successful implementation often requires their adaptation to specific contexts. Strong leadership, stakeholder engagement, and a commitment to continuous improvement are crucial for aligning with the principles outlined in sustainability

frameworks such as those provided by the National Research Council. Integrating these models into organisational strategies ensures that sustainability is embedded at all levels, driving long-term sustainable development.

3. Quantitative Methods Used to Analyse Data

3.1 Methodology

Data for this study were collected using a self-administered questionnaire distributed to a sample of participants within the City of Johannesburg (CoJ). The questionnaire was designed to capture information on various aspects of sustainability, including strategy and planning, operationalisation, social and environmental measures, and sustainability reporting. A total of 395 completed questionnaires were returned, resulting in a response rate that reflects substantial engagement with the survey instrument.

The collected data were coded and analysed using SPSS version 26.0. To ensure the reliability of the questionnaire items, Cronbach's alpha scores were calculated for each section of the questionnaire. All sections demonstrated reliability scores exceeding the recommended threshold, indicating consistent and dependable measurements across the research sections. Items that exhibited a Cronbach's alpha value greater than 0.95 were removed to avoid redundancy.

Confirmatory Factor Analysis (CFA) was employed to identify the key variables for each construct, ensuring that the questionnaire effectively measured the intended dimensions of sustainability. Additionally, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were conducted to confirm the suitability of the data for factor analysis. The extraction method used was Principal Component Analysis (PCA), with Varimax rotation, a technique that simplifies the interpretation of the factors by minimising the number of variables with high loadings on each factor.

Structural Equation Modelling (SEM) was then implemented to explore the causal relationships between the variables and to develop a comprehensive sustainability model for the CoJ. The SEM approach allowed for the evaluation of both the measurement model (how well the observed variables measure the latent constructs) and the structural model (the relationships between latent variables).

3.2 Reliability Statistics

The Cronbach's alpha scores for the various sections of the questionnaire are summarised in the table below. All sections exhibited reliability scores above the recommended threshold, indicating a high level of internal consistency. This suggests that the items within each section consistently measured the intended constructs.

Section	No. of Items	Cronbach's Alpha
B Sustainability Strategy and Planning	11	0.947
C Operationalising Sustainability	9	0.931
D Social and Environmental Measures	5	0.904
E Sustainability Reporting	12	0.950
Overall	38	0.946

Table 1: Reliability Test Output

3.3 Factor Analysis

The results of the factor analysis are presented below, showing the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity for each section. The high KMO values and significant Bartlett's Test results indicate that the data were

suitable for factor analysis. The Principal Component Analysis (PCA) with Varimax rotation confirmed the internal consistency of the constructs, with each section loading effectively on the relevant components.

Section	KMO Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
		Approx. Chi-Square	df	Sig.
B Sustainability Strategy and Planning	0.946	3203.449	55	0.000
C Operationalising Sustainability	0.918	2199.278	45	0.000
D Social and Environmental Measures	0.864	1204.671	10	0.000
E Sustainability Reporting	0.945	3808.060	66	0.000

Table 2: Kaiser-Meyer-Olkin and Bartlett's Test

The extraction method was principal component analysis, and the rotation method was Varimax with Kaiser Normalisation. This is an orthogonal rotation method that reduces the number of variables with high loadings on each factor to a minimum. It makes the interpretation of the factors easier. Inter-correlations between variables are revealed by factor analysis/loading.

Questions with similar loading imply measurement along a similar factor. An examination of the content of items loading at or above 0.5 (and using the higher or highest loading in cases where items cross-loaded at greater than this value) measured effectively along the various components.

The statements that comprised the sections Sustainability Strategy and Planning, Operationalising Sustainability, and Social and Environmental Measures were perfectly aligned along a single component. This implies that the statements that made up these sections perfectly measured what they were supposed to measure. It should be noted that the variables that comprised

Sustainability Reporting were loaded along two components. This indicates that respondents identified various trends within the section. The splits are colour coded within the section.

In most statistical packages, the factor analysis procedure contains two methods that differ in terms of their assumptions. They are factor analysis and principal component analysis, respectively. The outcomes obtained with their use are usually strikingly similar. In quantitative research, factor analysis is a relatively simple method for analysing the structure of the studied phenomenon. It is worth noting that the factor analysis must be performed on variables obtained from at least an interval scale. However, this method can also be used in the case of the popular Likert scale in social research.

Furthermore, it should be remembered that the study should have ten times more observations than the variables that we want to include in the analysis [18].

3.4 Rotated Component Matrix for Sustainability Strategy and Planning

Sustainability Strategy and Planning	Component 1
Sustainability programs and activities are linked to the pillars of sustainability (economic, environmental & social):	0.802
Sustainability interventions adhere to all legislation, codes of good practice, and national/international guidelines on sustainability:	0.783
All sustainability programs align with the principles of sustainability:	0.838
Sustainability interventions are linked to the business strategy and strategic objectives of the organisation:	0.819
A culture of sustainability is embedded in service delivery:	0.805
To what extent are staff across CoJ involved in sustainability initiatives:	0.817
There is stakeholder participation and engagement on issues of sustainability:	0.840
Sustainability is everyone's business in CoJ:	0.782
Lessons learned and taken into the design of future activities and programs:	0.833
There is sustainability discussions, awareness programs, workshops, and seminars:	0.802
Does the institution have established multidisciplinary and interdisciplinary structures to integrate sustainability issues:	0.780

Table 3: Sustainability Strategy and Planning

Extraction Method: Principal Component Analysis. One component extracted.

Table 3 above indicates that the items within this section are well-aligned and consistently measure the intended construct. The factor loadings range from 0.780 to 0.840, all of which are above the generally accepted threshold of 0.5, indicating strong correlations between each item and the overall factor. The highest loading was found for the item "There is stakeholder participation and engagement on issues of sustainability" (0.840), suggesting that this aspect is a crucial and well-recognised component of

sustainability strategy within the organisation. Similarly, other items, such as "All sustainability programs align with the principles of sustainability" (0.838) and "Lessons learned and taken into the design of future activities and programs" (0.833), also show strong loadings. This reinforces the importance of aligning sustainability programs with established principles and learning from past experiences. The consistently strong loadings across these items suggest that the organisation has a coherent and well-integrated approach to sustainability strategy and planning, with particular emphasis on stakeholder engagement and adherence to sustainability principles.

Operationalising Sustainability	Component 1
Building construction and renovation based on green design principles(LEED, etc.):	0.764
Energy conservation practices (including lighting, heating, cooling, ventilation, windows, etc.):	0.800
Waste reduction practices (such as e-communications, double-sided copying, "waste-free lunch" program, etc.):	0.809
Recycling of solid waste (including paper, plastic, metal, e-waste, etc.):	0.745
Sustainable food program (such as local, organic, and/or fair trade food):	0.805
Water conservation practices (including efficient toilets, minimal irrigation, harvested rainwater, etc.):	0.842
Sustainable transportation program (including bicycle/pedestrian-friendly systems, carpools, bus pass programs, biodiesel projects, etc.):	0.814
Environmental or sustainability assessments/audits:	0.813
There are structures that take responsibility for sustainability:	0.812
Sustainability activities and interventions are independently audited:	0.786

Table 4: Operationalising Sustainability

Extraction method: Principal Component Analysis. 1 component extracted.

In table 4 above, the factor loadings also demonstrate a strong alignment with the underlying construct, with values ranging from 0.745 to 0.842. The highest loading in this section is for the item "Water conservation practices (including efficient toilets, minimal irrigation, harvested rainwater, etc.)" at 0.842, indicating a significant focus on water conservation within the operationalisation of sustainability. Other high loadings, such as

"Environmental or sustainability assessments/audits" (0.813) and "There are structures that take responsibility for sustainability" (0.812), highlight the organisation's commitment to systematic assessments and accountability in sustainability practices. The consistently high factor loadings across this section suggest that the operationalisation of sustainability within the organisation is comprehensive and effectively integrated into various aspects of its operations, with particular emphasis on resource conservation and assessment practices.

Social and Environmental Measures	Component
	1
Employee diversity is encouraged:	0.811
Employee satisfaction is aligned with sustainability:	0.852
Community relations and community development:	0.883
Practices of natural resource conservation and emission levels are evident:	0.857
Stakeholder involvement in the community, social, and environmental issues:	0.851

Table 5: Social and Environmental Measures

Extraction method: Principal Component Analysis. 1 component extracted.

Table 5 also robust, with values ranging from 0.811 to 0.883. The highest loading was observed for the item "Community relations and community development" at 0.883, indicating a strong focus on community engagement and development as key components of the organisation's sustainability efforts. Items like "Employee satisfaction is aligned with sustainability" (0.852) and "Practices of natural resource conservation and

emission levels are evident" (0.857) also demonstrate strong loadings, underscoring the importance of aligning employee satisfaction with sustainability goals and actively managing natural resources and emissions.

These results suggest that the organisation's approach to social and environmental measures is well-rounded, with a strong emphasis on community relations, employee satisfaction, and environmental stewardship.

Sustainability Reporting	Component	
	1	2
Sustainability reports should prioritize financial and economic performance data:	0.200	0.815
Sustainability reports should include five dimensions; economic, governance, social, ethical, and environmental:	0.375	0.826
Sustainability reports, the priority should be given to the presentation of the corporate governance information:	0.330	0.835
Sustainability reports should be given to communicate social performance information:	0.431	0.801
The existence of a legal requirement will increase sustainability reporting and improve its quality:	0.607	0.564
Sustainability reporting is difficult without proper information systems infrastructure:	0.660	0.497
The lack of communication and coordination between the various participants in sustainability reporting process is one of the sustainability reporting challenges:	0.783	0.369
Consequences of disclosing sustainability information are other challenges of sustainability reporting:	0.730	0.302
Sustainability reports should be subject to independent auditing like corporate financial statements:	0.766	0.371
CGU can benefit more from sustainability reporting by strengthening management attitudes in all aspects of sustainable performance:	0.777	0.386
Balancing the provision of quantitative and qualitative information in sustainability reports is one of the challenges of sustainability reporting:	0.849	0.253
The lack of active engagement with stakeholders to better understand their expectations and information they need is one of the challenges of sustainability reporting:	0.845	0.223

Table 6: Sustainability Reporting

Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser Normalisation. Rotation converged in three iterations.

Table 6 above reveals a more complex structure, with items loading onto two distinct components. This indicates that respondents perceive different dimensions within sustainability reporting. Component 1 primarily captures challenges and practical aspects of sustainability reporting, such as the lack of communication and coordination between the various participants in the sustainability reporting process, which is one of the key challenges as evidenced by a loading of 0.783.

Another significant item in this component is that sustainability reports should be subject to independent auditing like corporate financial statements, which also shows a strong loading of 0.766. Component 2 reflects the prioritisation of different types of information within sustainability reports, with items like "Sustainability reports should prioritise financial and economic performance data" (0.815) and "Sustainability reports should include five dimensions; economic, governance, social, ethical, and environmental" (0.826) demonstrating high loadings.

The two-component structure suggests that sustainability reporting within the organisation is seen as multifaceted, involving both the challenges of effective reporting and the need to balance different types of information. The strong loadings in both components indicate that these aspects are well-recognised and distinct in the context of sustainability reporting.

3.5 Section Analysis

The section that follows examines the respondents' scoring patterns by variable and section. The results are presented first in the form of summarised percentages for the variables that comprise each section. The results are then further analysed based on the significance of the statements. Statements identified as redundant were omitted in some sections.

3.5.1 Section B: Sustainability Strategy and Planning

The topic of this section was Sustainability Strategy and Planning. According to the frequency distribution analysis, seven of the statements had the highest score of "moderate extent," and three statements had higher levels of "larger extent" (by combining "to a large and to a very great"). A chi square goodness-of-fit test was performed to determine whether the scoring patterns per statement were significantly different per option. The responses

to all of the statements were found to be significantly different ($p < 0.05$), as shown in Table 7 below.

Statements regarding Sustainability Strategy and Planning	Item No.	To a little or no extent	To some extent	To a moderate extent	To a large extent	To a very great extent	Chi Square p-value
Sustainability programs and activities are linked to the pillars of sustainability (economic, environmental & social):	B1	10.5%	18.6%	32.9%	27.8%	10.2%	<0.001
Sustainability interventions adhere to all legislation, codes of good practice, and national/international guidelines on sustainability:	B2	7.8%	20.5%	32.4%	27.8%	11.4%	<0.001
All sustainability programs align with the principles of sustainability:	B3	10.1%	20.7%	35.2%	24.1%	9.8%	< 0.001
Sustainability interventions are linked to the business strategy and strategic objectives of the organisation:	B4	9.6%	18.7%	32.2%	29.6%	9.9%	< 0.001
A culture of sustainability is embedded in service delivery:	B7	18.3%	22.2%	29.1%	21.4%	9.0%	< 0.001
To what extent are staff across CoJ involved in sustainability initiatives:	B8	23.0%	28.6%	28.1%	16.6%	3.6%	< 0.001
There is stakeholder participation and engagement on issues of sustainability:	B9	19.4%	26.3%	28.1%	19.9%	6.1%	< 0.001
Sustainability is everyone's business in CoJ:	B11	26.2%	24.6%	23.3%	15.1%	10.8%	< 0.001
Lessons learned and taken into the design of future activities and programs:	B15	22.4%	22.6%	29.5%	18.3%	7.1%	< 0.001
There is sustainability discussions, awareness programs, workshops, and seminars:	B17	34.5%	23.3%	23.8%	13.6%	4.9%	< 0.001
Does the institution have established multidisciplinary and interdisciplinary structures to integrate sustainability issues:	B18	26.9%	23.0%	26.1%	16.4%	7.7%	< 0.001

Table 7: Summarises the scoring patterns regarding sustainability strategy and planning of the organisation

Table 7 provides insights into respondents' perceptions of sustainability strategy and planning within the organisation. Overall, the results show a mix of moderate and strong support for the implementation of sustainability practices, though there are areas that could benefit from improvement.

The majority of respondents felt that sustainability programs are linked to the pillars of sustainability and adhere to relevant legislation and guidelines, with many indicating this to be true to a moderate or large extent. However, the embedding of a sustainability culture within service delivery and the involvement of staff in sustainability initiatives received more varied responses, with a significant portion of respondents feeling that these aspects were only moderately or somewhat implemented.

Stakeholder participation in sustainability efforts was generally

viewed positively, but there was a notable portion of respondents who felt that sustainability is not yet fully recognised as everyone's responsibility within the organisation. Furthermore, while there is evidence that lessons learned are being incorporated into future activities, and that sustainability discussions and awareness programs are taking place, these areas still show room for growth, as indicated by the significant number of respondents who felt these were only somewhat present.

While the organisation has made strides in integrating sustainability into its strategic planning, the responses suggest that further efforts are needed to fully engage staff, enhance stakeholder participation, and ensure that sustainability is a shared responsibility across the organisation. The statistical significance of the variations in responses highlights these as critical areas for ongoing development.

Statements regarding Operationalising Sustainability	Item No.	To a little or no extent	To some extent	To a moderate extent	To a large extent	To a very great extent	Chi Square p-value
Building construction and renovation based on green design principles (LEED, etc.):	C1	22.8%	32.0%	29.4%	12.5%	3.3%	< 0.001
Energy conservation practices (including lighting, heating, cooling, ventilation, windows, etc.):	C2	25.1%	29.9%	27.1%	14.1%	3.8%	< 0.001
Waste reduction practices (such as e-communications, double-sided copying, "waste-free lunch" program, etc.):	C3	27.1%	26.6%	28.4%	13.8%	4.1%	< 0.001
Recycling of solid waste (including paper, plastic, metal, e-waste, etc.):	C4	19.5%	25.6%	24.9%	22.8%	7.2%	< 0.001
Sustainable food program (such as local, organic, and/or fair trade food):	C5	24.0%	30.9%	27.9%	13.0%	4.1%	< 0.001
Water conservation practices (including efficient toilets, minimal irrigation, harvested rainwater, etc.):	C6	30.0%	29.1%	26.9%	9.4%	4.7%	< 0.001
Sustainable transportation program (including bicycle/pedestrian-friendly systems, carpools, bus pass programs, biodiesel projects, etc.):	C8	30.4%	27.1%	24.7%	15.2%	2.6%	< 0.001
Environmental or sustainability assessments/audits:	C11	24.0%	28.1%	28.4%	15.1%	4.3%	< 0.001
There are structures that take responsibility for sustainability:	C15	24.7%	26.0%	27.8%	16.1%	5.4%	< 0.001
Sustainability activities and interventions are independently audited:	C16	32.9%	23.1%	27.2%	13.6%	3.1%	< 0.001

Table 8: Summarises the scoring patterns regarding Operationalising Sustainability of the organisation

Table 8 presents the distribution of responses regarding the operationalisation of sustainability within the organisation, segmented into various aspects such as building construction, energy conservation, waste reduction, and other sustainability practices. The results show varying levels of agreement among respondents on the extent to which these sustainability practices are implemented.

A significant portion of respondents rated the extent of implementing building construction and renovation based on green design principles, as well as energy conservation practices, to be "to some extent" (32.0% and 29.9%, respectively). However, fewer respondents believed these practices were implemented to a large or very great extent, indicating that while these initiatives are present, they may not be fully integrated or consistently applied across the organisation.

Waste reduction practices, recycling, and sustainable food programs received similarly moderate ratings, with the majority of respondents indicating that these are being implemented "to some extent" or "to a moderate extent." These results suggest that while these initiatives are in place, there may be gaps in their execution or broader adoption within the organisation.

Water conservation practices and sustainable transportation programs also showed a tendency towards moderate implementation, with 30.0% and 30.4% of respondents, respectively, indicating that these practices are present "to some extent." The relatively lower percentages of respondents who felt these were implemented to a large or very great extent suggest that these areas, while recognised, may not be as fully developed or prioritised as other sustainability efforts.

The presence of environmental or sustainability assessments and audits, as well as structures responsible for sustainability, were also rated mostly in the "to some extent" or "to a moderate extent" categories. This indicates that while there is some level of oversight and accountability, it may not be as robust or widespread as necessary to ensure comprehensive sustainability across the organisation.

Finally, the independent auditing of sustainability activities and interventions received the highest percentage of "to a little or no extent" responses (32.9%), indicating a potential area of weakness in ensuring that sustainability practices are rigorously monitored and evaluated.

Overall, the responses suggest that while the organisation has made some progress in operationalising sustainability, there are significant opportunities for further development. The distribution of responses across the various categories highlights areas where sustainability practices are recognised but may require stronger integration, oversight, and commitment to achieve more widespread and effective implementation. The Chi-square p-values, all of which are less than 0.001, indicate that the observed differences in responses are statistically significant, underscoring the importance of addressing these gaps in sustainability practices.

3.5.2 Section D: Social and Environmental Measures

This section examines Social and Environmental Metrics. According to Table 9, the responses to all of the statements were significantly different ($p < 0.05$).

Statements Social and Environmental Measures	Item no	To a little or no extent	To some extent	To a moderate extent	To a large extent	To a very great extent	Chi Square p-value
Employee diversity is encouraged:	D1	14.0%	18.1%	32.7%	25.0%	10.2%	< 0.001
Employee satisfaction is aligned with sustainability	D2	29.2%	23.3%	29.7%	14.6%	3.3%	< 0.001
Community relations and community development:	D4	18.4%	24.0%	31.5%	18.2%	7.9%	< 0.001
Practices of natural resource conservation and emission levels are evident:	D5	25.4%	26.4%	30.5%	14.6%	3.1%	< 0.001
Stakeholder involvement in the community, social, and environmental issues:	D6	16.3%	23.4%	30.5%	20.6%	9.2%	< 0.001

Table 9: Frequency Distribution of Statements Regarding Social and Environmental Measures of The Organisation.

Table 9 summarises respondents' perceptions of the organisation's social and environmental measures, showing a generally moderate level of implementation across various areas. Employee diversity is largely seen as being encouraged, with most respondents indicating that this occurs to a moderate or large extent, though a notable minority feel that these efforts are limited. Similarly, the alignment of employee satisfaction with sustainability is perceived as moderate by many, but a significant portion of respondents believe this connection is weak, suggesting an area for improvement.

Community relations and development are recognised as moderately implemented, with most respondents acknowledging these efforts but indicating that they could be more robust. The practices of natural resource conservation and emission management also follow this pattern, with a significant number of respondents feeling these practices are only somewhat evident, highlighting the need for more consistent environmental

stewardship.

Stakeholder involvement in community, social, and environmental issues is also seen as moderately implemented, though there is a perception that this involvement could be stronger. Overall, while the organisation has made progress in these areas, the responses suggest there is room for further development to enhance the effectiveness and visibility of social and environmental initiatives. The statistically significant variations in responses underscore the importance of addressing these gaps to achieve more comprehensive and impactful sustainability practices.

3.5.3 Section E: Sustainability Reporting

This section examines the organisation's Sustainability Reporting. According to Table 10, the responses to all of the statements were significantly different ($p < 0.05$).

Statements Sustainability Reporting	Item no	To a little or no extent	To some extent	To a moderate extent	To a large extent	To a very great extent	Chi Square p-value
Sustainability reports should prioritize financial and economic performance data:	E1	9.7%	15.8%	29.6%	28.6%	16.3%	< 0.001
Sustainability reports should include five dimensions; economic, governance, social, ethical, and environmental:	E2	6.9%	10.5%	21.2%	29.8%	31.6%	< 0.001
Sustainability reports, the priority should be given to the presentation of the corporate governance information:	E3	7.2%	12.3%	26.7%	35.9%	17.9%	< 0.001
Sustainability reports should be given to communicate social performance information:	E4	7.5%	11.3%	29.0%	33.4%	18.8%	< 0.001
The existence of a legal requirement will increase sustainability reporting and improve its quality:	E6	5.4%	12.6%	24.5%	33.8%	23.7%	< 0.001
Sustainability reporting is difficult without proper information systems infrastructure:	E8	9.5%	9.5%	23.0%	30.2%	27.9%	< 0.001
The lack of communication and coordination between the various participants in sustainability reporting process is one of the sustainability reporting challenges:	E9	7.9%	10.5%	21.5%	31.8%	28.2%	< 0.001
Consequences of disclosing sustainability information are other challenges of sustainability reporting:	E11	11.3%	12.9%	28.8%	29.3%	17.7%	< 0.001
Sustainability reports should be subject to independent auditing like corporate financial statements:	E12	6.7%	10.8%	22.9%	35.0%	24.7%	< 0.001
CoU can benefit more from sustainability reporting by strengthening management attitudes in all aspects of sustainable performance:	E13	5.1%	6.4%	16.1%	31.1%	41.3%	< 0.001
Balancing the provision of quantitative and qualitative information in sustainability reports is one of the challenges of sustainability reporting:	E14	6.7%	8.7%	25.7%	35.5%	23.4%	< 0.001
The lack of active engagement with stakeholders to better understand their expectations and information they need is one of the challenges of sustainability reporting:	E15	7.4%	10.5%	21.2%	32.4%	28.6%	< 0.001

Table 10: Distribution of Statements Regarding Sustainability Reporting of the Organisation

Table 10 provides an overview of respondents' perceptions regarding sustainability reporting within the organisation, highlighting both strengths and challenges. Overall, the responses indicate a strong emphasis on comprehensive sustainability reporting, with a majority of respondents believing that financial, governance, and social dimensions should be included in reports to a large or very great extent. There is significant support for the prioritisation of financial and economic performance data, as well as for the communication of corporate governance and social performance information within sustainability reports.

However, challenges in sustainability reporting are also evident. A notable number of respondents identified difficulties associated with inadequate information systems infrastructure and the lack of communication and coordination among various participants in the reporting process. These challenges, alongside the consequences of disclosing sustainability information and the need for independent auditing, are seen as significant obstacles that need to be addressed.

The existence of a legal requirement is widely believed to

enhance the quality and frequency of sustainability reporting, with a substantial portion of respondents supporting this view. Additionally, there is strong agreement that balancing quantitative and qualitative information in sustainability reports is a critical challenge, as is the need for active engagement with stakeholders to understand their expectations better.

In summary, while the organisation appears to have a solid foundation in sustainability reporting, particularly in terms of content inclusion and the prioritisation of key areas, the responses suggest that overcoming logistical and communicative challenges will be essential for further improvement. The significant Chi-square values indicate that these perceptions are varied and statistically significant, pointing to the need for targeted efforts to enhance the organisation's sustainability reporting practices.

3.6 Correlations

The overall score for each construct was used to perform bivariate correlation among the constructs. The significant high positive correlation found between sustainability programs and activities linked to the sustainability pillars (economic, environmental, and social) and stakeholder participation and engagement on sustainability issues is 0.601. The greater the participation and engagement in sustainability, the stronger the pillars of sustainability, according to respondents, and vice versa.

Structural Equation Modelling (SEM) is a technique used to investigate the cause-and-effect relationship between variables in a variety of fields. SEM can also be used to determine linear causation between latent and observed variables. Multiple observed variables can represent these latent variables. In SEM, a hypothesised model with directional and non-directional relationships between latent and observed variables is created. In general, SEM is used to determine whether the model accounts for variation and covariation in observed or latent variables [19]. Furthermore, when analyses are properly conducted, theory development and construct validation are two important topics that can be addressed using SEM. SEM's goal, according to Hair, is to enable model comparisons with actual data [20].

This comparison yields so-called fit statistics, which evaluate the matching of model and data. If the fit is acceptable, the data support the assumed relationships between latent and observed variables (measurement models) as well as the assumed dependencies between the various latent variables (structural model). In some cases, the fit of a measurement model is all that matters. In other cases, structural model parameters may be of interest. Despite the fact that researchers use the term effect, a SEM is not a casual model. Although SEM can represent casual relationships in certain circumstances, a well-fitting SEM does not have to contain any information on casual dependencies at all. As a consequence, evaluating a SEM's fit is not a fatality test [20].

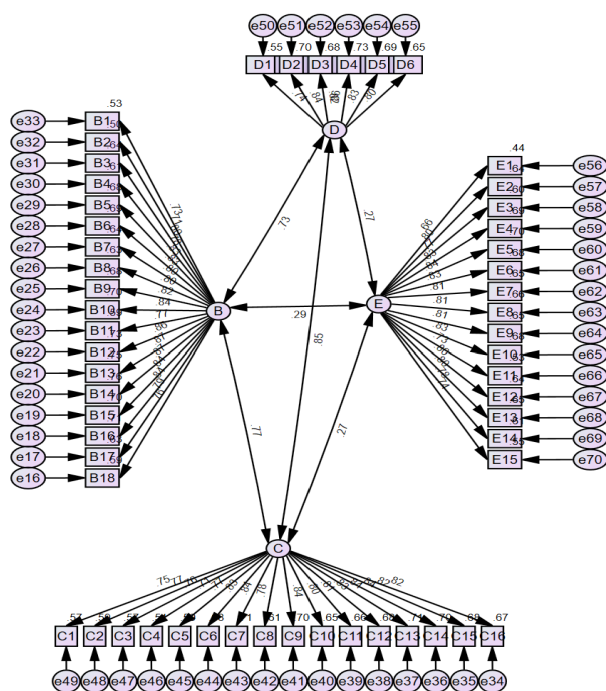


Figure I: The Path Diagram for the Modified Structural Equation Modelling (SEM)

Key	
B	Sustainability Strategy and Planning
C	Operationalising Sustainability
D	Social and Environmental Measures
E	Sustainability Reporting

3.7 Model Fit Summary

The suggested acceptable value for relative chi-square, CMIN/DF, should not be greater than 5, as these are used to reduce sample size dependence. TLI, CFI, NFI, and IFI, on the other hand, have cut-off points ranging from zero to one. A good model has an RMSEA value less than or equal to 0.05.

3.7.1 CMIN

CMIN is a Chi-square statistic used to compare the tested and independence models to the saturated model. The relative chi-square ratio, CMIN/DF, is an indicator of how much the fit of data to model has been reduced by removing one or more paths. The CMIN/DF ratio is less than the acceptable level of 5. (3.138). This satisfies the CMIN condition.

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	171	4469.094	1424	.000	3.138
Saturated model	1595	.000	0		
Independence model	55	22514.533	1540	.000	14.620

Table 11: CMIN/DF Ratio and Model Fit Statistics

3.7.2 Baseline Comparisons

These indices of goodness of fit compare the model to the independence model rather than the saturated model. The Normed Fit Index (NFI) is simply the difference in the chi-squares of the two models divided by the chi-square for the independence model. The NFI for this data is 0.802, which is less than the

recommended value of 0.9 for a good fit. The Comparative Fit Index (CFI) employs a similar method (a noncentral chi-square) and is said to be a good index to use even with small samples. It, too, ranges from 0 to 1, with 0.90 indicating good fit. The CFI score is 0.855.

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.802	.785	.856	.843	.855
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Table 12: Baseline Comparison Indices for Model Fit

3.7.3 Parsimony Adjusted Measures

PRATIO is the ratio of paths dropped to paths that could have been dropped (all of them). The Parsimony Normed Fit Index (PNFI) is the product of the NFI and the PRATIO, while the PCFI is the product of the CFI and the PRATIO. The PNFI

and PCFI are designed to reward those whose models are cost-effective (contain few paths). A value of 0.900 or higher is considered acceptable. This model has a value that is greater than the recommended (0.925).

Model	PRATIO	PNFI	PCFI
Default model	.925	.741	.790
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

Table 13: Parsimony-Adjusted Fit Indices for Model Evaluation

3.7.4 Covariances: Group Number 1 – Default Model

	Estimate	S.E.	C.R.	P	Label
B <--> D	.618	.067	9.277	***	par_52
E <--> D	.189	.041	4.660	***	par_53
E <--> B	.219	.044	5.012	***	par_54
B <--> C	.700	.070	9.962	***	par_55
C <--> D	.706	.070	10.142	***	par_56
E <--> C	.203	.042	4.785	***	par_57

Table 14: Covariance Estimates for Default Model in Group 1

3.7.5 Correlations: Group Number 1 – Default Model

The strength of the relationships determines the level of significance. As an example, the following correlations can be tested:

- Null hypothesis: There is no correlation between B and D.

- Alternative hypothesis: There is a significant relationship.
- The results show a significant strong, directly proportional relationship ($r = 0.734$, $p < 0.001$). The correlations were all significant in every case.

	Estimate
B <-> D	.734
E <-> D	.274
E <-> B	.291
B <-> C	.774
C <-> D	.852
E <-> C	.274

Table 15: Correlation Estimates for Default Model in Group 1

3.8 Summary

The model took into account all of the statements. An examination of the coefficients for each latent value revealed significant factor loadings. The path coefficients are also reflected on the diagram. All of the coefficients are high, indicating that the latent variables have strong positive correlations.

4. Conclusion

In conclusion, this study has developed a comprehensive sustainability model for municipalities, with a particular focus on the City of Johannesburg. The findings demonstrate the importance of integrating sustainability into all aspects of municipal operations, highlighting key components such as legislative alignment, business strategy incorporation, and active stakeholder engagement. The confirmatory factor analysis and Structural Equation Modelling (SEM) validated the overall model, confirming that these elements are critical for effective sustainability practices.

The study's results underscore that while there is a growing recognition of the importance of sustainability within municipalities, there are still significant opportunities for improvement, particularly in areas such as stakeholder involvement, the embedding of a sustainability culture, and the rigorous auditing of sustainability activities. These findings align with the broader discourse on sustainability, which emphasises the need for a balanced approach that considers economic, social, and environmental dimensions equally.

Moreover, the challenges identified in sustainability reporting, particularly regarding infrastructure and communication, point to the need for municipalities to enhance their reporting mechanisms to ensure transparency and accountability. The proposed model offers a structured approach for municipalities to navigate these complexities, fostering a more sustainable and resilient future.

Ultimately, this study contributes to the field by providing actionable strategies that municipalities can adopt to enhance their sustainability efforts. The model's applicability to the public sector, as evidenced by its alignment with core municipal functions, makes it a valuable tool for guiding sustainable development in urban settings. Moving forward, municipalities must prioritise the continuous improvement of sustainability practices to meet the evolving demands of their communities and contribute to the global sustainability agenda [21,22].

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