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## DEMAND SIDE RESPONSE PROGRAM FOR MORE SUSTAINABLE ELECTRICITY MARKET: A CASE STUDY OF TÜRKİYE

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**Abstract.** This study aims to examine Demand Side Response (DSR) programs, where the consumer side actively participates, to determine the most competitive, transparent, flexible, and suitable program for the structure of the Türkiye electricity market. The objective is to select one of the Demand Side Response (DSR) programs, using mathematical methods, that can provide the most effective response to Türkiye's increasing energy demand and present a market-specific proposal. The limited energy resources, losses in transmission, and environmental problems collectively drive the direction toward more efficient and economical energy use on the demand side (Benek Arslan, 2021). Therefore, various pricing programs and tariff strategies are implemented to regulate and balance demand (Özpınar, 2021). One of these pricing and tariff programs is the Demand Side Response (DSR) program, where consumption is reduced against fluctuations in energy prices in the electricity market or in case of system constraints and security (Hasanova & Varbak, 2021). The main objective of DSR programs is to offer energy to consumers at more affordable prices while ensuring an uninterrupted and sustainable energy supply. These programs promote energy efficiency among consumers, encouraging energy conservation and contributing to more sustainable energy consumption (Acar, Yule Bennett, & Scott, 2021). In this study, firstly, general information about demand side response (DSR) implemented in electricity markets is presented. The method section includes the analysis of DSR programs. The study aims to minimize the high prices in the market, system security, and transmission constraints by selecting one of the DSR programs and to encourage conscious consumption by managing energy consumption on the consumer side.

**Keywords:** Electricity market; Türkiye; demand side response; demand side response programs; multi-criteria decision making; sustainability; energy pricing; economic development

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**JEL Classifications:** Q1, Q2

**Additional disciplines:** Economy, Political sciences; Energy, Environment

## 1. Introduction

Electricity markets are a control mechanism that ensures electricity reaches consumers at the most favourable prices, economically and efficiently, by balancing supply and demand (Silva-Rodriguez, Sanjab, Fumagalli, Virag, & Gibescu, 2022). In this structure, producers constitute the supply side and consumers the demand side, while pricing is shaped according to supply (Çatak, 2022). Increasing electricity consumption, supply constraints, and environmental problems lead to high electricity prices in the market (Guan, Yan, Shan, Zhou, & Hang, 2023). In this case, the demand side should take an active role in the market by going beyond consumer habits with specific measures and systems. In international markets, the demand side is included in the market within the framework of specific mechanisms and rules and plays an active role in price formation (Tör, Oğuz, Kısakürek, Kuşuncu, & Köksal, 2021). In Türkiye's electricity markets, which have evolved with liberalization, prices are shaped by optimizing supply and demand, while energy trade is generally conducted between producers and wholesalers (Gözen, 2020). However, this creates constraints for consumers to react to price changes and provide market flexibility, leading to an inefficient market problem.

DSR programs in electricity markets allow consumers to restrict their consumption in the short, medium, and long terms as they wish. Therefore, it will be decided which program to integrate into which market, when, and under which conditions. This study selected the most suitable DSR program for the Türkiye electricity market through a mathematical approach. This approach will determine the DSR program that can quickly and easily integrate the consumer side into the currently traded markets. Our research has examined DSR programs that alter and manage consumer consumption habits in response to the increasing changes in electricity prices.

DSR programs regulate consumers' electricity usage habits by adjusting the amount and timing of consumption by shifting electricity consumption from peak to off-peak periods (Sarker, ve diğerleri, 2021). These programs are categorized into two headings (Vinoth Kumar, Sivakumar, & Rajan Singaravel, 2021).

### 1.1. Price-Based Demand Response

In these programs, consumers who voluntarily participate are billed with more favorable pricing by reducing their electricity consumption according to price signals in the market (Kansal & Rajive, 2023). In price-based demand response, there are three different pricing programs: Time-of-use pricing, Critical peak pricing, and Real-time pricing (Kholerdi & Ghasemi-Marzbali, 2021).

- **Time-of-Use Pricing:** A program that allows consumers to adjust their energy consumption using a mechanism during periods of high demand and high prices. Through this program, consumers can use energy at a more economical price by distributing their energy consumption demands in a more balanced manner. (Wesseh Jr. & Lin, 2022)
- **Critical Peak Pricing:** A pricing program designed to encourage consumers to reduce energy usage during critical hours, such as when unexpected system conditions occur or when distribution companies face high prices in wholesale electricity purchases. Consumers in this program receive price reductions for electricity usage during periods without critical peak pricing.
- **Real-Time Pricing:** A program that aims to reduce a consumer's energy consumption by adjusting it to real-time prices, which are usually announced one day in advance, one hour in advance, or 15 minutes in advance. To implement this program, a two-way communication infrastructure must ensure continuous communication between energy providers and consumers. This communication infrastructure informs consumers instantaneously when and at what levels energy prices are. Thus, consumers can shift their energy consumption to low-cost hours or adjust their energy use in line with their needs. (Li, Wan, & He, 2020)

### 1.2. Incentive-Based Demand Response

It is a mechanism where financial incentives are offered if the consumer reduces energy consumption in response to demand reduction calls by the system operator. Participation in this mechanism is voluntary; however, sanctions may be imposed on consumers who do not reduce their energy consumption or fulfil their contractual commitments after joining. Incentive-based demand response can be implemented in five ways: Direct Load Control, Interruptible Programs, Demand Bidding/Buyback Programs, Emergency Programs, Capacity Market, and Ancillary Services Market. (Dewangan, ve diğerleri, 2023)

- **Direct Load Control:** A program aimed at ensuring the security of the energy system by remotely switching on/off electric devices of residential and small commercial consumers by the system operator. Consumers participating in this program often receive discounts on their electricity bills.
- **Interruptible/Curtailable Programs:** A program that offers tariff reductions to usually large industrial (or commercial) consumers who agree to reduce their energy consumption in response to issues or limitations in electric systems. Consumers who refuse to reduce their consumption may face penalties such as higher electricity prices or be excluded from the program.
- **Demand Bidding/Buyback Programs:** Programs encouraging large industrial (or commercial) consumers or their representatives to actively participate in wholesale electricity markets by offering commitments to reduce consumption at a specified price. Additionally, it is a program where bids made to meet consumption in the market are retrieved through consumption reduction. Consumers accepting bids in this program face penalties if they fail to reduce consumption.
- **Emergency Markets:** A program that incentivizes consumers to reduce their usage in situations related to system security. Consumers participating in this program might face penalties if they do not reduce their consumption.
- **Capacity Markets:** Programs providing incentive payments to consumers committing to reduce their loads in case of unexpected events in the system. These programs often impose severe penalties for consumers failing to respond when load reduction is requested.
- **Ancillary Services Market:** Programs that provide incentive payments to consumers offered by the system operator in exchange for their commitment to reduce their load. This commitment allows them to stand ready as an operating reserve. If the system operator requests load reductions, consumers are usually paid based on spot market prices.

While DSR programs offer consumers the flexibility to respond to price changes, they also enable more efficient use of the electricity grid (Yu, Ho Hong, Ding, & Ye, 2019). This allows consumers to manage their consumption in the face of increasing electricity prices, thereby saving on their bills (Bucher et al., 2023). As a system operator, balancing energy demand at all times ensures more effective utilization of energy resources. Additionally, it enhances system security by reducing the risks of interruptions due to system overload. Many studies have shown that in terms of energy efficiency, decarbonization, and system flexibility, the DSR focuses on systems or policies to be implemented in electricity markets in Türkiye (Acar, Yule Bennett, & Scott, 2021). In this context, SWARA and TOPSIS, which are multi-criteria decision-making (MCDM) methods, and which of the DSR models can be integrated into the Türkiye electricity market structure quickly and easily have been studied.

In the literature studies we examined, Şanlı and Alanyalı, in their 2013 study, emphasized the advantages of DSR in Türkiye's energy market (Şanlı & Alanyalı, 2013). Beşli and Dağtekin, in their 2020 study, compared the price advantages brought by Real-Time Pricing, one of the DSR programs, and the low energy prices it provides to consumers (Beşli & Dağtekin, 2020). In the study conducted by Çakmak and Altaş in 2020, consumers attitudes towards the DSR program based on load shifting in smart grid technologies were examined (Çakmak & Altaş, 2020). In a study conducted by Hasanova and Varbak Neşe in 2021, energy consumption in residential buildings was addressed with demand-side management strategies through smart building technologies (Hasanova & Varbak, 2021). In the study conducted by Benek et al. in 2021, the importance of DSR in ensuring energy efficiency and savings was investigated and current practices were evaluated (Benek Arslan, 2021).

## 2. Methods

In this study, to determine the most appropriate DSR program for the Türkiye electricity market, DSR programs will be analyzed using SWARA and TOPSIS, two of the MCDM methods.

### 2.1. Multi-Criteria Decision Making (MCDM)

Decision-making is the process of selecting one or more alternatives that provide a solution according to certain criteria. While the decision-making process is simple when there is a single solution to the problem encountered,

the increase in criteria or conflicting criteria makes it difficult to choose between alternatives. (Więckowski, Kizielewicz, Shekhovtsov, & Salabun, 2023) In this context, the Multi-Criteria Decision Making (MCDM) method facilitates the decision-making process by comparing the criteria with each other and choosing the most suitable alternative for the purpose of the problem. It helps the decision-maker to make a choice between conflicting criteria.

The general approach to the decision-making process with MCDM methods is as follows (Yalçın, Kılıç, & Delen, 2022)

- The problem is defined.
- Criteria are identified to evaluate alternatives that provide a solution to the problem.
- Alternatives are identified.
- Alternatives are evaluated according to the criteria.
- The best alternative is found.

While Multiple Criteria Decision Making (MCDM) methods are utilized in various fields such as engineering, project management, environmental studies, energy, and more, some of the commonly used MCDM methods include AHP, ANP, SWARA, SAW, PROMETHEE, ELECTRE, and VIKOR methods (Taherdoost & Madanchian, 2023).

In our study, the criteria for the DSR program to be implemented in the Türkiye electricity market are initially weighted using the SWARA method. Subsequently, the TOU programs are ranked based on the weighted criteria using the TOPSIS method to select the most suitable program.

## 2.2. SWARA Method

The SWARA method, initially used by Keršuliene, Zavadskas, and Turskis (2010), is referred to as 'Step-Wise Weight Assessment Ratio Analysis' (Jafarzadeh Ghouschi, Garg, Rahnamay Bonab, & Rahimi, 2023). A notable feature of this method is its capability to evaluate experts' opinions regarding the prioritization of criteria (Rahmati, Mahdavi, Ghouschi, Tomaskova, & Haseli, 2022). According to expert opinions, the most critical criterion is placed at the top, while the least critical criterion is placed at the bottom, prioritizing and evaluating the criteria (Alinezhad, & Khalili, 2019). The procedural steps of the method are as follows:

- Criteria are determined to be independent of each other.
- The decision-maker assesses the importance of each criterion starting from the second criterion. For this, it compares criterion  $j$  with criterion  $j-1$  (1).

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases} \text{ is determined by the coefficient factor } (k_j). \quad (1)$$

Where:

$k_j$  = Coefficient factor;  $j$  = Criterion;  $s_j$  = Comparative importance of average value

- $* q_j = \begin{cases} 1 & j = 0 \\ \frac{q_{j-1}}{k_j} & j > 0 \end{cases}$  is determined by the variable ( $q_j$ ). (2)

Where:

$* q_j$  = Recalculated weight;  $j$  = Criterion;  $q_j$  = Variable;  $k_j$  = Coefficient factor

- $w_j = \frac{q_j}{\sum_{j=1}^n q_j}$  represents the relative value of the weights of criteria determined by each expert (3).

Where:

$w_j$  = Importance weight;  $q_j$  = Recalculated weight

In our study, in line with the opinions of experts, the evaluation criteria to be used to select the most appropriate DSR program for Türkiye's electricity market structure were determined in Table 1.

**Table 1.** Criteria and Definitions for the DSR Program

|                | CRITERIA               | DEFINITION                                                                                                                                                                                                                           |
|----------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C <sub>1</sub> | Transparency           | A transparent and fair market environment should be established. Trade secrets should be guaranteed for all market participants and market processes should be openly shared.                                                        |
| C <sub>2</sub> | Competitive            | It should encourage competition. It is important that different participants enter the market and provide demand at competitive prices. This way, the market works efficiently, and consumers are better served.                     |
| C <sub>3</sub> | Flexibility            | Market participants should be offered flexibility. Mechanisms enabling participants to handle various forms of demand and capacity should be in place, thereby enhancing the ability to meet energy market demands more effectively. |
| C <sub>4</sub> | Technology Integration | Encourage the use of advanced technologies. By integrating smart meters, automated demand management systems, and other advanced technologies, DSR users can be managed more effectively and improve market functioning.             |
| C <sub>5</sub> | Consumer Protection    | Protect the rights of consumers. Consumers should be informed and educated about the DSR. In addition, necessary measures should be taken regarding the privacy and security of consumer data.                                       |
| C <sub>6</sub> | Regulatory compliance  | It should comply with the energy legislation in Türkiye. It needs to be in line with regulations and policies governing energy markets and should be integrated into the existing legal framework.                                   |

To determine the importance of the criteria, 32 market experts ranked each criterion from most important to least important, as shown in Table 2,3,4 below.

**Table 2.** Assessment of Criteria by Market Experts

|   | Criteria       | DM <sub>1</sub> | DM <sub>2</sub> | DM <sub>3</sub> | DM <sub>4</sub> | DM <sub>5</sub> | DM <sub>6</sub> | DM <sub>7</sub> | DM <sub>8</sub> | DM <sub>9</sub> | DM <sub>10</sub> | DM <sub>11</sub> | DM <sub>12</sub> | DM <sub>13</sub> |
|---|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|
| 1 | C <sub>6</sub> | 0,19            | 0,15            | 0,17            | 0,23            | 0,13            | 0,13            | 0,12            | 0,30            | 0,05            | 0,19             | 0,21             | 0,19             | 0,14             |
| 2 | C <sub>1</sub> | 0,17            | 0,17            | 0,15            | 0,16            | 0,20            | 0,14            | 0,13            | 0,28            | 0,25            | 0,23             | 0,19             | 0,18             | 0,16             |
| 4 | C <sub>5</sub> | 0,16            | 0,19            | 0,18            | 0,18            | 0,18            | 0,12            | 0,26            | 0,21            | 0,42            | 0,10             | 0,14             | 0,16             | 0,21             |
| 3 | C <sub>4</sub> | 0,18            | 0,16            | 0,20            | 0,13            | 0,17            | 0,30            | 0,21            | 0,06            | 0,03            | 0,10             | 0,16             | 0,15             | 0,15             |
| 5 | C <sub>2</sub> | 0,15            | 0,18            | 0,12            | 0,15            | 0,17            | 0,17            | 0,18            | 0,11            | 0,16            | 0,27             | 0,17             | 0,17             | 0,16             |
| 6 | C <sub>3</sub> | 0,14            | 0,15            | 0,19            | 0,15            | 0,15            | 0,13            | 0,11            | 0,04            | 0,09            | 0,12             | 0,13             | 0,15             | 0,18             |

**Table 3.** Assessment of Criteria by Market Experts-Continued

|   | Criteria       | DM <sub>14</sub> | DM <sub>15</sub> | DM <sub>16</sub> | DM <sub>17</sub> | DM <sub>18</sub> | DM <sub>19</sub> | DM <sub>20</sub> | DM <sub>21</sub> | DM <sub>22</sub> | DM <sub>23</sub> | DM <sub>24</sub> | DM <sub>25</sub> | DM <sub>26</sub> |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| 1 | C <sub>6</sub> | 0,23             | 0,51             | 0,15             | 0,12             | 0,13             | 0,19             | 0,25             | 0,16             | 0,15             | 0,27             | 0,23             | 0,24             | 0,20             |
| 2 | C <sub>1</sub> | 0,17             | 0,03             | 0,21             | 0,10             | 0,22             | 0,27             | 0,15             | 0,11             | 0,20             | 0,21             | 0,16             | 0,20             | 0,22             |
| 4 | C <sub>5</sub> | 0,13             | 0,02             | 0,19             | 0,11             | 0,12             | 0,17             | 0,21             | 0,12             | 0,15             | 0,11             | 0,00             | 0,19             | 0,12             |
| 3 | C <sub>4</sub> | 0,27             | 0,25             | 0,17             | 0,23             | 0,13             | 0,13             | 0,12             | 0,20             | 0,19             | 0,12             | 0,33             | 0,12             | 0,13             |
| 5 | C <sub>2</sub> | 0,11             | 0,06             | 0,13             | 0,16             | 0,21             | 0,11             | 0,17             | 0,13             | 0,18             | 0,16             | 0,27             | 0,15             | 0,19             |
| 6 | C <sub>3</sub> | 0,09             | 0,13             | 0,14             | 0,28             | 0,20             | 0,12             | 0,10             | 0,28             | 0,13             | 0,14             | 0,00             | 0,11             | 0,14             |

**Table 4.** Assessment of Criteria by Market Experts-Continued

|   | Criteria       | DM <sub>27</sub> | DM <sub>28</sub> | DM <sub>29</sub> | DM <sub>30</sub> | DM <sub>31</sub> | DM <sub>32</sub> | Average |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|---------|
| 1 | C <sub>6</sub> | 0,42             | 0,14             | 0,27             | 0,11             | 0,12             | 0,06             | 0,1920  |
| 2 | C <sub>1</sub> | 0,16             | 0,17             | 0,12             | 0,08             | 0,19             | 0,08             | 0,1702  |
| 4 | C <sub>5</sub> | 0,24             | 0,19             | 0,14             | 0,10             | 0,15             | 0,47             | 0,1697  |
| 3 | C <sub>4</sub> | 0,09             | 0,19             | 0,20             | 0,07             | 0,18             | 0,23             | 0,1677  |
| 5 | C <sub>2</sub> | 0,04             | 0,16             | 0,11             | 0,21             | 0,13             | 0,09             | 0,1548  |
| 6 | C <sub>3</sub> | 0,06             | 0,15             | 0,16             | 0,43             | 0,23             | 0,06             | 0,1454  |

For each criterion, the final weights were obtained by taking the arithmetic average of the values determined by the market experts and ranked from most important to least important. The final weighting of the criteria is shown in Table 5 below.

**Table 5.** Weighting of Criteria

|                    | 1                     | 2            | 3                   | 4                      | 5           | 6           |
|--------------------|-----------------------|--------------|---------------------|------------------------|-------------|-------------|
| Criteria           | Regulatory compliance | Transparency | Consumer Protection | Technology Integration | Competitive | Flexibility |
| Importance degrees | 0,1920                | 0,1702       | 0,1697              | 0,1677                 | 0,1548      | 0,1454      |

Following the criteria weights determined using the SWARA method, the DSR program will be evaluated using the TOPSIS method.

### 2.3. TOPSIS Method

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), first introduced by Hwang and Yoon (1981), is a method for evaluating a limited number of alternatives against multiple criteria. (Tian et al., 2023) This method determines the most suitable alternative by comparing how close each alternative is to the ideal solution and how far it is from the negative-ideal solution. (Triantaphyllou, 2000) The procedural steps of the method are as follows:

- The alternatives to be evaluated are determined (4).
- With the participation of k decision-makers assessing n criteria, a decision matrix is obtained for each decision-maker (5).

$$A_{ij}^k = \begin{bmatrix} a_{11}^k & a_{12}^k & \cdots & a_{1n}^k \\ a_{21}^k & a_{22}^k & \ddots & a_{2n}^k \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1}^k & a_{m2}^k & \cdots & a_{mn}^k \end{bmatrix}$$

Where:

k = Decision-makers; n = Criteria;  $A_{ij}$  = Decision matrix

- Calculating the group value using the values obtained from k decision-makers and creating the group decision matrix.

$$a_{ij} = \left( \prod_{k=1}^k a_{ij}^k \right)$$

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$$

Where:

$a_{ij}$  = Decision matrix; k = Decision-makers

- By normalizing the decision matrix, a normalized decision matrix is obtained (6).

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^m a_{ij}^2}}$$

$$R_{ij} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

Where:

$r_{ij}$  = Normalized decision matrix;  $a_{ij}$  = Decision matrix

- The weighted decision matrix is obtained by weighting the normalized decision matrix (7).

$$v_{ij} = w_{ij} \times r_{ij}$$

$$V_{ij} = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ v_{m1} & v_{m2} & \cdots & v_{mn} \end{bmatrix}$$

Where:

$r_{ij}$  = Normalized decision matrix;  $w_{ij}$  = Criteria importance weights;  $v_{ij}$  = Weighted normalized decision matrix

- ( $A^*$ ) The positive ideal solution set is obtained (8).

$$A^* = \left\{ \left( \max_i v_{ij} \mid j \in J \right), \left( \min_i v_{ij} \mid j \in J \right) \right\}$$

$$A^* = \{v_1^*, v_2^*, \dots, v_n^*\}$$

Where:

$A^*$  = Positive ideal solution;  $v_{ij}$  = Weighted normalized decision matrix

- ( $A^-$ ) A negative ideal solution set is obtained (9)

$$A^- = \left\{ \left( \min_i v_{ij} \mid j \in J \right), \left( \max_i v_{ij} \mid j \in J \right) \right\}$$

$$A^- = \{v_1^*, v_2^*, \dots, v_n^*\}$$

Where:

$A^-$  = Negative ideal solution;  $v_{ij}$  = Weighted normalized decision matrix

- The distances of the alternatives to the positive ideal solution are calculated (10).

$$S_i^* = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^*)^2}$$

Where:

$S_i^*$  = Positive ideal solution point;  $v_{ij}$  = Weighted normalized decision matrix;  $v_j^*$  = Positive ideal solution

- The distances of the alternatives to the positive ideal solution are calculated (11).

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}$$

Where:

$S_i^-$  = Negative ideal solution point;  $v_{ij}$  = Weighted normalized decision matrix;  $v_j^-$  = Negative ideal solution

- Calculating the relative closeness values of alternatives to the ideal solution. (12)

$$C_i = \frac{S_i^-}{S_i^- + S_i^*}; 0 \leq C_i \leq 1$$

Where:

$C_i$  = Closeness Coefficient;  $S_i^-$  = Distance from the negative ideal solution;  $S_i^*$  = Distance from the positive ideal solution

In our study, the DSR programs that can be applied to the Türkiye electricity markets are shown in Table 6 below. These programs constitute the alternatives that we will consider in the TOPSIS method.

**Table 6.** Alternatives of DSR Programs

| Alternatives   |                                    |
|----------------|------------------------------------|
| A <sub>1</sub> | Time-of-Use Pricing                |
| A <sub>2</sub> | Critical Peak Pricing              |
| A <sub>3</sub> | Real-Time Pricing                  |
| A <sub>4</sub> | Direct Load Control                |
| A <sub>5</sub> | Interruptible/Curtailable Programs |
| A <sub>6</sub> | Demand Bidding/Buyback Programs    |
| A <sub>7</sub> | Emergency Markets                  |
| A <sub>8</sub> | Capacity Markets                   |
| A <sub>9</sub> | Ancillary Services Market          |

Each alternative was evaluated on a scale of 1-5 according to the criteria and a decision matrix was created (Table 7).

**Table 7.** Evaluation of Alternatives According to Criteria

|                | C <sub>1</sub> | C <sub>2</sub> | C <sub>3</sub> | C <sub>4</sub> | C <sub>5</sub> | C <sub>6</sub> |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| A <sub>1</sub> | 5              | 3              | 3              | 2              | 4              | 5              |
| A <sub>2</sub> | 2              | 3              | 1              | 4              | 1              | 4              |
| A <sub>3</sub> | 2              | 1              | 1              | 1              | 1              | 2              |
| A <sub>4</sub> | 2              | 1              | 3              | 3              | 3              | 1              |
| A <sub>5</sub> | 2              | 1              | 3              | 3              | 3              | 3              |
| A <sub>6</sub> | 3              | 1              | 1              | 1              | 1              | 4              |
| A <sub>7</sub> | 2              | 1              | 1              | 1              | 1              | 2              |
| A <sub>8</sub> | 2              | 2              | 1              | 1              | 1              | 3              |
| A <sub>9</sub> | 3              | 5              | 3              | 5              | 5              | 5              |

The decision matrix is normalized by equation (6). See Table 8.

**Table 8.** Normalized Decision Matrix

|                | C <sub>1</sub> | C <sub>2</sub> | C <sub>3</sub> | C <sub>4</sub> | C <sub>5</sub> | C <sub>6</sub> |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| A <sub>1</sub> | 0,841317       | 0,316619       | 0,496186       | 0,122686       | 0,494242       | 0,565125       |
| A <sub>2</sub> | 0,134611       | 0,316619       | 0,055132       | 0,490742       | 0,03089        | 0,36168        |
| A <sub>3</sub> | 0,134611       | 0,03518        | 0,055132       | 0,030671       | 0,03089        | 0,09042        |
| A <sub>4</sub> | 0,134611       | 0,03518        | 0,496186       | 0,276042       | 0,278011       | 0,022605       |
| A <sub>5</sub> | 0,134611       | 0,03518        | 0,496186       | 0,276042       | 0,278011       | 0,203445       |
| A <sub>6</sub> | 0,302874       | 0,03518        | 0,055132       | 0,030671       | 0,03089        | 0,36168        |
| A <sub>7</sub> | 0,134611       | 0,03518        | 0,055132       | 0,030671       | 0,03089        | 0,09042        |
| A <sub>8</sub> | 0,134611       | 0,14072        | 0,055132       | 0,030671       | 0,03089        | 0,203445       |
| A <sub>9</sub> | 0,302874       | 0,879497       | 0,496186       | 0,766785       | 0,772253       | 0,565125       |

The normalized decision matrix is weighted by equation (7). See Table 9.

**Table 9.** Weighted Normalized Decision Matrix

|                | C <sub>1</sub> | C <sub>2</sub> | C <sub>3</sub> | C <sub>4</sub> | C <sub>5</sub> | C <sub>6</sub> |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| A <sub>1</sub> | 0,143192       | 0,049013       | 0,072145       | 0,02082        | 0,082884       | 0,108504       |
| A <sub>2</sub> | 0,022911       | 0,049013       | 0,008016       | 0,083279       | 0,00518        | 0,069443       |
| A <sub>3</sub> | 0,022911       | 0,005446       | 0,008016       | 0,005205       | 0,00518        | 0,017361       |
| A <sub>4</sub> | 0,022911       | 0,005446       | 0,072145       | 0,046844       | 0,046622       | 0,00434        |
| A <sub>5</sub> | 0,022911       | 0,005446       | 0,072145       | 0,046844       | 0,046622       | 0,039061       |
| A <sub>6</sub> | 0,051549       | 0,005446       | 0,008016       | 0,005205       | 0,00518        | 0,069443       |
| A <sub>7</sub> | 0,022911       | 0,005446       | 0,008016       | 0,005205       | 0,00518        | 0,017361       |
| A <sub>8</sub> | 0,022911       | 0,021783       | 0,008016       | 0,005205       | 0,00518        | 0,039061       |
| A <sub>9</sub> | 0,051549       | 0,136146       | 0,072145       | 0,130123       | 0,129507       | 0,108504       |

The weighted normalized decision matrix yields ideal and negative ideal solution values through equations (8) and (9). See Table 10.

**Table 10.** Positive Ideal Solution and Negative Ideal Solution Values

|           |          |          |          |          |          |          |
|-----------|----------|----------|----------|----------|----------|----------|
| <b>A+</b> | 0,108504 | 0,143192 | 0,130123 | 0,129507 | 0,136146 | 0,072145 |
| <b>A-</b> | 0,00434  | 0,022911 | 0,005205 | 0,00518  | 0,005446 | 0,008016 |

Equations (10) and (11) are used to obtain the distance values to the ideal and non-ideal points. See Table 11.

**Table 11.** Distance from ideal and non-ideal points

|                      | <b>S+</b> | <b>S-</b> |
|----------------------|-----------|-----------|
| <b>A<sub>1</sub></b> | 0,147354  | 0,193933  |
| <b>A<sub>2</sub></b> | 0,212955  | 0,110598  |
| <b>A<sub>3</sub></b> | 0,273919  | 0,01302   |
| <b>A<sub>4</sub></b> | 0,237077  | 0,08697   |
| <b>A<sub>5</sub></b> | 0,224004  | 0,093645  |
| <b>A<sub>6</sub></b> | 0,249361  | 0,071123  |
| <b>A<sub>7</sub></b> | 0,273919  | 0,01302   |
| <b>A<sub>8</sub></b> | 0,25989   | 0,038373  |
| <b>A<sub>9</sub></b> | 0,091643  | 0,252838  |

Equation (12) was used to calculate the closeness coefficient of the alternatives to the ideal solution. See Table 12.

**Table 12.** Closeness Coefficient of Alternatives

|                      | <b>C</b> | <b>Prioritization</b> |
|----------------------|----------|-----------------------|
| <b>A<sub>1</sub></b> | 0,568241 | 2                     |
| <b>A<sub>2</sub></b> | 0,341824 | 3                     |
| <b>A<sub>3</sub></b> | 0,045377 | 8                     |
| <b>A<sub>4</sub></b> | 0,268388 | 5                     |
| <b>A<sub>5</sub></b> | 0,294807 | 4                     |
| <b>A<sub>6</sub></b> | 0,221924 | 6                     |
| <b>A<sub>7</sub></b> | 0,045377 | 8                     |
| <b>A<sub>8</sub></b> | 0,128655 | 7                     |
| <b>A<sub>9</sub></b> | 0,733968 | 1                     |

When these values are sorted from largest to smallest, it is concluded that the best alternative is A<sub>9</sub>. The obtained closeness values and rankings are presented in Table 13 below.

**Table 13.** Ranking of Alternatives

| <b>Ranking</b> | <b>Alternatives</b>                     |
|----------------|-----------------------------------------|
| 1              | Ancillary Services Market               |
| 2              | Time-of-Use Pricing                     |
| 3              | Critical Peak Pricing                   |
| 4              | Interruptible/Curtailable Programs      |
| 5              | Direct Load Control                     |
| 6              | Demand Bidding/Buyback Programs         |
| 7              | Capacity Markets                        |
| 8              | Real-Time Pricing and Emergency Markets |

According to Table 13, it has been observed that the most suitable DSR program capable of adapting to Türkiye's electricity market structure is the Ancillary Services Market. Compared to other TCC programs, the main reason for this selection is that the Ancillary Services Market is directly connected to the transmission level of the organizations that can reduce consumption, so that demand decreases can be monitored and measured more easily and operational processes can be carried out without the need for advanced technological tools (smart meters, etc.).

### 3. Results

As a result of the evaluation using SWARA and TOPSIS methods, it was determined that the most suitable program for Türkiye's electricity market structure is the Ancillary Services Market. In the Ancillary Services Market operated by TEİAŞ incorporated in Türkiye, tenders are organized under the name of "Demand Side Reserve Service". The conditions for participation in these tenders are that the enterprises must consume at least 10,000 MWh of electricity annually, be voluntary, and be directly connected to the transmission level. As the operator of the Türkiye electricity system, TEİAŞ will ensure the security of supply in the transmission system by making demand load reduction calls to consumers participating in the tenders. However, since market participants do not participate in the auctions, demand response cannot be implemented. The reason for this is

- Insufficient knowledge of demand response on the part of market participants
- Low prices in terms of profitability in the tenders made
- Since the tenders cover large-scale industrial consumers, these enterprises do not pay the necessary attention to energy costs.

In this context, by selecting the Ancillary Services Market program with mathematical methods, our study proves that demand response is the right choice from a market perspective.

In the articles we have reviewed, authors have generally considered demand response in conjunction with concepts such as energy efficiency, energy conservation, and security of supply. In this study, we go beyond these concepts and focus on why and how demand response should be implemented in a sustainable electricity market. At the same time, a DSR program that is suitable for Türkiye's energy sector dynamics is evaluated and selected based on the identified market criteria.

### 4. Discussion

In our study, which aims to provide a recommendation for the market by mathematically selecting one of the DSR programs suitable for the structure of the Türkiye electricity market, the Ancillary Services Market Program was found. However, the lack of expected participation in the implementation of the program may indicate that the Türkiye electricity market is not ready for these programs. In this context, before the programs can be implemented, new approaches are needed to change and guide consumption habits by providing necessary information and guidance on the demand side. In addition, incentives provided by market regulators may increase participation in DSR programs.

Looking at the other alternatives evaluated, the reasons for preferring other programs to the ancillary services market program are primarily the lack of legislative infrastructure. However, factors such as the lack of technological infrastructure (smart meters, smart grids, etc.), the lack of mechanisms and tools to manage energy demand, and the inability to measure and price electricity that is not consumed stand out.

Furthermore, to enable the demand side to compete on an equal footing with the supply side, a fair, transparent, competitive, and flexible market environment can be created by offering demand-side participants the opportunity to participate in energy markets.

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## COPING WITH CLIMATE-RELATED DISASTERS: A CASE OF A GREEN FARM COMMUNITY EXPERIENCED A FLOOD\*

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**Abstract.** This study investigates the enduring consequences of recurrent flood disasters on communities located in river basins and proximate to significant water bodies. Floods are identified as a primary contributor to disaster-related losses, affecting 34.2 million people in 2018 alone. The region under scrutiny has witnessed an escalation in the frequency and severity of natural catastrophes due to unpredictable climate changes over the last decade. Despite the profound challenges flooding poses, there is a need for more in-depth studies on the subject. Focusing on the Port St Johns community, this research addresses the existing gap by closely examining the difficulties confronted by residents during and after flood disasters. The study utilizes interviews, observations, and data analysis to gain context-specific insights. A purposive sampling approach is adopted, selecting 15 participants from disadvantaged backgrounds. Semi-structured interviews and thematic analysis are the primary data collection and analysis methods. The study's findings delve into the multifaceted impact of recurring flooding in the Green Farm Community, emphasizing the interplay of environmental factors, social responses, and historical trends. Themes such as infrastructural damage, property loss, and community preparedness challenges are explored. The municipality's role in flood support, timeliness and effectiveness is scrutinized. Environmental factors, including changing rainfall patterns and proximity to water bodies, are vital to the community's vulnerability. Recommendations include enhancing long-term planning, improving communication, assessing financial support adequacy, tailoring responses to community needs, investing in proactive preparedness, and ensuring equitable resource allocation. The study underscores the community's proactive measures, offering valuable insights for disaster management and resilience-building.

**Keywords:** flooding; disaster; preparedness; resilience

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### 1. Introduction

Climate-related disasters, encompassing floods, droughts, and tropical cyclones, stand as formidable challenges on a global scale, inflicting substantial human casualties and economic losses (McCollum et al., 2016; UNISDR, 2015; IPCC, 2012; DCG, 2019; Chen et al., 2023). The intensification of urbanization further amplifies vulnerabilities, reshaping land use patterns and exposing larger populations to the perils of natural hazards, particularly floods (GFDRL, 2015; Ministry of Cooperative Government and Traditional Affairs, 2019). Flood hazards, gauged by the probability of their destructive consequences, such as loss of life and property damage, underscore the urgency of understanding and mitigating these risks (Henry, 2006). McCollum (2006) characterizes natural disasters as monumental events causing catastrophic physical harm, widespread devastation, loss of life, and significant alterations to environmental conditions. Consequently, disasters represent a complex intersection of threats to human life, property, and the intricate fabric of economic, social,

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and cultural existence (Godwell and Lazarus, 2021). The repercussions of such disasters disproportionately affect the vulnerable and underserved segments of society (Godwell and Lazarus, 2021).

This research delves into the profound implications of recurrent flood disasters on a community near river basins and major bodies of water (Hallegatte, 2011; Schaffer-Smith et al., 2020). The adverse impact of these events is particularly pronounced among impoverished and vulnerable communities, illuminating the pressing need to comprehend and address the complexities of flood-induced challenges. This research aims to contribute to a deeper understanding of the intricate dynamics surrounding frequent flood disasters and their ramifications on the communities residing in flood-prone regions.

## 2. Background of the study

On April 22, 2019, Port St. Johns in the Eastern Cape Province of South Africa faced an unprecedented natural disaster as heavy rains triggered catastrophic flooding, leaving a trail of devastation in its wake (Port St. Johns Disaster Risk Management Satellite Centre, 2019). The impact of these torrential rains extended beyond the borders of Port St. Johns, affecting parts of KwaZulu-Natal as well. By April 2022, City Press revealed that the floods in KwaZulu-Natal had claimed the lives of over 4,000 people, inflicted severe injuries on many, and left numerous individuals missing (Sobuwa, 2022). Specifically focusing on the aftermath in Port St. Johns, records from the Disaster Risk Management Satellite Center highlighted the grim statistics. The disaster affected 11 wards, impacting 882 households. Among the victims, 656 households experienced damage to their possessions, 226 were rendered homeless, and 121 were residents (renting at Green Farm and around town) directly affected by the calamity.

While this research primarily centres on Green Farm in Port St. Johns, it's crucial to acknowledge that other areas in the Eastern Cape, such as Mbizana and Lusikisiki, also experienced the far-reaching consequences of the floods. Tragically, a 39-year-old woman lost her life in Mbizana, and in Lusikisiki, two schoolchildren drowned in the floodwaters (Godwell and Lazarus, 2021). The geographical setting of Port St. Johns, as described by the then-Minister of Cooperative Governance and Traditional Affairs, plays a pivotal role in exacerbating the impact of flooding. Green Farm is situated in a valley that absorbs water from the surrounding elevated areas. It faces perennial challenges due to its topography and location (Ministry of Cooperative Governance and Traditional Affairs, 2019 online). The vulnerability of this region to heavy rainfall, whether it be a natural occurrence or a consequence of mismanaged infrastructure, poses significant threats to local industry, agriculture, and the overall economy (Benso and Clay, 2004). Understanding the dynamics of such disaster-prone areas is imperative for devising effective strategies to mitigate the impact on communities and promote long-term resilience (Satilmis, 2023; Ghosh et al., 2023; Choudhury & Haque, 2024; Sari & Özer, 2024; Georgiadou et al., 2024; Maake et al., 2024).

## 3. Research problem

Port St Johns, a region characterized by its susceptibility to natural disasters, has been grappling with recurring catastrophes, primarily stemming from unpredictable climate changes (Gwindi, 2007). Despite the geographical vulnerability of the area, comprehensive preventive measures to avert these disasters are notably lacking (GFDRR, 2015). Over the past decade, the community has borne the brunt of these natural calamities, with rivers and dams frequently overflowing due to heavy seasonal rainfall and run-off, resulting in widespread floods and associated disasters (Port St Johns Disaster Risk Management Satellite Centre, 2019).

One incident reported by Daniel (2019) highlights the vulnerability of the Green Farm area to flash floods triggered by the overflowing Mzimvubu River. This alarming scenario is not isolated; rural settlements in low-lying areas find themselves cut off and inaccessible during such events (Hallegatte et al., 2015). These recurrent disasters have undoubtedly left an indelible mark on the community, impacting their lives, livelihoods, and overall well-being. Despite the evident challenges faced by the Port St Johns community in the aftermath of flooding, there needs to be a deeper understanding of the full extent of these challenges. Previous research has often overlooked the nuanced experiences of communities dealing with floods, particularly in the Port St Johns region. This study aims to bridge this gap by comprehensively assessing the challenges the Port St. Johns

community faces during and after flood disasters. By delving into the lived experiences of the community members, the research seeks to shed light on the multifaceted impacts of flooding on their lives.

Moreover, the study seeks to unravel the profound effects of flooding on the lives of the Port St Johns people. Beyond the immediate and visible consequences, such as property damage and displacement, the research aims to uncover the intricate ways flooding permeates the fabric of daily life for the community. By doing so, the study aspires to contribute to a deeper understanding of the complex interplay between natural disasters and community resilience, ultimately informing future strategies and interventions to enhance the community's ability to cope with and recover from such events.

#### 4. Objective of the study

- Highlight the necessity of understanding and addressing community-specific challenges in preparing for flood events.
- Examine the municipal response to flooding's short-term and long-term planning aspects.

#### 5. Theoretical framework

The Socio-Ecological Systems (SES) framework, as elucidated by Daniel (2019), stands as a robust theoretical lens through which the intricate relationships between social and ecological systems in the context of flood disasters can be comprehensively understood. This framework recognizes the inextricable link between human well-being and the resilience of ecosystems, emphasizing the necessity of integrating social, economic, and ecological considerations in formulating flood risk management strategies (Gunderson, 2000). By drawing attention to the interconnectedness between human and natural systems, the SES framework underscores the reciprocal influences and dependencies that shape the dynamics of flood disasters. A notable strength of the SES framework lies in its ability to accommodate the multidimensionality inherent in flood disasters. By encompassing social, economic, and ecological dimensions, the framework facilitates a nuanced analysis of the impacts of floods on the Green Farm Community. It enables researchers to explore the direct physical damages to infrastructure and property (ecological dimension) and the social and economic consequences, such as displacement, loss of livelihoods, and disruptions to community networks (social and economic dimensions).

Moreover, the SES framework acknowledges that communities actively shape their resilience and adaptive capacity. It underscores the significance of community engagement, local knowledge, and social networks in flood risk management (Mabuya, 2015). The framework recognizes the importance of local perspectives, experiences, and capacities by involving the Green Farm Community in decision-making. This participatory approach enhances the effectiveness and sustainability of flood risk management strategies by fostering ownership, cooperation, and empowerment within the community. However, the SES framework has limitations. Its potential oversimplification of the complex interactions between social and ecological systems, reducing them to linear cause-and-effect relationships, requires critical examination. Flood disasters often involve feedback loops, nonlinear dynamics, and uncertainties, necessitating a more nuanced understanding (Leroux et al., 2020).

Additionally, the framework may overlook power dynamics and inequalities within the social system. Integrating a social justice perspective becomes crucial to identifying and addressing social inequities and promoting more inclusive and equitable flood risk management approaches (Daniel, 2019). The SES framework must be adapted to the local context for successful application to the Green Farm Community. This adaptation involves engaging with local stakeholders, incorporating indigenous knowledge systems, and recognizing the community's values, beliefs, and practices related to flood management. This contextualization ensures that the framework aligns with the unique socio-cultural and environmental dynamics of the Green Farm Community, enhancing its relevance and effectiveness in guiding flood risk management strategies.

## 6. Literature review

### Conceptualizing Flood Disasters

Flood disasters, characterized by overflowing water onto normally dry land, result in widespread damage to property, infrastructure, and the environment (Beson and Clay, 2004; Chen, 2019). These events, often triggered by heavy rainfall, river overflow, or dam failure, have far-reaching consequences on communities' physical and socio-economic aspects (Bless et al., 2013). The disruptions caused by flood disasters extend beyond immediate physical damage, affecting standard life patterns, displacing people, and causing the loss of livelihoods and damage to agricultural fields (Bless et al., 2013).

Various regions globally, including Manicaland, Zimbabwe, and Port St Johns Municipality, South Africa, have experienced the devastating impacts of flood disasters. Deadly storms and floods in Manicaland led to significant damage to infrastructure and the displacement of thousands (Davies, 2020). In Port St Johns, South Africa, floods resulted in the evacuation of residents, destruction of homes, and crop loss (Daniel, 2019). South Africa, as a whole, has faced notable consequences, such as damage to infrastructure and agricultural activities, leading to economic hardships and displacement (Davies, 2020; Daniel, 2019).

### The Port St Johns Green Farm Community

This literature review focuses on the unique and vibrant Port St. Johns Green Farm Community in the rural Eastern Cape province of South Africa. Renowned for its commitment to sustainable and environmentally friendly farming practices, the community engages in organic farming, permaculture, and agroforestry (Mabuya, 2015). These practices minimize synthetic inputs, promote biodiversity, and enhance ecosystem services.

### Challenges Faced by the Green Farm Community

Despite its commitment to sustainable practices, the Green Farm Community faces challenges, including limited access to markets and infrastructure, hindering connections with buyers and access to necessary resources (Davies, 2016). The remoteness of the area and a lack of reliable transportation networks exacerbate these challenges. Additionally, the community needs more access to financial support and technical assistance (Davies, 2016).

### Achievements of the Green Farm Community

Nevertheless, the Green Farm Community has successfully promoted sustainable agriculture and community development. Green farming practices have improved soil fertility, reduced erosion, and enhanced biodiversity, fostering environmental conservation (Ramugondo, 2013; Mabuya, 2015). Beyond environmental benefits, green farming has generated employment, improved food security, and enhanced community livelihoods (Ramugondo, 2013; Mabuya, 2015). The community's engagement in organic agriculture has facilitated entry into niche markets, securing premium prices for their produce (Davies, 2016), thereby ensuring economic viability and long-term sustainability.

### Factors Contributing to Success

The success of the Port St. Johns Green Farm Community is attributed to factors such as assertive community cohesion, shared values, adaptability, and innovation in the face of challenges (Mabuya, 2015; Davies, 2016). Support from local organizations, NGOs, and government initiatives has been crucial in providing technical assistance, capacity building, and market linkages (Ramugondo, 2013; Mabuya, 2015).

While the literature provides a comprehensive overview of the impacts of flood disasters and highlights the success of the Port St. Johns Green Farm Community in sustainable agriculture and community development, there is a notable gap in addressing the specific strategies employed by the Green Farm Community to enhance their resilience to flood disasters. The literature must delve deeper into the community's disaster preparedness measures, response mechanisms, and long-term resilience-building strategies in the face of floods. Understanding the specific actions taken by the Green Farm Community to mitigate the adverse effects of floods and ensure the continuity of their sustainable farming practices would provide valuable insights for other communities facing similar challenges. Exploring the community's experiences in disaster risk reduction, early warning systems, and post-flood recovery efforts would contribute to the existing knowledge on community

resilience in flood-prone areas. Additionally, the literature review needs to explicitly discuss the role of technology, if any, in the Green Farm Community's disaster preparedness and response strategies. Investigating the utilization of technology, such as early warning systems, mobile applications, or remote sensing, could shed light on innovative approaches that contribute to community resilience in the context of flood disasters. In summary, the identified gap in the literature revolves around a need for a more detailed exploration of the Green Farm Community's specific actions and strategies related to disaster preparedness, response, and long-term resilience-building in the context of flood disasters.

In conclusion, the literature highlights floods' global, regional, and local impacts on infrastructure, economy, agriculture, and human well-being. The experiences of the Port St. Johns Green Farm Community serve as an inspiring example of sustainable agriculture and community development. Despite facing challenges, the community's commitment to green farming practices, innovation, and strong community ties has led to positive environmental, social, and economic outcomes. Documenting and understanding their experiences can be valuable for other communities and policymakers interested in promoting sustainable agriculture and rural development. The literature underscores the importance of effective disaster preparedness, response, and resilience-building measures to mitigate the adverse effects of floods and promote sustainable development.

## 7. Methodology

This study employs a qualitative research design, aiming to systematically explore and understand the subjective experiences and meanings attributed to the challenges faced by the Port St. Johns Green Farm Community during flood disasters (Gray, 2014). Qualitative research is well-suited for capturing rich, contextualized data through methods such as interviews, observations, and the analysis of textual or visual data (Creswell, 2019). A non-probability purposive sampling approach was employed to select participants for this study. Purposive sampling involves deliberately selecting participants with specific characteristics or experiences relevant to the research questions (Creswell, 2019). In this case, individuals who could provide rich and in-depth insights into the impact of flood disasters on the livelihood of the Green Farm Community were targeted. Criteria for participant selection were defined based on participants' knowledge, experiences, and direct exposure to flood disasters. The researcher identified and targeted individuals from the Port St. Johns Green Farm Community, considering their involvement and first-hand experiences with flood disasters.

The sample size comprised 15 participants from disadvantaged backgrounds residing in different locations within Green Farm. Semi-structured interviews were employed as the primary data collection method. This approach allows for a guided yet flexible conversation, with a prepared set of open-ended questions or broad topics guiding the discussion. The flexibility to probe further and explore specific areas of interest based on participants' responses enhances the depth and richness of the data. Thematic analysis was chosen as the qualitative data analysis method. Thematic analysis involves identifying, organizing, and interpreting patterns or themes within qualitative data to understand the research topic better. This method allows for a systematic exploration of the challenges experienced by the Green Farm Community during flood disasters. Ensuring research trustworthiness is paramount in qualitative research. Several strategies were implemented to establish credibility, dependability, conformability, and transferability of the findings. These include maintaining detailed records of the research process, employing member checking, seeking peer debriefing, and providing a detailed description of the research context and participants. Adherence to ethical considerations was a priority in this study to ensure the participants' protection and well-being and maintain the research process's integrity. Informed consent was obtained from all participants, confidentiality was assured, and the study was conducted with sensitivity to the cultural context and potential emotional impact on participants.

## 8. Findings

The main themes that surfaced in this analysis are infrastructural damage, loss of property, damage to the natural environment, challenges associated with community preparedness for flooding, the nature of flooding support from the municipality, and the effectiveness of the municipal response. Flooding has wide-ranging implications for the Green Farm Community. Understanding how these themes intersect and influence one another is crucial, as they collectively shape the community's resilience and response strategies in the face of such challenges.

Examining infrastructural damage within the community illuminates the vulnerabilities that critical assets such as roads, bridges, and buildings face during flood events. Simultaneously, the loss of property and its economic and emotional repercussions highlight such disasters' individual and communal impact. Damage to the natural environment poses long-term ecological concerns, emphasising the need for sustainable recovery and prevention strategies. Challenges associated with community preparedness shed light on the necessity of proactive measures to mitigate the severity of flooding's consequences. The nature of flooding support from the municipality reveals the role of local governance in aiding the affected population, addressing the timeliness, adequacy, and community-specific aspects of the response. Furthermore, the effectiveness of the municipal response scrutinises the immediate actions taken by the local authorities and their capacity to plan for the community's long-term well-being.

In the context of the Port St Johns green farm community, one of the primary themes in understanding the frequency of flooding pertains to the influence of environmental factors. This theme encompasses a range of elements, including rainfall patterns, river levels, and the community's proximity to bodies of water. Respondent highlighted, "Our farm is in a low-lying area, with the river nearby. During heavy rains, the river swells, and it's almost inevitable that flooding will occur." This underscores the significance of proximity to bodies of water as a contributing factor to flooding, as the community's location makes it inherently vulnerable to rising water levels.

Echoing this sentiment, Respondent remarked, "The rainfall patterns in this region have become increasingly erratic. We're experiencing intense downpours over shorter periods, exacerbating flooding risks." This statement emphasises the evolving nature of rainfall patterns and their direct link to flooding frequency, indicating that climate changes play a pivotal role in this environmental equation.

Furthermore, Respondent added, "Monitoring River levels is crucial for early warning. However, it's challenging to predict precisely when a flood will occur. We need better forecasting and communication systems." P7 highlights the need for advanced monitoring systems to mitigate the impact of environmental factors, showing that river levels can be a critical parameter for understanding and managing flooding in the community.

The feedback from participants encapsulates the relationship between environmental factors and flooding frequency in the Port St Johns green farm community. Proximity to bodies of water, changing rainfall patterns, and the need for improved monitoring systems emerge as pivotal aspects of this theme. Understanding these elements is vital for comprehending the community's challenges and devising strategies for resilience and preparedness against flooding.

Respondent mentioned, "Our community centre has been a hub for flood relief efforts. We have stockpiled essential supplies and established a communication network to coordinate during flooding events." This illustrates the importance of infrastructure and organisation within the community for responding to flooding. It also emphasises the role of community centres as vital resources in these situations. One key strength of the SES framework is its ability to capture the multidimensionality of flood disasters. By considering social, economic, and ecological dimensions, the framework enables a comprehensive analysis of the impacts of floods on the Green Farm Community. For example, it allows researchers to examine the direct physical damages to infrastructure and property caused by flooding (ecological dimension) and the social and economic consequences, such as displacement, loss of livelihoods, and disruptions to community networks (social and economic dimensions).

Respondent shared, "I've noticed a significant increase in awareness campaigns about flood risks. Our community leaders have been actively educating us about the signs of impending flooding and the importance of evacuation plans." One can drive the role of awareness campaigns and community leadership in ensuring that residents are well-informed and prepared for flooding events.

The SES framework recognizes that communities are not passive recipients of flood impacts but active participants in shaping their resilience and adaptive capacity. It emphasises the importance of community engagement, local knowledge, and social networks in flood risk management (Mabuya, 2015). By engaging with the Green Farm Community and involving them in decision-making processes, the framework acknowledges the significance of local perspectives, experiences, and capacities (Davies, 2020). This participatory approach enhances the effectiveness and sustainability of flood risk management strategies by fostering ownership, cooperation, and empowerment within the community. The data highlights demonstrate that the Port St. Johns green farm community has actively addressed their preparedness and response to flooding. This showcases their awareness of the issue and the practical steps they have taken, such as developing emergency plans, establishing infrastructure, and focusing on education and communication. In essence, the participants' responses indicate that community preparedness is a paramount theme, and it is evident that the Port St Johns green farm community recognizes the importance of being well-prepared to cope with the frequent occurrence of flooding. Their actions address the research question and underline the community's commitment to safeguarding themselves against this natural hazard.

Historical trends offer a crucial perspective on flooding frequency. The Respondent's remark underscores the importance of recognizing long-term patterns. Respondent said, "Over the past two decades, the frequency of flooding has increased significantly. This is a concerning shift that demands our attention." This highlights that historical data can reveal substantial changes in flooding occurrences. Respondent contributes to the discussion by pointing out the real impact of these trends. "The historical data show increased flooding and how it affects our community. Respondents say homes and farmlands have been repeatedly damaged, leading to economic and emotional stress.

Community preparedness for flooding in the Green Farm Community faces several significant challenges. These challenges stem from environmental factors, community dynamics, and resource limitations. The Respondent highlighted one critical issue related to community preparedness. "We've seen flooding here before, but it's always a surprise. We don't have a proper early warning system, which leaves us unprepared." This shows the lack of an effective early warning system as a foundational issue. Inadequate communication and preparation for impending floods can result in a lack of readiness when such events occur.

Similarly, respondents shared their experience, "People often don't take it seriously until the water is at their doorstep. There's a lack of awareness and a feeling of invincibility." This sentiment reflects a broader challenge in disaster preparedness – the psychological barrier of underestimating the risk until it becomes an immediate threat. It reveals the need for education and awareness campaigns to change this mindset.

Respondent emphasised resource constraints, "We're a small community with limited funds. We can't invest in flood-resistant infrastructure or comprehensive preparedness plans." This highlights a practical challenge faced by many smaller communities. Limited financial resources can hinder the implementation of infrastructure improvements or the establishment of well-funded preparedness initiatives. Respondent provided an insightful perspective on community dynamics: "There's a lack of coordination. Everyone is doing their own thing. We need more collaboration and organisation." This addresses the issue of fragmented efforts within the community. With coordination and organisation, the effectiveness of preparedness efforts can be maintained.

The data highlight four interrelated themes that encapsulate the challenges with community preparedness for flooding in the Green Farm Community: (1) inadequate early warning systems, (2) a lack of awareness and a sense of invincibility, (3) resource limitations, and (4) the need for improved coordination and organization. The absence of a robust early warning system emerged as a significant challenge. Respondent shows the community's reliance on reactive measures rather than proactive ones. An effective early warning system is pivotal in providing residents with timely information about impending floods, allowing them to take necessary precautions. With such a system, the community can avoid unexpected flooding events.

This challenge has far-reaching implications. In the context of the research question, it hinders community preparedness and directly responds to the issue at hand. With early warning systems, the community can adequately prepare for flooding events, perpetuating the cycle of unpreparedness and vulnerability. Respondent

delves into the psychological aspect of community preparedness. The perception that flooding will not happen to them until imminent creates a false sense of security. This mindset can result in a lack of engagement in preparedness activities. To address this, educational campaigns are essential. Residents must understand the risks and recognize the importance of preparedness even when floodwaters are not immediately threatening.

In the context of the research question, this challenge speaks to the community's readiness, or lack thereof, in the face of flooding. Overcoming this challenge requires a concerted effort to change residents' attitudes and perceptions about the likelihood and severity of flooding events. Respondents show the financial constraints faced by the Green Farm Community. Small communities often need more financial capacity to invest in flood-resistant infrastructure and comprehensive preparedness plans. This challenge directly affects their ability to mitigate flood risks and prepare for potential disasters.

In the context of the research question, this challenge highlights a structural barrier to community preparedness. Implementing necessary measures and infrastructure improvements becomes easier with adequate resources. Additionally, it reflects the socioeconomic aspect of the community's vulnerability to flooding. The Respondent's perspective sheds light on the issue of community coordination. The lack of organisation and collaboration can lead to fragmented and ineffective preparedness efforts. Withmunity's ability to respond cohesively to flooding events is compromised without a unifiemaintained

Regarding the research question, this challenge points to a critical aspect of community preparedness. To address the theme of preparedness, there must be a concerted effort to foster better organisation and collaboration among community members, local authorities, and relevant stakeholders. The challenges with community preparedness for flooding in the Green Farm Community include the absence of effective early warning systems, the need to change residents' attitudes and perceptions, resource limitations, and improved coordination and organisation. These challenges hinder the community's readiness and directly respond to the research question, highlighting the complexities that must be addressed to enhance preparedness for flooding in this community. The nature of support from the municipality in response to flooding in the Green Farm Community involves timeliness, communication, financial assistance, and a tailor-made approach. P9 said, "The municipality's response is sometimes timely, but it is a temporary solution. They did what was necessary to control the immediate crisis, but there was limited long-term planning." The statement underscores the importance of considering both short-term and long-term aspects of municipal support. While immediate actions are crucial during a flood, addressing the lasting consequences and planning for future resilience is equally essential.

Respondent added, "I appreciate the efforts made by the municipality, but communication can improve. There is a lack of clarity about evacuation plans and where to seek help during the flood." This emphasises the significance of effective communication during a crisis. It highlights the need for the municipality to provide clear, accessible, and up-to-date information to the community to ensure their safety and well-being.

According to Respondent, "The financial support provided by the municipality was helpful for some, but it didn't cover all the losses. Many of us had to dip into our savings to recover what we lost during the flood." This raises an essential financial dimension of support. While financial assistance is a critical aspect of the municipal response, assessing whether the provided support is sufficient to aid the community's recovery and prevent additional economic strain on the affected residents is imperative. The nature of support from the municipality in response to flooding in the Green Farm Community involves timeliness, communication, financial assistance, and a tailor-made approach. Respondent said, "The municipality's response is sometimes timely, but it is a temporary solution. They did what was necessary to control the immediate crisis, but there was limited long-term planning." The statement underscores the importance of considering both short-term and long-term aspects of municipal support. While immediate actions are crucial during a flood, addressing the lasting consequences and planning for future resilience is equally essential.

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Additionally, community members actively participate in disaster preparedness and response activities. Early warning systems have been established to allow timely evacuation and relocation of residents during flood events (Daniel, 2019). Joint efforts with government agencies and non-governmental organizations resulted in the construction of flood-resilient infrastructure, including improved drainage systems and flood barriers (Davies, 2020). A community's solid social cohesion and collective decision-making processes play a vital role in a community's ability to respond to and recover from flood events (Davies, 2020). Despite these adaptation measures, challenges remain. More financial resources and access to technical expertise are needed to ensure communities can implement more comprehensive flood protection strategies (Davies, 2020). The region's remoteness and lack of adequate infrastructure complicate emergency response and post-flood recovery efforts (Daniel, 2019).

Action and recovery strategies in place. Respondent, a long-term resident of the Green Farm Community, emphasises the importance of preparedness, stating, "Preparedness is key, and we need the municipality to be proactive. The lack of proactive measures can make the situation worse." This underscores the significance of planning in dealing with flooding. An effective municipal response requires measures to prevent or mitigate flood damage.

Respondent, who has been involved in community volunteer work, echoes this sentiment: "We've been organising community drills for years, and we've seen first-hand the importance of preparedness. The municipality should be involved in these drills, too." Here, Respondent highlights the constructive collaboration required between the community and municipal authorities in preparing for floods. This productive collaboration can improve the overall response to flooding incidents. Environmental factors, including rainfall frequency, significantly shape the community's vulnerability to flooding. The natural environment is not only a victim but also a crucial factor influencing the extent of damage. Infrastructural damage emerged as a recurring theme, highlighting the vulnerability of the community's physical assets and the disruption to daily life. The loss of property represents not only an economic shock but also an emotional one for residents. Simultaneously, damage to the natural environment raises concerns about long-term ecological consequences. The community's preparedness for flooding is critical in mitigating its impact, and the findings suggest challenges. One of the most significant themes explored is the nature of flooding support from the municipality. The analysis revealed a mix of positive and negative perceptions, with timeliness, communication, financial assistance, and community-tailored approaches emerging as critical aspects of the discussion. Furthermore, the effectiveness of the municipal response to flooding has been scrutinised. While immediate actions were taken, questions about long-term planning and the comprehensiveness of the response persist.

The obtained results from the analysis of the Green Farm Community's experiences with flooding provide novel insights and practical value in some key areas:

### **Challenges in Community Preparedness:**

**Novelty:** The study identifies specific challenges in community preparedness for flooding, such as the absence of effective early warning systems, psychological barriers, resource limitations, and coordination issues. These challenges contribute to a comprehensive understanding of communities' barriers to becoming resilient to flooding.

**Practical Value:** The identified challenges offer practical guidance for community leaders, local authorities, and policymakers on areas that need targeted interventions to enhance community preparedness and response.

**Nature of Municipal Support and Effectiveness of Response:**

**Novelty:** The research delves into the nuanced aspects of municipal support, including timeliness, communication, financial assistance, and tailor-made approaches. It also evaluates the effectiveness of the municipal response in both short-term crisis management and long-term planning.

**Practical Value:** The detailed insights into the nature of municipal support and the effectiveness of the response provide valuable information for local authorities and emergency management agencies. This can guide improvements in communication strategies, resource allocation, and long-term planning for flood events.

**Community-Municipality Synergy and Communication:**

**Novelty:** The study emphasizes the importance of community-municipality synergy in flood preparedness, advocating for the involvement of local authorities in community drills and initiatives. Additionally, it underscores the critical role of transparent and timely communication from the municipality during flood events.

**Practical Value:** These findings offer practical recommendations for community leaders and municipal authorities to collaborate more effectively, engage in joint preparedness activities, and improve communication channels for better community resilience.

The obtained results contribute novel insights by exploring the intricate dynamics of environmental factors, community preparedness challenges, the nature of municipal support, and the effectiveness of the response. The practical value lies in offering specific recommendations for improving community resilience, municipal response strategies, and resource allocation in the face of recurrent flooding. While there may be some similarities with the broader literature on flooding, the unique context of the Green Farm Community and the specific challenges identified in this study distinguishes it from earlier research.

The findings have revealed several key themes that collectively paint a comprehensive picture of the challenges and dynamics associated with this recurring environmental hazard. One of the central findings is the influence of environmental factors on flooding frequency. The community's proximity to bodies of water, changing rainfall patterns, and the need for advanced monitoring systems have been identified as critical factors. The data demonstrates that environmental factors play a pivotal role in shaping the community's vulnerability to flooding, with the location, climate changes, and monitoring systems all impacting the frequency of flood events. The findings of this study centred on the themes of damage to the natural environment, infrastructural damage, and health and safety concerns resulting from flooding in the Green Farm Community. They offer a comprehensive and nuanced understanding of the multifaceted impact of this natural disaster. These themes represent complex challenges that intersect and collectively shape the community's resilience and response strategies. Analysing these findings, one can draw significant conclusions and develop pertinent recommendations for the community's well-being and preparedness. The damage to the natural environment, including deforestation, pollution, and habitat destruction, emerges as a pressing concern. The observations from participants emphasise the urgent need for action to reverse the trend of environmental degradation. The loss of nesting sites for bird species due to coastal erosion highlights the tangible impact on local biodiversity.

The intersection between habitat loss and urbanisation is evident, emphasising the necessity for responsible urban planning to mitigate these effects. Water pollution raises concerns about the sustainability of local water resources and potential health risks associated with contaminated water. The analysis of the data gathered from the Green Farm Community regarding the nature of flooding support from the municipality reveals a nuanced picture of the community's experiences and expectations. When considering the timeliness of the municipal response, it is evident that immediate actions are taken to control the crisis. Still, as highlighted by P9, there is often a sense that these efforts are akin to temporary solutions. This finding underscores the importance of balancing short-term crisis management and long-term planning. While addressing the immediate needs is critical, the sustainability and resilience of the community require a more comprehensive, forward-thinking approach. Analyzing the effectiveness of the municipal response to flooding highlights the interconnectedness of preparedness, mitigation, and recovery strategies. Participants' emphasis on preparedness as a key aligns with the broader understanding that an effective response begins with proactive measures. A municipality's role in flood preparedness cannot be underestimated, and a lack of proactive measures can exacerbate the situation during flood events. This calls for comprehensive planning and preparedness initiatives that anticipate potential flood impacts.

Community-municipality synergy in flood preparedness is essential. Involving the municipality in community drills and preparedness initiatives can significantly enhance the response to flooding incidents. This finding highlights the need for active collaboration between community members and local authorities to strengthen preparedness and mitigation measures. The effectiveness of the municipal response also hinges on communication. Transparent and timely communication is a cornerstone of an efficient response strategy. Such communication reduces panic and empowers residents to make informed decisions during flood events. This finding emphasises the critical role of the municipality in providing precise and reliable information to the community. Resource allocation is another pivotal component of an effective municipal response. Vulnerability assessments are vital to ensuring that resources are distributed equitably. This finding underscores the necessity of allocating resources based on the unique needs of different areas within the Green Farm Community. Fair and informed resource allocation is essential to mitigate the impact of flooding and reduce disparities in vulnerability.

## Conclusions

This study delves into the multifaceted challenges of recurring environmental hazards in the Green Farm Community, particularly flooding. The findings elucidate key themes around environmental factors, social responses, and historical trends, collectively shaping the community's resilience and preparedness. The influence of proximity to water bodies, changing rainfall patterns, and the imperative need for advanced monitoring systems emerge as central to understanding flooding frequency.

Moreover, the community's proactive measures, such as emergency response plans and infrastructure development, reflect a commitment to readiness and resilience in the face of recurrent floods. Historical trends underscore an alarming increase in flooding frequency over the past two decades, resulting in tangible consequences like property damage and emotional stress. Nevertheless, the community's adaptive responses indicate a capacity for proactive measures, offering hope in the face of evolving challenges.

The study's depth extends to the multifaceted impact of flooding, encompassing damage to the natural environment, infrastructural challenges, and health and safety concerns. Environmental degradation, manifested through deforestation and pollution, raises urgent calls for action. Infrastructure disruptions pose risks to public safety and divert resources from community development. Health concerns stemming from water contamination and waterborne diseases underscore the vulnerability of community members and the imperative for comprehensive disaster preparedness. Examining the role of the local government in responding to flooding reveals a nuanced picture. While immediate actions are taken in crisis management, there's a need for a more comprehensive, forward-thinking approach to ensure sustainability and resilience. Communication gaps, financial support adequacy, and the importance of a community-specific approach require attention. The study underscores the interconnectedness of preparedness, mitigation, and recovery strategies, emphasizing the pivotal role of the municipality in flood management.

In conclusion, the study addresses the research question and provides a robust foundation for informed decision-making and community resilience-building. The intricate dynamics of environmental factors, social responses, and historical trends underscore the complexity of flooding challenges. The Green Farm Community's experiences and responses offer valuable insights into disaster management and community well-being. The recommendations aim to enhance the community's resilience, emphasizing long-term planning, improved communication, financial support adequacy, community-specific strategies, and active collaboration between the community and local authorities. These findings call for a concerted effort to improve flood management and disaster resilience through a collaborative approach between the Green Farm Community and local authorities.

## Recommendations

### Enhance Long-Term Planning

Develop comprehensive, long-term flood management plans. Address both immediate response and long-term resilience. Include strategies for preventing future flooding and minimizing its impact.

### Improve Communication

Focus on clear, accessible, and real-time communication during flood events. Provide residents with detailed evacuation plans, contact information, and support services. Ensure communication is timely and reliable to enhance community confidence.

### Assess Financial Support Adequacy

Conduct a thorough assessment of financial support provided to flood-affected residents. Ensure that financial assistance covers the majority of losses incurred during flooding. Reduce the economic burden on residents to facilitate a smoother recovery process.

### Tailor Responses to Community Needs

Adopt a more community-specific approach to flood response. Customize responses based on the unique vulnerabilities and characteristics of the Green Farm Community. Ensure that strategies consider the distinct requirements of the community for maximum effectiveness.

### Invest in Proactive Preparedness

Proactively engage in flood preparedness initiatives in collaboration with the community. Participate in community drills to enhance overall preparedness. Establish early warning systems and support residents in developing their preparedness measures.

### Equitable Resource Allocation

Inform resource allocation decisions through vulnerability assessments. Ensure fairness and effectiveness in distributing resources. Address the specific needs of different areas within the Green Farm Community to reduce disparities in vulnerability.

These recommendations aim to strengthen the community's resilience, improve response strategies, and foster collaboration between the municipality and the Green Farm Community. Implementing these measures will contribute to more effective flood management and enhanced disaster resilience in the face of recurring environmental challenges.

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## MANAGING THE FLOW OF PEOPLE AND GOODS AT THE BORDER - THE ROLE OF IT SYSTEMS IN IMPROVING THE EFFICIENCY OF CROSS-BORDER LOGISTICS

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**Abstract.** Contemporary challenges related to the management of the movement of people and goods in border areas present us with the need for effective border control, while maintaining the fluidity and efficiency of logistics processes. This article examines the role of information systems in improving the efficiency of cross-border logistics. It focuses on the ways in which advanced information technologies can support both border control processes and the logistical aspects of the movement of goods and people at the border. Through a review of existing IT systems, case studies and analysis of practices, this article identifies key challenges, benefits and potential innovations in the area of border flow management. The conclusions of this analysis can provide valuable guidance for practitioners, policymakers and researchers interested in improving logistics processes at borders using information systems.

**Keywords:** management; logistics; information systems; border areas

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**JEL Classifications:** K42, K33, R1

**Additional disciplines:** management and quality sciences

### 1. Introduction and theoretical background

The border, which is a separate territory of a state, determines the spatial extent of its sovereignty. On the one hand, it is a separating factor, when certain conditions are met, it acts as a "filter" and a zone of economic contacts between countries (cross-border cooperation) (Ratti, 1996). Boundaries are also defined as a dividing line between areas with different political, administrative, cultural, social, institutional, competence, environmental or other affiliations that form the basis or reason for the distinction. As Komornicki (2022) rightly points out, the border can divide and unite, which means that it can be a barrier or a zone of cooperation. One of the basic functions of the border is to control all flows through the state border, the so-called "permeability" of the border. It applies to both people and goods. The level of permeability of the border varies from the possibility of free movement of people and goods across the border or burdened with special permits and restrictions. It is a combination of two factors: the degree of formalisation of the border (e.g., visa regulations, customs tariffs) and the degree of development of cross-border transport infrastructure (e.g., the number and condition of communication routes crossing the border, the number of border crossings). Increasing the level of permeability of the border (formalization) creates new conditions for the development of border areas: positive and negative.

There is a separate strand of literature devoted to the cross-border logistics (e.g., He, Wu, & Choi, 2021, Sun, 2021; Xie, Feng & Zhou, 2022; Bandaranayake, Kiriden, & Kulatunga, 2022; Ye, 2024).

An example of a border fully permeable to Polish is Schengen. It is here that a catalogue of measures to facilitate border controls in both passenger and freight traffic has been applied. The Schengen Borders Code provides for the free movement of persons (Commission communication, 4 March 2022).

Due to its location, Poland has a dual function, in relation to the EU Member States, securing the EU's external border by the Polish Border Guard, which is a guarantee of securing the interests of the entire "area without borders". The second function is cooperation with third countries (including currently with regard to Ukraine (Shahlon-Pszenny, 2024)). The analysis used the method of statistical analysis and legal comparisons in this area.

## **2. Examples of comprehensive EU integrated border management policies**

The authors presented the forms of implementation of the integrated border management policy of the European Union on selected examples. The discussed programmes and undertakings concern, m.in the fight against organised crime and evolving threats, protection against terrorism, cooperation and exchange of information between authorities, as well as facilitation of legal border crossings and effective prevention of illegal border crossings by refugees.

The following assumptions for cooperation between EU countries in the field of combating organised crime have been developed, m.in in the EU Security Union Strategy for 2020-2025 (Vasilkov et al., 2023), which was adopted by the Justice and Home Affairs Council (JHA) in 2020. These include the security environment of the future, countering evolving threats, protection against terrorism and organised crime, and a strong European security ecosystem. The fourth area focuses on issues related to cooperation and exchange of information between authorities as the most effective tool for combating crime and terrorism. It then underlines the importance of strong external borders, guaranteeing the integrity of the Schengen area and the security of citizens, with an emphasis on modern and effective management. Cooperation and exchange of information responsible for the security of government and local services and bodies. This involves, m.in, the use of modern technologies and biometrics in documents, the interoperability of information systems used by services in EU countries, and the development of future-oriented tools. (EU Security Strategy 2020-2025).

Subsequently, the Modernization Program of the Police, Border Guard, State Fire Service and State Protection Service in the years 2022-2025 was implemented." In order to ensure high security of SG telecommunications systems and to maintain high network availability in order to enable constant communication with border control systems, network equipment and end devices for the SG telecommunications system were purchased as part of the project. The implementation of the project made it possible to increase the functionality and ensure the continuity of operation of the Border Guard's telecommunications system, as well as to ensure efficient access for users to the central IT systems of the Border Guard and the implemented software. In the area of ICT security, the Border Guard operates a number of classified networks and ICT systems, including the Central System for the Processing of Classified Information and the Integrated System for Monitoring, Response and Protection against ICT Security Incidents KORUND.

Another example of a comprehensive European integrated border management policy is the implementation strategy (EUIBM 2023-2027). The main objectives are: facilitating legal border crossings, preventing unauthorised border crossings, preventing cross-border crimes. The implementation of the EUIBM's activities is based on a continuous readiness to respond to threats and to provide the necessary tools to respond to and manage any such threats at the external borders (Commission Communication, 2023).

### 3. The role of information systems in improving border logistics

The Border Guard m.in uses systems such as the Entry/Exit System (EES), the Schengen Information System (SIS), the Visa Information System (VIS) and the European Travel Information and Authorisation System (ETIAS) to improve the logistics of border crossing points (Zawadzka, 2019).

The Entry/Exit System (EES) aims to strengthen border control, prevent illegal immigration and facilitate the management of migrant flows. The EES contributes to the identification of persons who may not fulfil or no longer fulfil the conditions for residence and duration in the territory of the Member States. The EES is a centralised system that is interoperable at central level with the VIS and a uniform national interface for communication with Member State authorities. (Gajda, 2018). SIS The Schengen Information System (SIS) is the most widely used and the largest information exchange system for security and border management in Europe. (Meszaros, 2018; Bellanova & Glouftisios, 2022). The Visa Information System (VIS) is used to process data and decisions on applications for short-stay visas for the purpose of visiting or transiting through the Schengen area. (Gajda, 2023). The ETIAS (European Travel Information and Authorisation System) was established on the basis of Regulation (EU) 2018/1240 of the European Parliament and of the Council of 12 September 2018. Therefore, the primary purpose of the system is to "seal" the borders and prevent the entry of people who pose a threat into the territory of the Member States (Zawadzka, 2019).

ECRIS-TNC) - was established on the basis of Regulation (EU) 2018/1726 of the European Parliament and of the Council of 14 November 2018 on the European Union Agency for the operational management of large-scale IT systems in the area of freedom, security and justice (EU-LISA) (Lungu, 2020).

Eurodac, which has been in operation since 15 January 2003, is an EU-wide database of asylum seekers containing the fingerprints of irregular migrants. The purpose of this database is to help determine which country is responsible for examining an asylum application under the Dublin Convention. It is an important tool for the development of the Common European Asylum System. The system is used to determine whether a person apprehended for illegally crossing the EU's external border or staying illegally in a Member State has applied for asylum in the EU, Norway or Iceland. The Eurodac system comprises the Central Unit, initially operated by the Commission but now managed by the EU Agency for Large-Scale IT Systems (Jones, 2014).

Customs authorities in Poland use, m.in the following systems when carrying out border controls: Automated Export System (AES) – enables fully automated handling of export declaration and entry summary declaration (WDS), as well as exchange of information in electronic form between customs offices in the European Union. The system ensures that customs authorities carry out their customs supervision effectively.

Automated Import System (AIS) is an IT system used to handle all documents related to the import of goods, e.g. customs declarations and declarations, as well as statistical declarations. It is used to handle operations related to the import of goods into the EU customs territory. AIS improves business processes in imports and statistics of trade in goods between European Union member states (Wójcik & Rybicka, 2013).

The New Computerised Transit System 2 (NCTS2) is used to submit declarations for the transit procedure and to monitor transit operations by customs authorities (Odell, 2013). The system has been implemented in the European Union countries and in the countries parties to the Convention on the Common Transit Procedure (WPT Convention) the members are: EU countries, Liechtenstein, Norway, Turkey, Serbia, Macedonia, Iceland, and Switzerland.

Customs Information System (SIC) – was developed for the purpose of cooperation between customs services, as one of the three systems (Europol Information System and Schengen Information System). It was created in order to improve cooperation between police, border and customs services of the European Union Member States (Czermińska, 2014). The legal basis for its operation is the Convention drawn up on the basis of Article K. 3 of the Treaty on European Union, on the use of information technology for customs purposes (CIS) 1995). The system consists of a central database that is accessible to all Member States. The priority task of the system is to improve control and fight fraud, to ensure effective management of the control of goods at the external

borders. The programme supported trans-European computerised communication and information exchange systems, as they are essential for the functioning of customs administrations in the Community and for the exchange of information between them.

In order to improve border traffic, an integrated system of the Border Guard and the National Revenue Administration Digital Border has been created, which enables the transfer of data on checked travellers from the Border Guard databases to the databases of the National Revenue Administration. Therefore, the traveller presents the documents at check-in only to the Border Guard officer. The Digital Border System has replaced the previously used Integrated Border Handling System CAIFS II at the external border of the European Union. It has significantly improved the methods of handling people, vehicles and goods within road and rail border crossings and has expanded the possibilities of supporting the service with new types of traffic, i.e., border air traffic, sea ferry traffic, sea container traffic and sea freight traffic. From the point of view of the clients of the National Revenue Administration, the Digital Border system is to be a tool to support their business and tourist activities related to the movement of goods and people across the external border of the European Union. The Digital Border ensures efficient customer service at border crossings located at the EU's external border using automatic data exchange, automatic vehicle identification and traffic control mechanisms.

The Electronic Transport Supervision System (SENT) was developed to monitor the road and rail transport of the so-called "sensitive goods" and the trade in heating fuels is used by customs authorities in Poland (Szymanek, 2021). Legal acts regulating the control of the transport of goods subject to SENT: (Act, 2017; Regulation, 2019; Regulation, 2021; Regulation, 2022; Regulation, 2013). For the purposes of the implementation of the Act on Supervision Systems in Road and Rail Freight Transport and Fuel Trading, a register of SENT notifications has been created and is maintained in the IT system (Sarnowski & Lewandowski, 2021). The SENT register was created to enable electronic reporting. (Chackiewicz, 2021). From 1 July 2024, the regulations on the obligation to register foreign carriers performing international road transport in the SENT system will come into force.

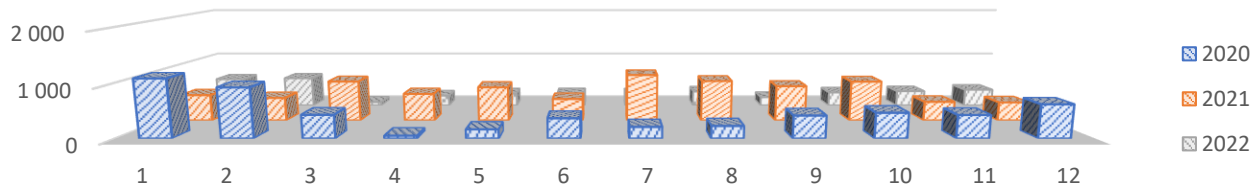
The Technical Centre for Computer Forensics was established in 2015 as part of the HERCULE III project, which was 80% funded by the European Anti-Fraud Office (OLAF). It is used by customs authorities in Poland. Program implementation of computer forensics in the Customs Service No. OLAF/2015/D1/042, as a result of which equipment and specialized software were purchased, intended for collecting, retrieving, securing and analyzing digital data on various types of electronic media used by criminal groups. (Zimoch, 2018). The Centre provides: substantive and technical support for the customs administration in the field of computer forensics, equipment and software, development of procedures in the field of computer forensics, monitoring and implementation of new solutions in computer forensics, cooperation with other domestic and foreign services, law enforcement agencies and international organizations, conducting trainings, developing training materials, coordinating and supervising activities, testing the effectiveness of implemented processes and implemented solutions, issuing opinions on draft legal acts concerning computer forensics, implementation of uniform principles of operation in the field of computer forensics, participation in procedural activities in cases of crimes and fiscal offences, seizure and search of devices containing IT data or IT systems, preparation of reports on tests of IT devices or IT systems, analysis of data obtained by means of methods computer forensics, appearing before the court in criminal and penal fiscal proceedings as experts in the field of computer forensics, supporting implementation units in obtaining and securing digital evidence, preparing data and developing analyses in the field of cell properties. Technological progress and digitization apply to all uniformed services (Orłowska, 2023).

#### **4. Selected statistical data of the Border Guard and customs authorities in the years 2020 – 2023**

The Border Guard m.in uses systems such as the Entry/Exit System (EES), the Schengen Information System (SIS), the Visa Information System (VIS) and the European Travel Information and Authorisation System (ETIAS) to improve the logistics of border crossing points (Zawadzka, 2019). Both the Border Guard and the customs authorities keep their statistics on detentions during border and customs controls. These are mainly cases of attempts to smuggle excise goods into the EU. In order to illustrate the scale of the problem and the numbers of border traffic, the authors have compiled a compilation of statistical data for the years 2020 – 2023

on the border between the Republic of Poland and Ukraine. The presented data was mainly based on information provided by the Border Guard in terms of the number of travelers crossing the border, cars, trucks and other vehicles. Figures 1-3 present data on attempts to smuggle excise goods thwarted by customs authorities.

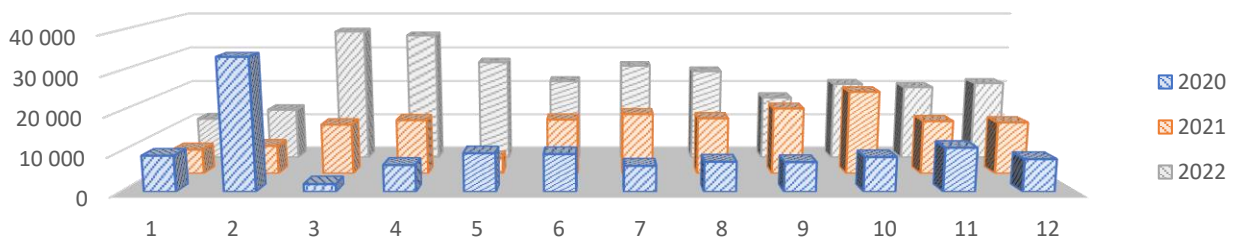
## ALCOHOL (LITR)



**Fig 1.** Excise goods seized by customs authorities at the EU's external border in 2020-2022 – alcohol in litres.

Source: Author's own elaboration based on the Security Monitor of the Eastern Border of the Republic of Poland of the EU External Border in 2020-2022

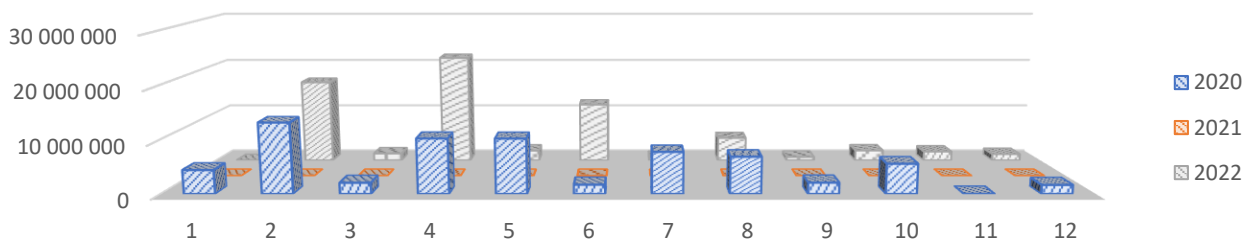
## FUEL (LITER)



**Fig 2.** Excise goods seized by customs authorities at the EU's external border in 2020-2022 – fuel in litres.

Source: Author's own elaboration based on the Security Monitor of the Eastern Border of the Republic of Poland of the EU External Border in 2020-2022

## CYGARETS (ART.)

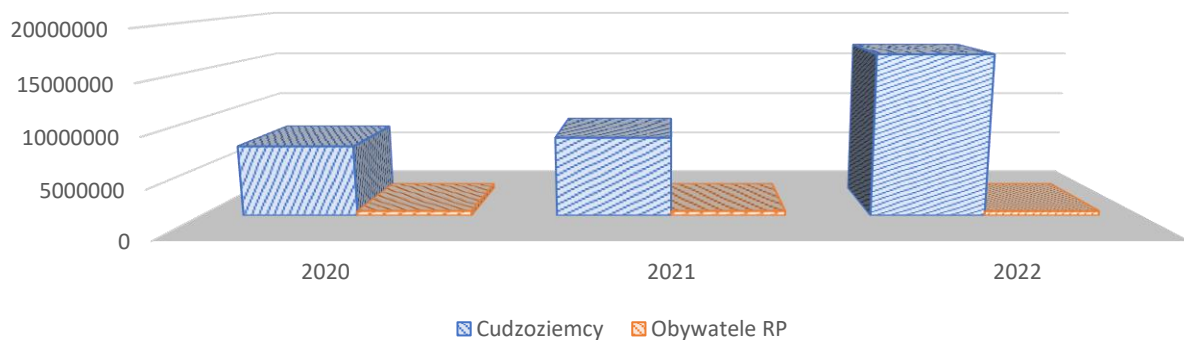


**Fig 3.** Excise goods seized by customs authorities at the EU's external border in 2020-2022 – papers in pieces.

Source: Author's own elaboration based on the Security Monitor of the Eastern Border of the Republic of Poland of the EU External Border in 2020-2022

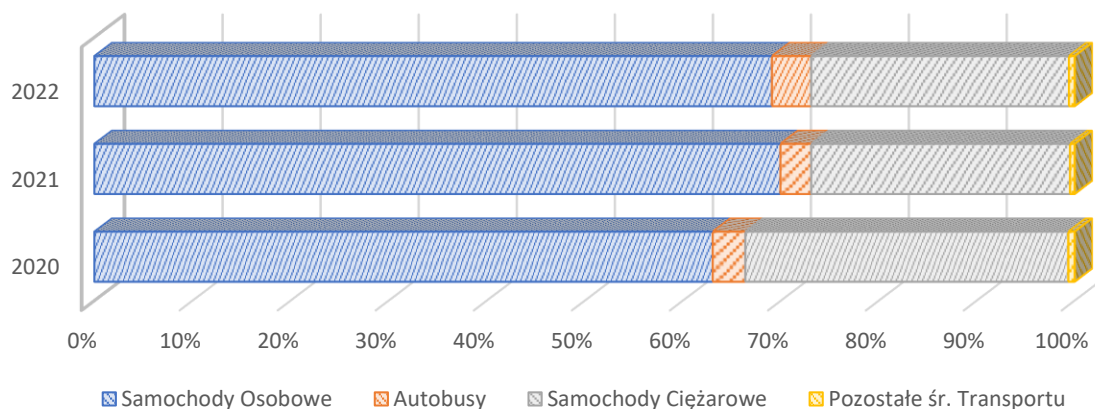
According to data on the quantities of excise goods seized in the form of cigarettes, alcohol and fuel, the highest number of alcohol was seized at the EU's external border, 7351 litres, in 2021. The highest amount of fuel was retained in 2022: 277,510 litres. Fuel retention in 2021 represents 65.5% compared to 2022, while the highest number of cigarettes was seized in 2021 at 171,049,904. Seized cigarettes in 2020 account for 46.4% of cigarettes seized in 2022.

As an example of the volume of traffic at the border, the authors gave statistics from the border of Polish with the territory of Ukraine. The decisive factor influencing the sudden increase in border traffic in this region was the outbreak of the war in Ukraine on February 24, 2022. According to the information of the Border Guard, in 2022 the traffic on the border with Ukraine doubled from 8.7 million in 2021 to 17.3 million in 2022 (Monitor, 2023, p.2). Figures 4 and 5 show passenger and car border traffic on the border with Ukraine.



**Fig 4.** Passenger border traffic on the border with Ukraine – the number of border crossings by Polish citizens and foreigners in 2020-2022

Source: In-house analysis based on Border Guard statistics for 2020-2022, accessed: 10.11.2023



**Fig 5.** Border traffic of road transport vehicles on the border with Ukraine in 2020-2022.

Source: In-house analysis based on Border Guard statistics for 2020-2022, accessed: 10.11.2023

As already indicated at the beginning of the article, the National Tax Administration, the Border Guard, the Police, the Fire Brigade, the Veterinary Inspection, the Airport Security Guard, and the State Plant Health and Seed Inspectorate also operate on the state border. Border guards cooperate with state and local government authorities (develop strategies for action) (Chackiewicz, 2020).

## Conclusions

An in-depth analysis of the role of IT systems in managing the flow of people and goods at the border allows us to conclude that they are an indispensable tool in improving the efficiency of cross-border logistics. The research carried out in this article clearly indicates that advanced information technologies can make a significant contribution to improving border processes, improving security and increasing the smooth flow of goods and people.

An analysis of existing IT systems used at borders, along with examples of best practices, shows the potential of these solutions and their positive impact on the efficiency of cross-border logistics. In particular, the ability to monitor and analyse data in real time, process automation and inter-institutional integration are key elements that enable a rapid response to changing conditions and the optimisation of the flow of goods and people.

However, in order to fully exploit the potential of information systems in border flow management, it is necessary to continuously improve and adapt these solutions to changing needs and challenges. The implementation of advanced IT systems should also be supported by adequate staff training and the provision of adequate technical and financial resources.

It is also worth stressing that effective management of the flow of people and goods at the border requires international cooperation and the peer-to-peer exchange of information and experience between the various actors involved in border processes.

The authors presented the activities of the Border Guard and the National Revenue Administration while performing activities at the external border of the EU. They discussed selected examples of integrated information systems used during border controls. Other services will be the subject of further considerations and analyses in subsequent studies. As an example of the integration of border service systems, the Digital Border implemented to improve border traffic by creating an integrated system of the Border Guard and the National Revenue Administration, which enables the transfer of data on checked travellers from the Border Guard databases to the databases of the National Revenue Administration. It is worth noting that integrated IT systems are also used in the broadly understood phenomenon of combating cross-border crime. Therefore, this article indicates the important role of information systems in improving the efficiency of cross-border logistics and emphasizes the need for further research and innovation in this field. We hope that the conclusions of this article will be valuable for practitioners, policymakers and researchers interested in improving flow management processes at the border.

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## THE ACCEPTANCE OF SUSTAINABLE E-COMMERCE BY SMALL AND MEDIUM-SIZED ENTERPRISES: A CASE OF VIETNAM

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**Abstract.** E-commerce has been adopted by businesses and consumers in Vietnam for consumption activities, profit-seeking, buying and selling goods, conducting business, competing, and expanding markets. Businesses have chosen e-commerce due to its benefits, the trend of applying digital technology, and the ongoing modern business environment. Many studies have identified factors influencing the acceptance of e-commerce, but only some studies have approached sustainable e-commerce. Developing sustainable e-commerce requires businesses to invest more money and technology in business processes, which consumers may only sometimes accept. This article applies the TOE framework to identify factors influencing the acceptance of sustainable e-commerce by measuring the importance coefficient of these factors. The research results reflect changes in the factors affecting the acceptance of sustainable e-commerce. The study also provides recommendations for stakeholders involved in developing sustainable e-commerce.

**Keywords:** sustainable e-commerce; Technology-Organization-Environment (TOE) framework; influencing factors

**Reference** to this paper should be made as follows: Quyet, C. B. 2024. The acceptance of sustainable e-commerce by small and medium-sized enterprises: a case of Vietnam. *Insights Into Regional Development*, 6(1), 46-58. [http://doi.org/10.9770/IRD.2024.6.1\(4\)](http://doi.org/10.9770/IRD.2024.6.1(4))

**JEL Classifications:** O33

### 1. Introduction

Implementing new technologies in practice always faces two extremes: acceptance-opposition, readiness to embrace hesitation and concern, and agreement-denial. Like the story that unfolded centuries ago when machinery was introduced into production, many workers feared losing their jobs, threatening their livelihoods and incomes. E-commerce has also been seen as a business sector utilizing new technology, accepted by businesses and consumers for nearly three decades. Alongside the benefits of e-commerce, its harms and obstacles also coexist. However, addressing the harms and obstacles of e-commerce has gradually been resolved, such as the issue of online fraud, information risks, disclosure of personal financial secrets, and sale of counterfeit/fake goods online. While e-commerce still faces certain obstacles, humanity has witnessed the rapid development of this commercial form. E-commerce has changed how people do business, shop, trade, distribute goods and services, and distribute benefits among stakeholders in commodity value chains, supply chains, and national and global consumption chains.

From a scientific perspective, e-commerce also attracts many researchers in economics, business, commerce, and consumer behaviour to clarify the existing issues in the e-commerce business, seeking optimal solutions in implementing electronic business (Ramdansyah & Taufik, 2017; Ziaran et al., 2021; Fedorko et al., 2021; Cherednichenko et al., 2023). Research on the acceptance of e-commerce by businesses has answered many questions, elucidating the motivations and reasons why businesses accept e-commerce with widely used models such as TAM (Technology Acceptance Model) and TOE (Technology-Organization-Environment framework)

over the past thirty years.

The Technology Acceptance Model (TAM) is a model that conceptualizes how users accept and use technology. Behavioural intention (BI) is a factor that drives people to use technology, and BI is influenced by attitude (A), which is the general impression of the technology. The model suggests that when users are introduced to a new technology, several factors influence their decision about how and when they will use it, namely perceived usefulness (PU) and perceived ease of use (PEOU). Davis (1989) defines: "PU is the degree to which a person believes that using a specific system will enhance their job performance" and "PEOU is the degree to which a person believes that using a specific system will not require much effort." In other words, users will choose technology only when perceived as valuable and easy to use. In addition to PU and PEOU, the influence of external social factors on attitude and intention to use technology is also essential. In the context of e-commerce, the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003) is constructed to explain users' intention to use information systems and subsequent usage behaviour. UTAUT posits that there are four main factors, of which three factors: 1) expected performance, 2) effort expectancy, 3) social influence directly determines intention and usage behaviour, and the fourth factor, facilitating conditions, directly influences user behaviour.

The TOE model, i.e. Technology-Organization-Environment (TOE) framework, is a theoretical framework that explains the adoption of technology within organizations and describes how the process of technology innovation adoption and implementation is influenced by the technological context, organizational context, and environmental context as proposed by Tornatzky and Fleischer (1990). The TOE focuses on broader macro-level factors (meaning the technological infrastructure of the organization adopting the new technology, internal aspects of the organization, and external environmental factors) rather than the detailed behaviours of individuals within each organization.

Therefore, when researching the acceptance of new technology, such as accepting electronic payments, accepting the use of social networks, accepting ERP usage, accepting mobile commerce, e-commerce, etc., at the individual or consumer level, models such as the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM) should be applied. Conversely, TOE is more appropriate for organizational technology acceptance studies and is less or rarely used in individual consumer technology acceptance research. The advantage of TOE is that it divides the factors influencing the acceptance of technology applications by organizations into three groups, including a group of technology measures - T, and two other groups: internal factors related to the organization - O, and external factors related to the environment - E. TOE only consists of three groups of framing factors. In contrast, the component factors group can vary freely. The disadvantage is that the division of factors is too general; sometimes, a specific factor can belong to either the T or O group, for example, the technological infrastructure of the organization, or the factor of IT human resources could fall into all three groups T, O, E. However, due to the clear division of the three groups of factors in each study, researchers have overcome this by establishing component factors and assigning them to a specific factor group. Therefore, when researching the acceptance of new technology, such as accepting electronic payments, accepting the use of social networks, accepting ERP usage, accepting mobile commerce, e-commerce, etc., at the individual or consumer level, models such as the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM) should be applied. Conversely, TOE is more appropriate for organizational technology acceptance studies and is less or rarely used in individual consumer technology acceptance research. The advantage of TOE is that it divides the factors influencing the acceptance of technology applications by organizations into three groups, including a group of technology measures - T, and two other groups: internal factors related to the organization - O, and external factors related to the environment - E. TOE only consists of three groups of framing factors. In contrast, the component factors group can vary freely. The disadvantage is that the division of factors is too general; sometimes, a specific factor can belong to either the T or O group, for example, the technological infrastructure of the organization, or the factor of IT human resources could fall into all three groups T, O, E. However, due to the clear division of the three groups of factors in each study, researchers have overcome this by establishing component factors and assigning them to a specific factor group.

## 2. Viewpoints on Sustainable E-commerce

How does the concept of sustainable e-commerce differ from that of regular e-commerce? Sustainable e-commerce is a new topic that has attracted many researchers because the understanding, perspectives, and conditions for sustainable e-commerce development vary significantly among international organizations, countries, and e-commerce businesses. In Vietnam, the perspective on sustainable e-commerce is addressed in the Sustainable E-commerce Development Report: Driving Forces for the Digital Economy in 2023, jointly published by VCCI, Lazada, and a group of industry experts. The report does not define sustainable e-commerce but establishes the contents of sustainable e-commerce development across six key aspects: sustainability in long-term investment in infrastructure, technology, logistics, and human resources; sustainability in business to create more value for all parties by building a community with values shared by partners, businesses, and consumers; sustainability in technology, reflecting businesses' priority investment in technologies that support platform openness; sustainability in customer experience, aiming to expand connections with diverse payment partners and methods; and social sustainability: implementing the strategy of universalizing e-commerce across all sectors and regions nationwide. Thus, the perspective on sustainable e-commerce development in this report is seen from the standpoint of e-commerce businesses, specifically, those continuing to invest in e-commerce to generate profits for the business, benefits for customers and society, and long-term development in the future. From the sustainable development perspective of the United Nations, which is to "meet the needs of the present without compromising the ability of future generations to meet their own needs," sustainable e-commerce development has been approached consistently with the viewpoint of the United Nations by the Committee on the Internal Market and Consumer Protection (IMCO) of the European Parliament, as well as numerous authors. Table 1 summarizes the viewpoints on sustainable e-commerce from current studies.

**Table 1.** A compilation of studies on sustainable e-commerce

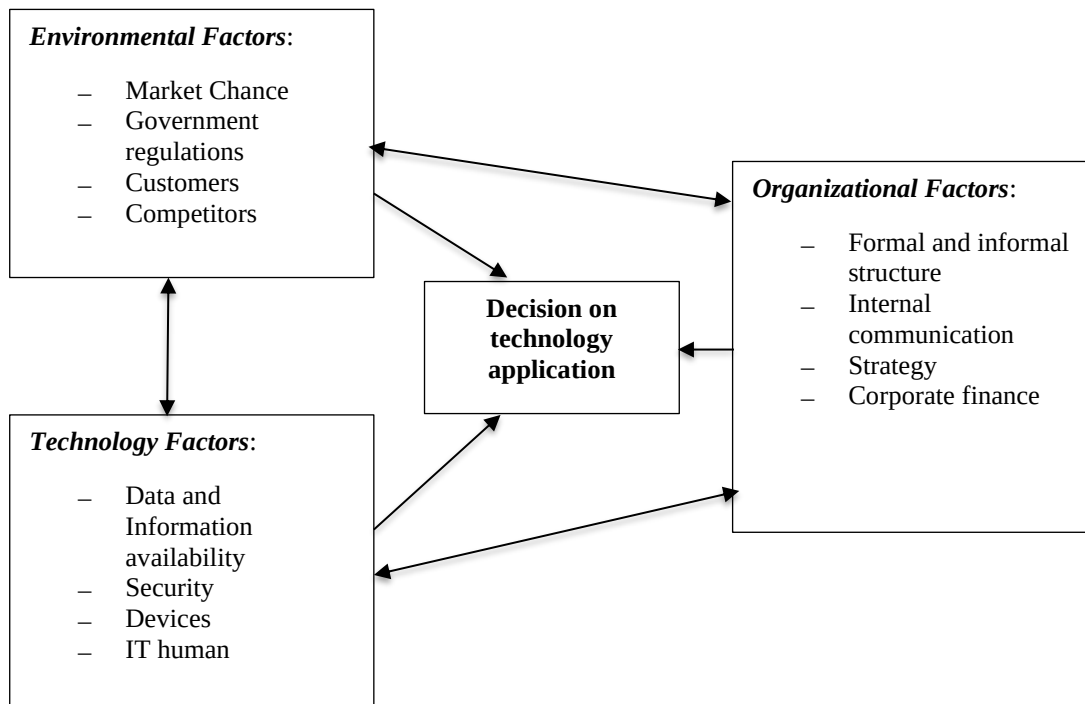
| No. | Research Group/Author                               | Content, Perspective                                                                                                                                                                                                                                                                                              |
|-----|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Pazaitis, Kostakis & Bauwens, 2017                  | Voice the need to maintain a balance between the development of online retail businesses and the negative impacts on the environment and society.                                                                                                                                                                 |
| 2   | Oláh, Kitukutha, Haddad, Pakurár, Máté & Popp, 2019 | All stakeholders need to collaborate and take appropriate responsibility to promote sustainable e-commerce development.                                                                                                                                                                                           |
| 3   | IMCO, UN                                            | Developing guidelines and policies on sustainable e-commerce development.                                                                                                                                                                                                                                         |
| 4   | DHL, 2021                                           | Researching efficient environmentally friendly packaging methods.                                                                                                                                                                                                                                                 |
| 5   | Amazon                                              | Describing some sustainable e-commerce development activities.                                                                                                                                                                                                                                                    |
| 6   | Raghavan, 2022                                      | Sustainable e-commerce involves conducting business activities in a manner that does not degrade the natural environment through measures and approaches that address the needs of current generations without jeopardizing future generations.                                                                   |
| 7   | Virstiuk, (2022)                                    | Sustainable e-commerce necessitates environmentally friendly shipping, the use of eco-friendly packaging, and minimizing returns.                                                                                                                                                                                 |
| 8   | Bigcommerce                                         | Entailing social equity, environmental protection, and economic development.                                                                                                                                                                                                                                      |
| 9   | Sun, Grondys, Nazim Hajiye, & Zhukov, 2021          | The three aspects of sustainable e-commerce are economic sustainability, reflecting the quality of electronic business activities; environmental sustainability, reflecting a company's impact on the environment; and social sustainability, reflecting the level of interaction with employees, customers, etc. |
| 10  | Laudon & Traver, 2014                               | The development of sustainable e-commerce is associated with the responsibility of all stakeholders to protect the environment.                                                                                                                                                                                   |

Source: Author

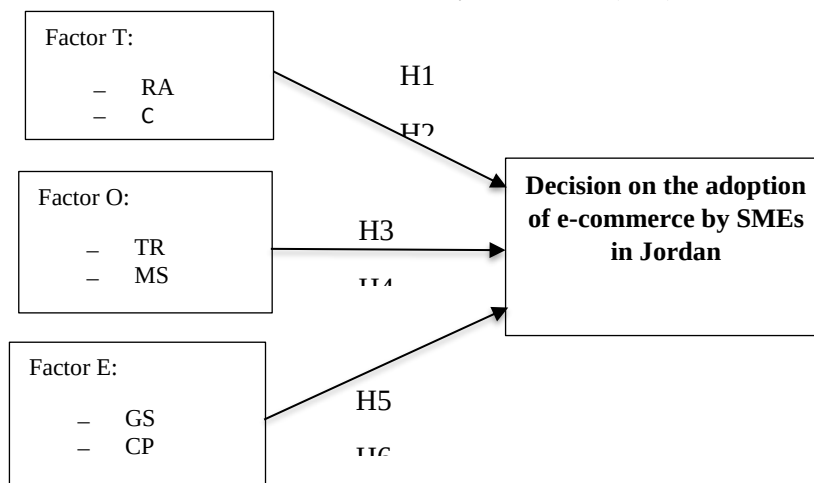
As shown in Table 1, the viewpoint on sustainable e-commerce is that e-commerce development is tied to environmental protection, benefits all parties and generations, and is the responsibility of stakeholders in the present. Thus, sustainable e-commerce is the application of e-commerce to meet the needs of individuals and organizations but requires balancing the interests of all parties and future generations, with environmental protection at its core. This viewpoint aligns with the United Nations perspective on sustainable development since 1987, contextualized within e-commerce. It demands responsibility from all relevant parties, from manufacturers, distributors, carriers, and consumers, for sustainable e-commerce development.

### 3. Research model of the acceptance of sustainable e-commerce by enterprises according to the TOE framework

Awareness of enterprises' sustainable e-commerce development: what benefits and challenges are there in accepting sustainable e-commerce? According to Rash's (2021) study on the acceptance of e-commerce by small and medium enterprises (SMEs) in Jordan, there are six variables influencing the acceptance of e-commerce, including 2 variables belonging to the T factor: relative advantage of technology - RA and compatibility - C, 2 variables belonging to the O factor: organization's technological readiness - TR and management support - MS, and 2 variables belonging to the E factor: government support - GS and competitive pressure - CP. The model of factors influencing the acceptance of e-commerce is built from the original TOE framework, as shown in Figure 1, and Figure 2 is the modified model by Rash (2021).



**Figure 1. TOE prototype**  
Source: Tornatzky and Fleischer (1990)



**Figure 2. Model of factors influencing the adoption of e-commerce by SMEs in Jordan**

Source: Rash (2021)

In Rash's (2021) study, the author drew upon the research of Tornatzky and Fleischer (1990) and the research models of Rogers (1983) on the Diffusion of Innovations (DOI) theory when utilizing variables RA and C as two components of the T factor. In the O factor, the author built upon Abed's (2020) study on the acceptance of social commerce using the TOE framework with the variable MS and drew from Alraja et al. (2020) with the variable TR. In the E factor, the variables GS were derived from Al Zoubi and Al Zoubi (2018) and the variable CP from Rahayu and Day's (2015) research.

In Abed's (2020) study on the acceptance of mobile commerce using the TOE framework by small and medium enterprises in Saudi Arabia, six factors were also proposed, including two variables belonging to the T factor, namely RA similar to Rash's (2021) study, and information security; two variables belonging to the O factor, MS similar to Rash's (2021) study, and organizational readiness; and two variables belonging to the E factor, CP which has been adopted by Rash (2021), and customer benefits.

In Oláh et al. (2019) study on sustainable e-commerce, the group of authors constructed a model with three independent variables: environmental dimension, economic dimension, and social dimension, and the dependent variable was sustainable e-commerce development. The study's main purpose was to investigate how integrating the three dimensions/aspects of e-commerce could make e-commerce more sustainable by accepting trade-offs that could bring maximum benefits to retailers, consumers, and the environment.

The research on the acceptance of sustainable e-commerce by Vietnamese businesses employing the TOE framework and drawing on insights from the studies of Abed (2020), Rash (2021), and Oláh et al. (2019) with adjustments to the constituent variables of the 3 TOE factors T, O, E, specifically:

The T factor group: The research inherits from the studies of Abed (2020) and Rash (2021), using the variable RA, that when businesses perceive the benefits of sustainable e-commerce, they will accept it. The organisational technological capability variable is used with the variable compatibility - C in Rash's (2021) study and the information security variable in Abed's (2020) study. The proposed hypotheses are:

H1: Relative advantage (RA) positively influences SMEs' acceptance of sustainable e-commerce.

H2: The organisation's technological capability (TR) positively influences SMEs' acceptance of sustainable e-commerce.

Note that the flexibility of TOE allows the research group to adjust the TR variable from the O group to the T group, as it is appropriate because the organisation's technological capability also belongs to the technology factor.

The O factor group draws from the research of Abed (2020) and Rash (2021), using the variables MS and organizational readiness replaced by the variable financial capability of the organization - a variable measuring the economic dimension in Oláh et al. (2019) model. The hypotheses are proposed as follows:

H3: Management support within the organization - MS positively influences SMEs' acceptance of sustainable e-commerce.

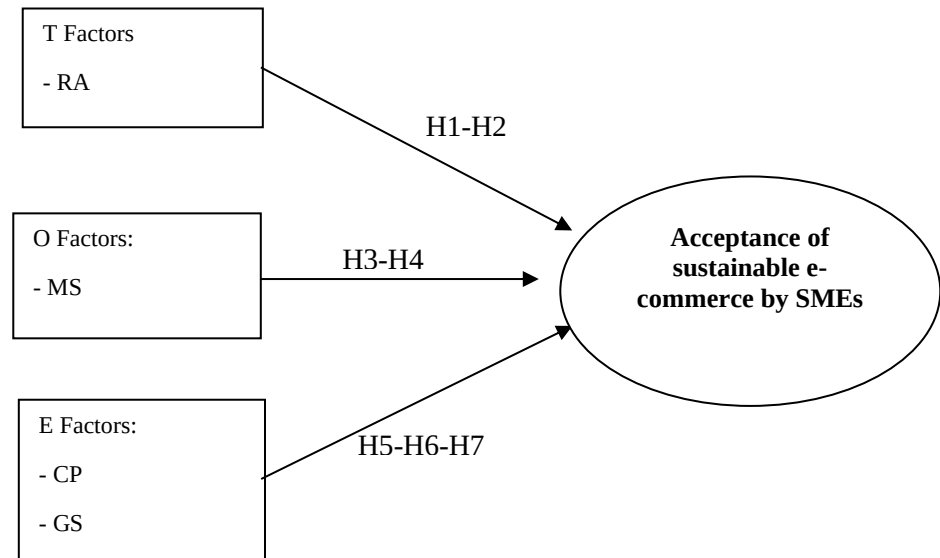
H4: Financial capability of the organization - FC positively influences SMEs' acceptance of sustainable e-commerce.

The E factor group incorporates findings from the research of Abed (2020), Rash (2021), and Oláh et al. (2019). The variable competitive pressure - CP, government support - GS, and customer benefits are replaced by consumer acceptance. In accepting sustainable e-commerce, the government imposes strict environmental regulations, causing SMEs to increase costs and create pressure on customers. Therefore, within the E factor group, three hypotheses are proposed:

H5: Competitive pressure - CP positively influences SMEs' acceptance of sustainable e-commerce.

H6: Government regulations and policies - GS positively influences SMEs' acceptance of sustainable e-commerce.

H7: Customer acceptance - CA positively influences SMEs' acceptance of sustainable e-commerce. The proposed research model is depicted in Figure 3.



**Figure 3.** Proposed research model

Source: Author

#### 4. Research Methodology

To test the statistical significance of the seven hypotheses, data were collected from small and medium-sized enterprises (SMEs) in Vietnam. The number of enterprises collected after excluding those with no application of e-commerce totalled 285, of which 80% had opened online stores on electronic trading platforms for online sales, 48% had e-commerce websites, and 95% used social media pages to showcase goods or sell online. Surveys were sent to these enterprises to collect information on the acceptance of sustainable e-commerce. Questions regarding the acceptance of sustainable e-commerce development options were measured using a 5-point Likert scale (1 = strongly disagree, to 5 = strongly agree). Table 3 summarizes the data obtained from the survey on SMEs' acceptance of sustainable e-commerce in Vietnam (SeCom).

**Table 3.** Data Encoding and Statistical Results

| No.                     | Encoding | Descriptive question                                              | Score Levels and Response Rates |     |     |     |     |
|-------------------------|----------|-------------------------------------------------------------------|---------------------------------|-----|-----|-----|-----|
| <i>Factor group T</i>   |          |                                                                   | 1                               | 2   | 3   | 4   | 5   |
| Relative advantage      | ra1      | S-eCom offers more benefits than traditional commerce             | 33%                             | 27% | 20% | 10% | 10% |
|                         | ra2      | S-eCommerce offers more benefits than e-Commerce                  | 12%                             | 13% | 35% | 25% | 15% |
|                         | ra3      | S-eCommerce helps businesses achieve long-term sustainable growth | 9%                              | 12% | 44% | 25% | 10% |
|                         | ra4      | All members of the organization benefit from choosing S-eCommerce | 8%                              | 15% | 50% | 21% | 6%  |
| Technological readiness | tr1      | Technology infrastructure adequacy                                | 5%                              | 15% | 30% | 27% | 23% |
|                         | tr2      | Technology-responsive human resource adequacy                     | 8%                              | 16% | 52% | 19% | 5%  |

|                                                              |        |                                                        |     |      |       |     |       |
|--------------------------------------------------------------|--------|--------------------------------------------------------|-----|------|-------|-----|-------|
|                                                              | tr3    | Investing in technology is always right                | 9%  | 8,5% | 45%   | 28% | 9,5%  |
|                                                              | tr4    | External compatibility                                 | 12% | 15%  | 33%   | 25% | 15%   |
| <i>Factor group O</i>                                        |        |                                                        |     |      |       |     |       |
| Management Support                                           | ms1    | Business leaders have S-eCom development strategies    | 10% | 12%  | 46%   | 18% | 14%   |
|                                                              | ms2    | Leaders develop team members                           | 9%  | 11%  | 46%   | 24% | 10%   |
|                                                              | ms3    | Leaders have S-eCom development plans                  | 14% | 13%  | 39%   | 19% | 15%   |
| Financial Capability                                         | fc1    | Financial readiness for S-eCom development             | 5%  | 30%  | 40%   | 16% | 9%    |
|                                                              | fc2    | Diminished financial capacity when implementing S-eCom | 6%  | 24%  | 38%   | 21% | 11%   |
|                                                              | fc3    | Easy financial mobilization when implementing S-eCom   | 18% | 22%  | 42%   | 25% | 3%    |
| <i>Factor Group E</i>                                        |        |                                                        |     |      |       |     |       |
| Competitive Pressure                                         | cp1    | Implementing S-eCom for survival                       | 10% | 17%  | 39%   | 19% | 15%   |
|                                                              | cp2    | Facing too many competitive rivals                     | 5%  | 23%  | 47%   | 16% | 9%    |
|                                                              | cp3    | Potential competitors                                  | 10% | 10%  | 46%   | 20% | 14%   |
| Government support                                           | gs1    | Government favorable to S-eCom                         | 6%  | 30%  | 39%   | 20% | 5%    |
|                                                              | gs2    | Government policies have some shortcomings for S-eCom  | 6%  | 26%  | 42%   | 19% | 7%    |
|                                                              | gs3    | Lack of S-eCom development policies                    | 10% | 30%  | 32%   | 17% | 11%   |
|                                                              | gs4    | Policies incompatible with S-eCom                      | 23% | 38%  | 21%   | 16% | 2%    |
| Customer benefits                                            | cb1    | Customers Expect S-eCom                                | 9%  | 11%  | 46%   | 24% | 10%   |
|                                                              | cb2    | Customers accept higher costs for S-eCom               | 8%  | 12%  | 44,3% | 18% | 17,3% |
|                                                              | cb3    | Customers accept reduced satisfaction for S-eCom       | 5%  | 19%  | 36%   | 29% | 7%    |
| <i>Organizational Decision to Use sustainable e-commerce</i> |        |                                                        |     |      |       |     |       |
| S-eCom                                                       | Secom1 | Economic sustainability                                | 23% | 18%  | 39%   | 29% | 1%    |
|                                                              | Secom2 | Environmental sustainability                           | 20% | 15%  | 45%   | 17% | 3%    |
|                                                              | Secom3 | Social sustainability                                  | 6%  | 13%  | 37%   | 23% | 17%   |

Source: Author

With a survey sample of 285 questionnaires comprising general information about the businesses, including 23 questions elucidating the factors influencing the acceptance of sustainable e-commerce and 3 questions measuring the dimensions of sustainable e-commerce, reliability and representativeness in elucidating the sustainable e-commerce (S-eCom) application decision have been achieved. All questions used scales in factor analysis using EFA, and the sample size was determined to be at least  $n = 5*m$ , where m is the number of questions (Roger, 2006).

## 5. Data Analysis

The study utilized SPSS 22 software to analyze and process the data.

### 5.1. Results of Testing the Reliability of Factor Scales

To evaluate the reliability of the scales in the research model, the authors used the composite reliability coefficient with a threshold greater than 0.6 for confirmatory studies and the composite correlation coefficient of observed variables greater than 0.3. All observed variables met the requirements (see Table 4).

**Table 4.** Summary of Cronbach's Alpha Test Results

| Name of Observed Composite Variable                              | Symbol | Number of Observed Variables | Initial Cronbach's Alpha | Removed Observed Variables | Subsequent Cronbach's Alpha |
|------------------------------------------------------------------|--------|------------------------------|--------------------------|----------------------------|-----------------------------|
| Relative advantages of sustainable e-commerce                    | ra     | 4                            | 0,836                    | 0                          | 0,836                       |
| Technological readiness of the organization                      | tr     | 4                            | 0,724                    | 0                          | 0,724                       |
| Management support for the development of Sustainable e-Commerce | ms     | 3                            | 0,752                    | 0                          | 0,752                       |
| Financial capability of the organisation                         | fc     | 3                            | 0,851                    | 0                          | 0,851                       |
| Competitive pressure                                             | cp     | 3                            | 0,812                    | 0                          | 0,812                       |
| Government support policies for sustainable e-commerce           | gs     | 4                            | 0,838                    | 0                          | 0,838                       |
| Customer benefits from sustainable e-commerce                    | cb     | 3                            | 0,793                    | 0                          | 0,793                       |
| Acceptance of sustainable e-commerce                             | Secom  | 3                            | 0,719                    | 0                          | 0,719                       |

Source: SPSS Data Analysis Results

### 5.2. Exploratory Factor Analysis Results

The research team employed the exploratory factor analysis technique to reduce the 24 independent variables in the research model. Appropriate criteria for exploratory factor analysis include a Kaiser-Meyer-Olkin (KMO) coefficient  $> 0.5$ , variance explained greater than 50%, and factor loading coefficients  $> 0.5$ . The principal component analysis method with varimax rotation was used.

The results of the exploratory factor analysis of independent variables: the KMO coefficient of the factors is  $0.748 > 0.5$ , Bartlett's test is statistically significant ( $\text{Sig} < 0.05$ ), Eigenvalue  $> 1$ , the total variance explained from 7 out of 24 variables is  $81.29\% > 50\%$ , indicating that the EFA model is appropriate (see table 5 and table 6).

**Table 5.** KMO and Bartlett's Test

|                                                  |           |
|--------------------------------------------------|-----------|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | .748      |
| Bartlett's Test of Sphericity                    | 10839.693 |
| df                                               | 465       |
| Sig.                                             | .000      |

Source: SPSS Data Analysis Results

**Table 6.** Total Variance Explained

| Component | Initial Eigenvalues |               |              | Extraction Sums of Squared Loadings |               |              | Rotation Sums of Squared Loadings |               |              |
|-----------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|-----------------------------------|---------------|--------------|
|           | Total               | % of Variance | Cumulative % | Total                               | % of Variance | Cumulative % | Total                             | % of Variance | Cumulative % |
| 1         | 6.604               | 24.460        | 24.460       | 6.604                               | 24.460        | 24.460       | 5.315                             | 19.685        | 19.685       |
| 2         | 4.930               | 18.261        | 42.721       | 4.930                               | 18.261        | 42.721       | 3.323                             | 12.309        | 31.994       |
| 3         | 4.384               | 16.236        | 58.957       | 4.384                               | 16.236        | 58.957       | 3.313                             | 12.272        | 44.266       |
| 4         | 2.230               | 8.259         | 67.216       | 2.230                               | 8.259         | 67.216       | 3.175                             | 11.761        | 56.027       |
| 5         | 1.567               | 5.805         | 73.020       | 1.567                               | 5.805         | 73.020       | 3.044                             | 11.274        | 67.301       |
| 6         | 1.208               | 4.473         | 77.494       | 1.208                               | 4.473         | 77.494       | 2.439                             | 9.032         | 76.333       |
| 7         | 1.006               | 3.725         | 81.219       | 1.006                               | 3.725         | 81.219       | 1.319                             | 4.886         | 81.219       |
| 8         | .810                | 2.999         | 84.218       |                                     |               |              |                                   |               |              |
| 9         | .673                | 2.491         | 86.709       |                                     |               |              |                                   |               |              |
| 10        | .595                | 2.203         | 88.913       |                                     |               |              |                                   |               |              |

Extraction Method: Principal Component Analysis.

Source: SPSS Data Analysis Results

Similarly, for the EFA analysis of dependent variables, there are Tables 7 and 8.

**Table 7.** KMO and Bartlett's Test

|                                                  |                    |         |
|--------------------------------------------------|--------------------|---------|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. |                    | .650    |
| Bartlett's Test of Sphericity                    | Approx. Chi-Square | 167.947 |
|                                                  | df                 | 3       |
|                                                  | Sig.               | .000    |

Source: SPSS Data Analysis Results

KMO = 0.650 > 0.5, indicating that the factor analysis is appropriate. Sig < 0.05 demonstrates that the observed variables are correlated with each other. The results of the rotated factor matrix analysis reveal 1 factor extracted from the observed variables, with an explained variance of 63.559% and an Eigenvalue of 1.907 > 1. (see Table 7, 8)

**Table 8.** Total Variance Explained

| Component | Initial Eigenvalues |               |              | Extraction Sums of Squared Loadings |               |              |
|-----------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|
|           | Total               | % of Variance | Cumulative % | Total                               | % of Variance | Cumulative % |
| 1         | 1.907               | 63.559        | 63.559       | 1.907                               | 63.559        | 63.559       |
| 2         | .659                | 21.973        | 85.532       |                                     |               |              |
| 3         | .434                | 14.468        | 100.000      |                                     |               |              |

Extraction Method: Principal Component Analysis.

Source: SPSS Data Analysis Results

### 5.3. Pearson Correlation Test

The Pearson correlation test is used to examine the linear correlation between independent and dependent variables and identify multicollinearity issues early when independent variables are strongly correlated. The Pearson correlation coefficient closer to 1 indicates a stronger correlation, closer to 0 indicates a weaker correlation, and if sig < 0.05, then there is a correlation; if sig > 0.05, then there is no correlation (refer to Table 9).

**Table 9.** Pearson Correlation Test

|    |                     | Secom | ra     | tr   | ms    | fc     | cp    | gs    | cb     |
|----|---------------------|-------|--------|------|-------|--------|-------|-------|--------|
| qd | Pearson Correlation | 1     | .646** | .098 | .122* | .770** | .124* | .138* | .775** |
|    | Sig. (2-tailed)     |       | .000   | .103 | .042  | .000   | .038  | .021  | .000   |
|    | Covariance          | .731  | .385   | .067 | .071  | .439   | .090  | .080  | .468   |
|    | N                   | 285   | 285    | 285  | 285   | 285    | 285   | 285   | 285    |

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

Source: SPSS Data Analysis Results

The results from Table 9 indicate that the Sig value for the variable "Technological Readiness of the Organization" (tr = 0.103) is greater than 0.05. Therefore, there are only 6 independent variables that have a linear correlation with the dependent variable 'Acceptance of Sustainable e-Commerce (Secom)'.

#### 5.4. Multiple Linear Regression Analysis

The independent variables were entered into the model using the Enter method. The model's appropriateness was evaluated through R-square, hypothesis testing of the overall model significance using F-test, and the significance of the regression coefficients using the t-value (refer to Tables 10 and 11).

**Table 10.** Model Summary

| Model | R                 | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|-------|-------------------|----------|-------------------|----------------------------|---------------|
| 1     | .825 <sup>a</sup> | .681     | .674              | .488459111399              | 1.672         |

a. Predictors: (Constant), ra, ms,tc, cp, gs, cb

b. Dependent Variable: Secom

Source: SPSS Data Analysis Results

**Table 11.** Results of Multiple Linear Regression Test**Model Summary**

| Model | R                 | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|-------|-------------------|----------|-------------------|----------------------------|---------------|
| 1     | .825 <sup>a</sup> | .681     | .674              | .488459111399              | 1.672         |

a. Predictors: (Constant), ra, ms,tc, cp, gs, cb

b. Dependent Variable: Secom

Source: SPSS Data Analysis Results

R-squared = 0.681 = 68.1%, which means that 6 independent variables account for 68.1% of the variance in the dependent variable, while the remaining 31.9% is attributed to factors outside the model and random error. The Durbin–Watson value is 1.672, falling within the range of 1.5 to 2.5, indicating no violation of the first-order autocorrelation assumption (Qiao, 2011).

#### 5.5. Coefficients Table and Test for Multicollinearity

The multiple linear regression analysis with 6 independent variables using the Enter method yielded results in Table 12. If the Sig value is greater than 0.05, the independent variable is not significant. In Table 12, the variable "cp" has Sig > 0.05 and needs to be removed to continue the analysis for Table 13.

**Table 12.** Coefficients

| Model        | Unstandardized Coefficients |            | Standardized Coefficients | t     | Sig. | Collinearity Statistics |       |
|--------------|-----------------------------|------------|---------------------------|-------|------|-------------------------|-------|
|              | B                           | Std. Error | Beta                      |       |      | Tolerance               | VIF   |
| 1 (Constant) | .246                        | .240       |                           | 1.027 | .306 |                         |       |
| ra           | .200                        | .060       | .163                      | 3.321 | .001 | .485                    | 2.061 |
| cp           | .073                        | .067       | .058                      | 1.089 | .277 | .408                    | 2.449 |
| fc           | .439                        | .081       | .343                      | 5.414 | .000 | .292                    | 3.423 |
| ms           | .065                        | .035       | .064                      | 1.863 | .044 | .987                    | 1.013 |
| cb           | .045                        | .067       | .036                      | .672  | .050 | .407                    | 2.455 |
| eg           | .455                        | .073       | .376                      | 6.191 | .000 | .317                    | 3.154 |

a. Dependent Variable: Secom

Source: SPSS Data Analysis Results

**Table 13.** Coefficients

| Model        | Unstandardized Coefficients |            | Standardized Coefficients | t     | Sig. | Collinearity Statistics |       |
|--------------|-----------------------------|------------|---------------------------|-------|------|-------------------------|-------|
|              | B                           | Std. Error | Beta                      |       |      | Tolerance               | VIF   |
| 1 (Constant) | .305                        | .233       |                           | 1.308 | .192 |                         |       |
| ra           | .195                        | .060       | .159                      | 3.240 | .001 | .489                    | 2.046 |
| fc           | .448                        | .081       | .350                      | 5.550 | .000 | .295                    | 3.388 |
| ms           | .065                        | .035       | .064                      | 1.864 | .043 | .987                    | 1.013 |
| cb           | .101                        | .043       | .081                      | 2.330 | .021 | .979                    | 1.022 |
| eg           | .450                        | .073       | .372                      | 6.138 | .000 | .318                    | 3.144 |

Source: SPSS Data Analysis Results

The regression equation is standardized as follows:

$$\text{Secom} = 0.159\text{ra} + 0.350\text{fc} + 0.064\text{ms} + 0.081\text{cb} + 0.372\text{eg}$$

Thus, there are five component variables composing three factor groups, with one variable in group T (nêu tên? - ND), two variables (ms and fc) in group O, and two variables (cb and eg) in group E. Two out of seven hypotheses were rejected through data analysis, namely the Technological Readiness of the Organization (tr) and Competitive Pressure (cp). The equation above reflects that five hypotheses are accepted across all three factor groups T, O, and E, influencing the acceptance of sustainable e-commerce. Notably, the financial capability within factor O and Government Support for Sustainable e-Commerce Development within factor E have the highest impact coefficients on SMEs' acceptance of sustainable e-commerce. Management support and customer benefits have relatively low impact coefficients on SMEs' acceptance of sustainable e-commerce.

## 6. Discussion and Recommendations

The TOE framework can be applied to study the factors influencing the acceptance of sustainable e-commerce. Previous studies by Abed (2020) and Hassan N Rash (2021) have used the TOE framework to investigate e-commerce acceptance. This study drew from and developed the research model with seven proposed factors positively correlating with the acceptance of sustainable e-commerce applications. The results of data analysis with a scale of 285 responses have shown changes in the factors influencing SMEs' acceptance of sustainable e-commerce. Some components, such as the organisation's technological readiness to accept e-commerce, are no longer critical. This can be explained by the fact that about 80% of businesses have opened online stores on electronic platforms, and 95% of businesses use social media for advertising and online sales, making technological readiness less crucial for SMEs.

If competitive pressure requires businesses to enhance e-commerce applications, as in previous studies, this component maintains its importance. However, in this study, competitive pressure no longer significantly drives SMEs to accept sustainable e-commerce. Additionally, acceptance of sustainable e-commerce must meet

sustainability requirements in economics, environment, and society, requiring businesses to have good financial resources and be proactive in the highly competitive e-commerce market. Government regulations on sustainable e-commerce businesses have the most substantial impact on SMEs' acceptance of sustainable e-commerce because only governments with mandatory rules and supportive policies can create an effect on thousands of companies participating in various stages of e-commerce, building sustainable e-commerce value chains.

Overall, the findings suggest that businesses should align with government policies and regulations while ensuring financial stability to adopt sustainable e-commerce practices effectively.

Based on the research findings, it is evident that governments need to swiftly develop management policies and support mechanisms for businesses to implement sustainable e-commerce. Vietnam's government and relevant authorities should establish policies and guidelines to guide enterprises in conducting sustainable e-commerce shortly.

Businesses wishing to implement sustainable e-commerce quickly need to prepare well in terms of financial capability. Alongside assessing the business advantages of e-commerce in their industry, leaders of the enterprise need to have a roadmap for implementing sustainable e-commerce. This aligns with international companies like DHL and Amazon, which already have established brands, strong financial capabilities, and plans for implementing sustainable e-commerce (DHL, 2021).

## 7. Conclusion and Future Research Directions

In a study on sustainable e-commerce, Ingaldi and Ulewicz (2019) argued that companies implementing sustainable e-commerce while meeting customer expectations face a significant challenge due to increased product and service costs. In this study, five factors influencing SMEs' acceptance of sustainable e-commerce were identified, with the customer benefits factor, although not pivotal, being one of them. The research results reflect that businesses can implement sustainable e-commerce; however, this depends on internal and external factors.

Limitations of the study include a limited scale of business involvement and a lack of expert opinions on the factors influencing the acceptance of sustainable e-commerce. The research primarily relied on drawing from existing models published worldwide, which may only partially be suitable for the Vietnamese environment. The following research direction should address this study's limitations and examine the acceptance of sustainable e-commerce among Vietnamese consumers.

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## BLOCKCHAIN TECHNOLOGY FOR HEALTH INFORMATION MANAGEMENT: A CASE OF ZIMBABWE\*

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**Abstract.** Porous paper-based systems, manipulation of data, information access constraints, and untimely reporting of information characterize Health Information management in developing countries such as Zimbabwe. This article aims to explore how the adoption and implementation of Blockchain technology can solve health information management challenges in Zimbabwe's public health sector. This article explores the opportunities and challenges of implementing Blockchain technology in Zimbabwe's public health sector through qualitative desk research. The significant findings in this paper reflect that blockchain has the potential to prevent health records from being manipulated, modified or corrupted without a consensus, making the technology secure. It also improves access to health data for all stakeholders in the medical domain. Furthermore, this technology has the potential to improve data management and enforce accountability and transparency in vital clinical functions such as procurement and finance, resulting in the provision of quality health services. However, blockchain has not been given much attention in Zimbabwe's public health sector as its implementation has the potential to be hampered by numerous challenges such as inadequate information communication technology infrastructure and skills, security and privacy concerns, usability, resistance to change and lack of financial resources to procure hardware and software needed for this technology. Thus, this paper recommends that health policymakers engage in more research to understand better and evaluate the value of this technology in Zimbabwe to ensure it can thrive in resource-constrained settings.

**Keywords:** blockchain; health information system; Zimbabwe; opportunities; challenges

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**JEL Classifications:** I1, I19

**Additional disciplines:** information and communication

### 1. Introduction

There is considerable literature to support that Blockchain technology is part of the 4<sup>th</sup> industrial revolution (4IR) and offers significant benefits for the health domain (Chukwu and Gary, 2020; Niyitunga, 2022; Ghosh et al., 2023). Blockchain technology is defined by Haleem et al. (2021) as an electronic, distributed ledger which is only editable with consensus. This feature enables this technology to be immutable. The immutability of blockchain is one of the chief reasons behind its wide adoption in the medical field (Kaur et al., 2023). While its adoption and implementation appear to be in its infancy stages in developing countries, and some pilot projects have been unsuccessful, this emergent technology is considered crucial with great potential to revolutionize health information management in developing contexts (Niyitunga, 2022). As such, this

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technology is finding its way into the healthcare industry across the global south to deal with the prevalent challenges in health information systems.

Manual paper-based health information systems, Electronic Health Information Systems and Electronic Health Records (EHRs) currently used in developing countries, Zimbabwe included have several disadvantages. Firstly, the security of health information is a serious matter for the health domain in developing countries (Chilunjika and Chilunjika, 2023). Many healthcare institutions in these countries keep valuable health data in centralized repositories (usually in ageing and outdated Information Technology infrastructure) (Luthuli and Trywell, 2017). In most cases, these data repositories become prime targets for cyber-attacks. These security concerns also raise data validity issues and health information sharing, which has exposed many healthcare consumers to possible societal stigma and financial threats. Another challenge facing health institutions in developing countries is that health data is generally inaccessible and non-standardized across health information systems, making it difficult to retrieve, scrutinize, present and disseminate data in an aggregated manner (Tossy, 2014). Health information is also collected from numerous sources and is kept in centralized repositories, which makes data management and sharing difficult and time-consuming. The COVID-19 pandemic also highlighted the lack of Interoperability among healthcare systems in the global south (Chilunjika and Chilunjika, 2023). A situation which hampers the timely dissemination of health information to support tasks such as diagnosis, health surveillance and health policymaking. Taking these matters into consideration, there is thus a need for an improved, decentralized, interoperable and immutable health information system to supersede the existing system. Blockchain technology is a novel and innovative system that can help solve some of the challenges faced by health systems in developing countries (Matlebjane and Ndayigamiye, 2022).

Nonetheless, research about Blockchain use in the health domain is currently limited, particularly in developing countries such as Zimbabwe. As Blockchain technology is making its way into health systems, it is essential to examine whether it can transform health information management in a developing context using Zimbabwe as the case study. This paper, therefore, seeks to explore the benefits of adopting Blockchain technology in the medical domain, with a particular emphasis on examining and conceptualizing the potential benefits and challenges of this technology for managing health information systems.

This article seeks to answer the following research questions:

1. How can Blockchain technology be used to improve health information management in Zimbabwe's public health sector to improve the delivery of health care?
2. What challenges can hamper the adoption and implementation of Blockchain technology in Zimbabwe's public health domain?

The subsequent section sets out the conceptual framework used for this paper and the methods used to collect and analyze data. Next, the findings are presented and analyzed, followed by conclusions and recommendations.

## **2. Literature Review**

### **2.1 Blockchain Defined**

To understand how blockchain works, defining it and outlining its key features is essential. While there is no generally accepted definition of blockchain, several scholars have put forward definitions describing what this technology entails. According to Bassam (2021), a Blockchain is a digital, decentralized database containing a continuously growing list of data in chronological order. According to Attaran et al. (2017), a Blockchain is a digital, decentralized architecture containing an incessantly expanding log of transactions called "blocks" connected in a chain through mining. The mining process turns pending records into a mathematical conundrum. Authorized parties (miners) solve the conundrum using computer systems and produce what is called a hash (a sequence of letters and numbers unique to the block) (ibid). Each block contains a timecode, transaction data and a unique cryptographic hash of the previous block. The system contains data from all preceding blocks to create a chain. If information inside any of the blocks is altered, the system sets up a chain reaction that could immediately freeze the whole system. Once the blockchain processes the data, every digital device connected to the network locks in simultaneously, creating a permanent and immutable online record.

de Villiers, Kuruppu & Dissanayake (2021), on the other hand, define Blockchain technology as a subcategory of a digital, distributed ledger, which decentralizes the control of information using an application of cryptography. Consequently, this produces three main outcomes:

1. Transparency- all authorized individuals can see, trace and verify information as a public record
2. Veracity- there is a guarantee that all transactions are accurate and complete.
3. Disintermediation- reduction of central authority in data management (meaning the system is not owned or controlled by anybody but is simultaneously owned and controlled by all parties involved).

Simply put, blockchain technology is a system that exhibits features such as security, transparency, data integrity, decentralization, inalterability, and anonymity with no central authority to control agreement. Due to these features, blockchain is perceived as a technology leading to significant disruptions in all industries, including health.

## 2.2 Definition of Health Information System

A health information system is vital in medicine, patient treatment, disease prevention and health policymaking. Koumamba et al. (2021) define a health information system as designed to manage all healthcare-related information. This includes applications and platforms that gather, store, manage and disseminate hospitals' administrative data, patients' electronic medical records or a system supporting health policy decisions. The Pan American Health Organisation (2023) also defines a health information system as an electronic system with open information collected from numerous sources and ethically utilized through Information Communication Technologies to produce strategic data for the benefit of public health. According to the World Health Organisation (2019), a health information system generates data that allows decision-makers at all levels to identify needs and challenges, make evidence-based judgments on health policies and distribute limited resources optimally.

Similarly, Koumamba et al. (2021) note that this system can be leveraged to improve patient outcomes, inform medical research and influence health policy outcomes. The quality of health care provision or the effectiveness of health policy making and health planning depends on the availability of reliable, timely and accurate data to support decision-making, which health information systems offer. A health information system is thus an essential component of a viable healthcare system.

Examples of Health Information System platforms include:

### *Electronic Health Records (EHRs)*

These are longitudinal and comprehensive records of patient data in electronic form (Abdulai 2020). EHRs contain key clinical and administrative data, including medical test results, treatments, laboratory data, progress notes and demographics. These records are designed to share information with other digital platforms so that healthcare providers can access a patient's health data.

### *Practice Management Software*

According to Davey and Davey (2015), Practice Management Software is a system designed to help hospitals with administrative and billing tasks. The system can also schedule patients' doctor appointments, process health insurance claims, and track patient records.

### *Master Patient Index*

Prabath-Jayatissa et al. (2018) assert that the Master Patient Index system connects decentralized patient records across repositories. The system contains a record for each patient registered at a specific healthcare centre and indexes all other records for that patient. The Master Patient Index is also used to reduce duplication of patient records and inaccurate patient data that can result in insurance claim denials.

### *Patient portals*

Patient portals give individuals unlimited access to their health information online. This information includes laboratory results, prescriptions, therapy reports, and referral letters. Vyas and Muzumdar (2022) note that some patient portals allow real-time communication between patients and doctors, prescription refill requests and the

ability to schedule appointments. Simply put, patient portals are online gateways for patients, providing quick, 24-hour access to health information from any place with an internet connection.

#### *Clinical Decision Support system*

The Clinical Decision Support (CDS) system is used to analyze data from various clinical and administrative systems to help physicians make informed clinical decisions (Sutton et al., 2022). The information generated from this system can help healthcare providers prepare diagnoses or predict medical events such as drug reactions (ibid). This system also filters data to help health practitioners care for individual patients. The benefits of using CDS systems include a reduction in medical errors, increased adherence to clinical guidelines and improved patient safety (Jia et al., 2016).

#### *District Health Information System 2*

The District Health Information System 2 (DHIS2) is an open-source health information management software used by governments around the globe. It is a platform used to gather, authenticate, examine and present comprehensive data tailored for various health activities such as early disease detection and notification, service availability mapping, supply chain management and health programme monitoring and evaluation (Dehnavieh et al., 2019). According to Farnham et al. (2023), the system provides accurate, timely, complete health data for health planning, patient monitoring, and disease surveillance. It speeds up health information access for health institutions, governments and other important health organizations.

### **2.2.1 The Importance of a Health Information System**

#### *Improves health data management*

The health domain produces and utilizes volumes of data with the ultimate goal of providing quality services. Health surveys, patient information, research data, health insurance claims and other administrative data all contribute to this data. Even with proper and systematic management, data produced becomes reliable. Evidence suggests that centralized storage and retrieval of this data demonstrate the importance of organizing information into databases to improve secure information access and retrieval (Wagenaar et al., 2015; Amouzou, 2021; Farnham et al., 2023). Farnham et al. (2023) further note that as centralized repositories, health information systems enhance the secondary analysis of health data and provide stakeholders in the medical field with insights useful in identifying challenges and needs and making informed decisions.

Furthermore, the Interoperability of health information systems also enables better health data management. Interoperability of health information systems refers to the seamless exchange and use of health data between different hospitals, systems, stakeholders and applications. According to Wagenaar et al. (2015), the Interoperability of health information systems enables data exchange and optimizes health outcomes. This is because numerous health information systems can access, exchange, integrate and use vital health information in a standardized and meaningful manner.

#### *Leads to informed decision-making*

Amouzou et al. (2021) emphasize that health information systems facilitate improved decision-making through various platforms such as practice management software, electronic health records and CDS systems. CDS systems, for instance, utilize Artificial Intelligence (AI), statistical pattern recognition and Machine Learning (ML) to provide evidence-based recommendations to health practitioners to support health decision-making (Sutton et al., 2020). The CDS system encompasses a variety of functions such as disease management, drug-dose calculations, diagnostics and alarm systems that automatically remind healthcare providers of specific actions that need to be done (ibid). According to Lipton et al. (2011) alerts sent by CDS systems are of the main benefits of this technology. Similarly, Calloway et al. (2013) denote that these alerts are among the most commonly used decision-support tools in the medical domain. These alerts can remind clinicians of crucial medical events and guide them in tackling these situations. For instance, a study by Song et al. (2022) concluded that a CDS system can effectively monitor and manage hypertension according to specific protocols based on historical patient trends. The DHIS2 software can also support informed health decision-making by notifying health policymakers of the country's health indicators, which are key when planning and allocating resources (Dehnavieh et al., 2019). DHIS2 software enables policymakers to assess the quality and quantity of health care

services provided, which is important to effective health service delivery. The DHIS2 platform thus helps ensure stakeholders have access to information for forecasting and planning at both institutional and national levels.

#### *Reduces medical errors*

Ahmed et al. (2019) argue that medical errors are a major public health problem and a leading cause of death globally. Medical errors endanger patient's health and lead to poor health outcomes. These errors can range from misdiagnosis to administering the wrong drugs. In the United States of America (USA), medical errors are estimated to kill more than seven thousand patients annually. In contrast, the number is estimated to be even higher in developing countries (Wilson Law 2023). Reducing medical errors and improving patient safety are thus important goals in health care. Research evidence shows that implementing health information systems and proper health record management has great potential in reducing medical errors (Niyitunga, 2022; Mutair et al., 2021). EHRs, for instance, contain information that could easily highlight a patient's medical history. Access to these EHRs helps minimize preventable medical errors such as drug allergies. During the COVID-19 pandemic, Chilunjika and Chilunjika (2023) discussed the utility of EHRs and suggested that the Interoperability of these systems helped treat chronically ill patients.

#### *Enhances operational efficiency*

As an information-intensive industry, health institutions are constantly seeking ways to improve data management, leading to operational efficiency and quality health services. A major way health institutions seek to improve efficiency is by adopting digital technologies to manage data and automate administrative and clinical processes (Muinga et al., 2020). These technologies include patient portals, practice management software and hospital information management systems. One area where health information technologies can improve efficiency is patient registration and appointment scheduling. When patient data is captured electronically, errors are reduced, and data accuracy is enhanced. The use of patient portals, for instance, simplifies patient registration and facilitates efficient appointment scheduling, reducing patient waiting times. In their study on OnkoNetwork, a cancer patient management network in Hungary, Pitter et al. (2019) noted that using patient portals resulted in a seventy per cent reduction in average patient waiting time. This was achieved by using the platform's capabilities to fast-track appointment scheduling. A study by Reichert and Jacobs (2018) highlighted the adverse effects of long waiting periods in emergency departments on patient outcomes, including higher death rates. Reichert and Jacobs (2018) further note that efficient appointment scheduling facilitated by patient portals can help decrease these adverse effects.

Data accessed through health information systems also allows healthcare managers to allocate scarce resources based on hospital and departmental needs, which leads to operational efficiency (Adeleke et al., 2015). This data includes human resource management information such as the number of staff available, skills inventory, demographics and factors influencing health personnel recruitment and turnover. The availability of such information enables health administrators to utilize human resources efficiently, monitor performance and make strategic decisions on the available staff. Health information systems also support financial data's accountability, security, and integrity. If financial records are not correctly managed, there will be a proliferation of theft, embezzlement, and other related corrupt activities, which, in the long run, affect the delivery of quality health care (Niyitunga. 2023).

### **3 Methodology**

This qualitative desktop review study aims to explore the opportunities and challenges of Blockchain technology in Zimbabwe's Public Health Sector. The methodology employed in this paper consists of three main procedures: literature review, search and selection of relevant sources and data presentation and analysis. The first procedure in this methodology involved conducting an unstructured comprehensive literature review to gain an in-depth understanding of the opportunities and challenges of Blockchain technology in the health domain. The review covered relevant scholarly papers, conference papers, books, reports, newspapers and other sources related to the opportunities and challenges of Blockchain technology in the medical field in developing countries, particularly in Zimbabwe. The next step focused on searching and selecting relevant sources that provide insights into the opportunities and challenges of blockchain in the health sector. The authors identified reputable sources such as scholarly articles, conference papers, books, reports, newspapers, and reputable online

literature. Keywords such as Blockchain technology, health domain, opportunities, challenges, developing countries and Zimbabwe were used to search. The selection process included screening the retrieved literature based on its relevance to the topic and research questions. Once relevant literature was identified, a thorough analysis was conducted to extract valuable information about Blockchain technology's opportunities and challenges in Zimbabwe's public health sector. This step also involved synthesizing, organizing and presenting the data obtained from various sources to gain a comprehensive overview of the opportunities and challenges of Blockchain technology in Zimbabwe's public sector.

### 3. Results

#### 3.2 An overview of Zimbabwe's Public health sector

This section provides an overview of Zimbabwe's public health sector and some of the general challenges that this sector is facing. The Zimbabwean health system is structured based on the Primary Health Care Approach principles. What this means is that health is delivered at four levels, which are clinics, district hospitals, provincial hospitals and lastly, quaternary hospitals, which are meant to function as a referral chain (Muzvidziwa-Chilunjika and Chilunjika, 2020). Zimbabwe's health system is well defined in terms of hierarchy, with the Ministry of Health and Child Care (MoHCC) at the apex. The ministry is responsible for policy formulation and implementation, administration, and overseeing and coordinating all health programs and plans, amongst others (MoHCC, 2023). However, public health sectors in developing countries such as Zimbabwe are considered rigid due to their resistance to change and novel technologies. Over the past four decades, the government of Zimbabwe has implemented policies, reforms, projects and plans to revamp its public health sector and improve health service delivery (Muzvidziwa-Chilunjika and Chilunjika 2020). Despite these attempts, the performance of Zimbabwe's public health sector has continued to deteriorate.

McClure (2020) conducted a review to identify challenges that hamper providing quality healthcare in Zimbabwe's public health sector. They found out corruption, poor health information management systems, manual paper-based procurement and supply chain systems, weak leadership, poor financial management, and lack of ICT infrastructure and skilled personnel hamper the effectiveness of Zimbabwe's public health sector. Similarly, a study by Muzvidziwa-Chilunjika et al. (2020) on health system challenges in Zimbabwe reported that even though there have been attempts to improve the quality of health service delivery in Zimbabwe through different reforms, none of the strategies have resulted in desired goals due to resistance to change, corruption and poor health financing. McClure (2020) believes that the government of Zimbabwe will have to commit itself fully to ensure that implementing health reforms will result in desired health outcomes. Chilunjika et al. (2022) also highlighted a need to allocate adequate resources to improve the performance of public health institutions.

Additionally, there is a need for research to identify flaws within the entire public health system in Zimbabwe and the strategies and reforms that are needed to strengthen and revamp it. These strategies include adopting ICTs to improve the efficiency and effectiveness of the six health system building blocks (health information, health financing, health workforce, leadership and governance, health services and medical products). This is in line with the World Health Organization, which states that innovative strategies such as ICTs are needed to ensure the attainment of Universal Health Coverage in developing countries (Olu et al., 2019).

The next section discusses Zimbabwe's health information management system and its challenges. This is important in identifying the areas in which Blockchain technology has the potential to improve.

#### 4.2 Zimbabwe's Public Health Information System and its shortcomings

The crux of any health information system is to guarantee that accurate data, in the correct format, is provided at the right time and placed to the rightful individual at the lowest cost possible. Given the health information system's outsized role in the medical field, it is imperative to explore the challenges that affect the effectiveness of this system in Zimbabwe's public health sector. Identified challenges include: manual data capturing, lack of Interoperability between health institutions, privacy and security concerns, inaccessible health information, untimely data reporting and poor quality of health information. These challenges are discussed in subsequent sections.

### *Manual data capturing*

This study found out data capturing in Zimbabwe's public health sector is mainly done manually and that most public health institutions rely on the paper-based system. For instance, a study by Khumalo (2018) reported that Zimbabwe's national health information system has been plagued by incomplete data at national, provincial, district and clinic levels due to the paper-based record system. This system utilizes a variety of paper records, which are prepared at all clinics and compiled every month for submission to the district level, then to the provincial and ultimately the national level. However, this presents challenges to the system's efficiency due to persistent shortages of paper registers used for data capturing at the hospital level (Khumalo 2018). These constant shortages mean that data recording at all health system levels needs to be conducted more timely and regularly.

Moreover, incomplete health data from these paper forms compromises quality health policy making, planning and equitable distribution of inadequate resources to essential areas such as emergency responses and disease surveillance. A study by Madziwa (2019) also raised concerns over the incompleteness of health information produced from the manual paper-based system used in Zimbabwe's public health sector. This author stipulates that due to this system, there is limited reporting of morbidity and mortality statistics at referral hospitals. Moreover, statistics on postnatal care and sexual reproductive health indicators are not captured in this system (Chilinjika et al., 2022). Subsequently, the MoHCC needs a complete and accurate picture of the country's health status.

In regards to administrative functions such as Human Resource Management (HRM), a study by Gweshe et al. (2022) brought to light that the MoHCC heavily relies on a paper-based HRM system to maintain its employees' records, such as appointment forms, leave records, academic qualifications and other employee-related information. According to the Civil Service Commission, which is the human resource wing of the government of Zimbabwe, all employees' records should be kept at all levels of the ministry's bureaucratic structure, meaning every health worker has at least five paper files with the same human resource information. For example, a primary health care nurse stationed at a rural clinic will have their paper HR records at the parent clinic, district office, provincial office, head office, and Salary Service Bureau. This presents a risk to employee records management since paper files can easily be lost, damaged or not updated promptly. Additionally, Madziwa (2019) found out that financial management at some public health institutions, particularly those in rural areas, could be more efficient as financial records are recorded and stored on paper. Crucial challenges facing these health institutions include embezzlement of funds and manipulating financial records (McClure 2022). These alarming challenges impact the financial stability and operational efficiency of public hospitals in Zimbabwe. Consequently, leading to the provision of poor healthcare to most Zimbabweans who rely on the public health system.

The literature reviewed highlighted that patient information at public hospitals is also captured using the manual paper-based system (Masuku, 2019; Maphosa et al., 2019). For instance, a study by Madziwa (2019) revealed that patient notes in Zimbabwe are currently handwritten and kept in files and storage rooms for retrieval later. This system for capturing and storing patient information makes it difficult for clinicians to access critical information they need to provide necessary treatment to their patients. Moreover, important patient data is usually in different hospitals. Therefore, doctors cannot coordinate care or reduce medical errors. In line with this, Masuku (2019) recommends adopting digital technologies as they can transform data management in Zimbabwe by moving away from manual paper-based recording.

### *Timeliness of data reporting*

The timeliness of health data reporting is also a major challenge in Zimbabwe's public health sector (Madamombe et al., 2022). Since 1992, the country's public health sector has been using the Weekly Disease Surveillance System (WDSS), a surveillance tool to provide early warning of potential public health threats and program monitoring functions that may be disease-specific or multi-disease (Khumalo 2018). This system, however, is characterized by delayed and inadequate reporting from the primary healthcare facilities to district, provincial and national levels due to paper-based recording. Marlowe et al. (2019) underscored that sending paper records from the lowest tier of the healthcare system to the national level can sometimes take up to a

month, thus affecting the timeliness of health data reporting. A study by Madamombe et al. (2022) also provided evidence of the lack of timeliness in the country's paper-based health information system when they noted that in 2020, four out of thirteen health facilities in Makonde District timely submitted forms that had one hundred per cent of the required data filled out. Similarly, Khumalo (2018) highlighted that the timeliness, completeness and accuracy of paper records submitted by health facilities vary significantly by district and province, suggesting that public health institutions in Zimbabwe are only sometimes meticulous when contributing to the national health information system. According to Khumalo (2018), this, in the long run, affects the analysis, interpretation and dissemination of health data needed for policy making, planning and distribution of limited resources.

#### *Capacity*

Lack of capacity is also a key challenge facing Zimbabwe's paper-based health information system. According to Khumalo (2018), most public health institutions lack the storage capacity to keep paper registers, files and patient records. Similarly, Niyitunga (2022) notes the poor storage of inactive health records in many African public hospitals. Health records are generally kept in dusty, insect-infested store rooms and outdated formats, meaning they only last briefly because they become fragile and deteriorate quickly. Additionally, Khumalo (2018) notes that Zimbabwe needs more health information officers to capture, analyze, and interpret health data efficiently, as a massive brain drain has rocked the country. Furthermore, the need for more human resource capacity development of the remaining health information officers impedes quality health information management in most public hospitals (Madziwa, 2019). As a result, weak human resources in health information management led to poor capturing and reporting of crucial health statistics, health emergencies and performance indicators at all health system levels.

#### *Lack of Interoperability between health institutions*

Efficient data sharing is one of the most important components of any viable health system. It is, however, worth noting that public hospitals in Zimbabwe need more innovative and efficient ways to share health data for better healthcare coordination. Masuku (2019) notes that health information in Zimbabwe's public health institutions is stored in different databases and has various formats and data types. Consequently, this results in an incomplete understanding of individual and population health needs, which leads to poorer health outcomes and higher costs. Moreover, this study established that there currently needs to be healthcare interoperability standards intended for all public hospitals across the country, meaning that each hospital has its standards, which sometimes do not match those used by other public hospitals (Masuku, 2019; Madziwa, 2019). This means that public hospitals in Zimbabwe use a different approach and language for collecting, storing and exchanging data. Lack of Interoperability between public hospitals detracts patients from getting proper treatment and further complicates the possibility of fighting diseases and achieving good health in Zimbabwe.

#### *Privacy and Security concerns*

The lack of the essential legislative frameworks, political willpower and capacity to deal with ethical concerns such as the security and privacy of medical records and consent to use patient data are recurrent challenges which appear in many health information management studies in Zimbabwe (Furusa and Coleman, 2018; Chilunjika, 2019; van Stam, 2021). Electronic health records, for instance, are susceptible to security and privacy breaches, which negatively impact their use in the health domain. In their study, Furusa and Coleman (2018) found out that patients and health personnel in Zimbabwe want the assurance that using electronic health records will not result in unauthorized disclosure of personal data as this is the backbone of a good relationship between the two parties. Unsecured health records thus pose a hazard to patients and health personnel, as patients may feel unsafe to openly discuss their accurate health conditions, which impedes proper diagnoses and treatment.

### **4.3 Possible benefits of Blockchain in Zimbabwe's public health sector**

As noted in the preceding sections, there are many issues and challenges with the health information system in Zimbabwe, which could be profoundly beneficial if Blockchain technologies were integrated. These benefits include Data security, increased transparency, Interoperability, enhanced data availability and improved management of health records. These potential benefits are discussed below.

### *Increased transparency*

The ability of blockchain to capture transactions on distributed ledgers presents novel opportunities for public health institutions in Zimbabwe to foster transparency, prevent corruption and build confidence in the public health domain. As already discussed, blockchain is a transparent technology with a trust-based framework that makes all health transactions traceable and visible to all participants in the healthcare delivery chain instantly. Any effort to manipulate a record in the blockchain could be easily detected. For instance, the immutable nature of Blockchain technology makes it ideal in health supply chain management systems. Currently, pharmaceutical supply chain management in Zimbabwe is marred by many loopholes where anyone can forge documents or alter or remove evidence of corruption (Chilunjika et al., 2023). Adopting blockchain helps ensure that pharmaceutical supply chain logistics information avoids uncontrolled adjustments. This increases trust and prevents the unlawful handling of records, payments and drugs by various pharmaceutical procurement parties.

Additionally, this technology can help maintain accurate financial records in the financial management process (Alhadhrami et al., 2017). Traditional financial management in Zimbabwe's public health sector involves a lot of manual processing, and accounting information is easy to tamper with, resulting in data distortion, fraud, and theft of funds (Chilunjika, 2012). Unique features of blockchain, such as timestamp mechanisms, provide effective data traceability and auditability, meaning all financial records on the blockchain can be tracked against time stamps and will not be erased. Blockchain also streamlines financial operations by reducing reliance on intermediaries such as third-party providers and vendors, reducing administration costs (Pandey and Litoriya, 2020). Eliminating middlemen also helps to process transactions more transparently and significantly faster than manual methods. A study by Chilunjika et al. (2023) on pharmaceutical procurement in Zimbabwe revealed that using third parties creates widespread corruption, which manifests through bribes and kickbacks. Consequently, this leads to the procurement of sub-standard medicine and vaccines, which are detrimental to the health of Zimbabweans. Blockchain in this critical area in health can help address corruption by providing a transparent track record of pharmaceutical procurement transactions.

### *Data Security*

Data security, privacy, sharing and storage issues are paramount concerns associated with health information management in Zimbabwe (Chidhau et al., 2021). Patient management, particularly, hinges on sharing patient information among various hospitals and physicians, which may result in data loss, data theft and unauthorized access. Adopting a technology (Blockchain) that can reduce these challenges would be an ideal move for public health institutions in Zimbabwe to ensure patient data security. Blockchain platforms work with standard algorithms and protocols for data encryption and cryptography, allowing for secure and controlled data sharing (Matlebjane and Ndayizigamiye, 2022). In the modern world of online health data, there have been tremendous efforts to breach information, including patient data, clinical trials, insurance information and imaging around the globe (Teli and Masoodi, 2021). In their study, Teli and Masoodi (2021) reported numerous health data breaches in which over one hundred and fourteen million people have been affected. Blockchain, with its data encryption characteristic, can make hacking very difficult since no one can access data without the consent of all parties concerned, thus its usefulness in the medical domain. Dubovitskaya (2019) also submits that public health institutions can use the Keyless Signature Infrastructure (KSI), a blockchain-based application that protects online health records from hackers and internal misuse. This application provides data security in the health domain while ensuring the privacy of health information (Dubovitskaya, 2019).

### *Better and Improved management of health records*

Porous paper-based health information systems, manipulation of data, untimely reporting, and information access constraints have impacted the quality of health services in Zimbabwe, resulting in high mortality rates (Muzvidziwa-Chilunjika and Chilunjika, 2021). Blockchain technology can improve health records management, providing physicians and patients with centralized and real-time access to their medical history (Capece and Lorenzi, 2020). Because it enables the establishment of easily accessible centralized data, Blockchain technology improves the quality of healthcare services (ibid). Clinicians can use this technology to sync all of their patient's health records in real time; consequently, time is saved, and patients are treated more efficiently. It also improves and promotes health records governance, allowing health information systems to be more interoperable, secure and effective (Chen et al., 2019). For example, in Tanzania, AID: Tech, an

Ireland-based organization, has launched a Blockchain platform designed to provide a secure and transparent system for the management of health records and payments (PharmaAccess, 2018). This system also helps health institutions minimize fraud and improve the accuracy of health financial records. The successful implementation of this technology in a developing country like Tanzania can suggest that if adopted and implemented, Zimbabwe can yield similar benefits.

#### *Improved Interoperability of health information systems*

Blockchain-based healthcare systems can address interoperability challenges in Zimbabwe's public health domain. Lack of Interoperability hinders the delivery of timely health services as the right data is not made available at the right time to the right people. According to Mittal and Thakur (2018), restricted data sharing among health institutions results in a loss of 150,000 lives and US\$18.6 billion annually. This statistical evidence warrants the need for health systems to share information seamlessly. Blockchain technology has been proposed to provide secure Interoperability and organize access to health records through patients, third parties and healthcare providers while maintaining the privacy, security and integrity of crucial health data. Kenya is a developing country that has harnessed blockchain technology to improve the Interoperability of its health information systems. Through its Medixus Blockchain-based platform, hospitals and health personnel can communicate and collaborate securely (Omnia Health 2023). The system also provides a transparent and secure platform for sharing patient data such as imaging and prescriptions, enabling more efficient and faster healthcare provision (ibid). Interoperability of health information systems is therefore crucial as it facilitates communication and the sharing of health data in a standardized and meaningful manner.

#### *Sound pharmaceutical supply chain management*

One of the main benefits of Blockchain technology in the health domain is its ability to improve the pharmaceutical supply chain. Contemporary pharmaceutical supply chain systems are complex, involving numerous players (manufacturers, suppliers and customers) across the globe (Zakari et al., 2022). The digitalization and online sale of medicines have also opened doors to the production of counterfeit pharmaceuticals, lowered quality and untraced transportation of medicines. Authors such as Bocek et al. (2017) and Zakari et al. (2022) proposed that blockchain would help trace the origins of medical products and track their movement throughout the supply chain process. This safeguards suspicious and counterfeit drugs from entering the distribution chain. Uganda is one African country that has successfully adopted blockchain technology to improve its pharmaceutical supply chain. It uses the Mediconnet Blockchain platform to track the distribution of medicines and other pharmaceutical supplies (Omnia Health, 2023). According to Omnia Health (2023), Mediconnet allows for the tracking of drugs from manufacturers to the patient, which helps reduce the incidence of counterfeit products and improves the overall efficiency of the health system.

Blockchain technology can also address security concerns through the use of cryptographic technologies which validate blocks of pharmaceutical transactional information (Bocek et al., 2017). It also addresses the falsification of medicines through serialization (Botcha et al., 2019). For instance, when using blockchain, the entire pharmaceutical supply chain has verification checks that authenticate serial numbers. Blockchain also enhances medicine traceability to prevent theft and quality control is achieved through digital signatures. This technology also enables pharmaceutical developers and manufacturers to run clinical trials and share medical samples in a secure environment (Chiacchio et al., 2020). In addition, it improves accountability and transparency in clinical trial reporting as each stage is time-stamped.

## **4.2 Barriers to Blockchain Adoption in Zimbabwe**

To discuss the challenges hampering the adoption of Blockchain in Zimbabwe, this paper adopted the Technology, Organizational and Environmental TOE framework by Tornatzky and Fleisher (1990). Researchers have widely used this theory to study IT adoption. This theory uses three factors to identify IT adoption decisions: technology, organizational, and environmental. As such, this paper categorizes challenges hampering the adoption of Blockchain in Zimbabwe into technological, organizational and environmental themes. These challenges are discussed in subsequent sections.

*Technological challenges*

Regarding ICTs, the technological context involves technical skills and the complexity and development of technologies for adoption. Numerous scholars have agreed that technological challenges hamper adopting and implementing Blockchain-based applications in the health sector (Capece and Lorenzi, 2020; Chukwu and Garg, 2022; Ghosh et al., 2023). Blockchain is still in its infancy, so it is vulnerable to technical errors and unreliability. Hence, it has yet to be widely adopted in developing countries. Other technological challenges of Blockchain technology include scalability, cost of IT equipment, data integrity and security, time of transaction processing and Interoperability. Consequently, this technology must generally accept technical standards to ensure its Interoperability and the data's consistent formats across different Blockchain platforms (Ndayizigamiye and Dube, 2019).

Ndayizigamiye and Dube (2019) also add that inadequate accessibility of IT infrastructure among users impedes stable and effective Blockchain implementation and use. Similarly, Chilunjika and Chilunjika (2023) submit that most developing nations, Zimbabwe included, need better IT infrastructure to support the full and sustainable adoption of advanced technologies such as blockchain. Investment in IT infrastructure is thus an important factor if Blockchain technology is to flourish in developing contexts. The dearth of IT experts due to the massive brain drain witnessed in Zimbabwe is also a significant technological barrier to Blockchain implementation (Furusa and Coleman, 2018). The complexities of this technology, coupled with the need for IT experts, present problems for health institutions in Zimbabwe in adopting and implementing it.

*Organizational and Environmental challenges*

Dowelani et al. (2022) and Akinradewo et al. (2022) mentioned organizational challenges such as resistance to change, organizational readiness, status quo mindset, inter-organizational connectedness and poor management support as key organizational challenges hampering the adoption of blockchain. Other key organizational challenges highlighted in the literature include a lack of integration with the existing system, uncertain return on investment, lack of funding and inadequate infrastructure (Biswas and Gupta, 2019). Organizational culture in organizations plays a significant role in the adoption of innovations. In their study, Boore et al. (2017) note that corporate culture guides employees through work discipline and expected behaviour towards change. Resistance to change, for instance, acts as a barrier to Blockchain adoption. Organizations and employees usually vacillate to replace or change traditional ways of doing business, creating a major obstacle to Blockchain adoption (Dowelani et al., 2022).

Lack of funding is also a major obstacle to Blockchain adoption in the public health domain (Matlebjane and Ndayizigamiye, 2022). Many ministries of health in developing countries face the need for more monetary resources to furnish public health institutions with advanced technologies such as blockchain due to limited budgetary allocations from the government (Chilunjika and Chilunjika, 2023). In Zimbabwe, the Ministry of Health and Child Care is generally allocated a budget below the Abuja Declaration target of fifteen per cent of the national budget. For example, over the seven years covering from 2015-2021 on average, the country's budget contributed thirty-five per cent of the total actual health spending, while donor partners contributed sixty-five per cent (UNICEF, 2021). This evidence shows that health financing through the government needs to be higher in Zimbabwe, thus hampering the adoption of technologies such as blockchain in the health domain.

Lastly, environmental factors such as lack of political will, poor governance, weak regulations, security and privacy concerns, ecosystem readiness, ecological costs and intellectual property were highlighted by Dowelani et al. (2022) as key environmental obstacles hampering the adoption of blockchain in developing countries. Scholars such as Katuwal et al. (2020) and Matlebjane and Ndayizigamiye (2022), for instance, mention governance issues and lack of clear regulations as substantial challenges for Blockchain technology adoption in developing countries such as Zimbabwe. Since Blockchain technologies represent a significant shift from traditional data management, clear regulations are crucial for successfully implementing these technologies. However, several studies, such as Katuwal et al. (2020) and Matlebjane and Ndayizigamiye (2022), have emphasized that numerous nations still need to be ready to adopt blockchain due to a lack of effective regulation. Matlebjane and Ndayizigamiye (2022) also add that Blockchain-based applications have specific features that should be assessed regarding compliance with data governance frameworks, laws and regulations. The ambiguity about Blockchain regulation issues in most countries creates hesitation among users and stakeholders,

which serves as an obstacle to the widespread adoption of this technology. Effective Blockchain regulations ensure stakeholders can collaboratively participate in decision-making based on their shared trust and established rules, which helps reduce unlawful activities and cybercrimes. In this regard, effective regulations, guidelines, policies, and corresponding enforcement is necessary to ensure proper governance of Blockchain applications in the health domain.

## Conclusion and Recommendations

This study explored the opportunities and challenges of implementing Blockchain technology in Zimbabwe's public health sector. The paper began with a conceptual analysis of both health and Blockchain literature, which aided in understanding the role of health information systems and Blockchain technologies and their impact on the provision of health care. The study found that health information systems are vital tools needed to support diagnosis and treatment of patients, health planning, decision making and the allocation of resources. It was also established that poor data management and the use of manual paper-based health information systems continue to impede the provision of health in Zimbabwe, undermining the well-being of Zimbabweans. The paper also found that Blockchain technologies are beginning to lay a path for a new revolution in traditional health information systems in Africa and have the potential to play a more significant role in the future. The underlying characteristics of blockchain can facilitate data management, data security and data integrity. It enables easy access and sharing of health records, allowing timely and better treatment of patients. Blockchain technologies also aid in combating corruption, embezzlement of funds and the proliferation of counterfeit drugs, which plague the Zimbabwean public health sector and hinder the delivery of quality care. Given this, the Ministry of Health and Child Care, together with the government and other relevant stakeholders, should invest in the deployment of this important technology. Effective guidelines, policies, and corresponding enforcement should be implemented to ensure the proper use and governance of blockchain in the health sector. Finally, adequate research should be conducted before the adoption of Blockchain in Zimbabwe to establish their feasibility.

As a new technology, and since there is still a need for more data to assess the impact of Blockchain on HIS in Zimbabwe, this study provides valuable insights that health policymakers can use before its adoption and implementation. This is because the implementation of blockchain in developing countries needs to be prudently planned and managed to realize its full benefits.

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## DEMYSTIFYING THE POTENCY OF MARKETING AS A TOOL FOR CREATING COMPETITIVE ADVANTAGE IN CHALLENGING TIMES\*

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**Abstract.** The COVID-19 pandemic has caused unexpected shocks to several sectors of the economy, including the insurance industry. The devastating effects of the pandemic have also affected the marketing model and the strategies' effectiveness. Therefore, this study sought to demystify the potency of marketing strategies as a tool for achieving competitive advantage in challenging times. An exploratory and qualitative research design was used to gain in-depth insight into the motivations and perceptions of a purposive sample of 15 insurance customers. Thus, interviews were conducted to gather data to determine the potency of the marketing strategies. The research findings showed that different companies used various marketing strategies, resulting in varying customer satisfaction. Some companies used low-cost strategies, while others focused on product differentiation strategies. It was further found that most customers prefer a lower price and reliable service from trustworthy insurers. In addition, it was noted that companies with high customer satisfaction levels outperformed their competitors and achieved a competitive advantage in the short-term insurance sector. This sector is customer-centric, so a higher emphasis must be placed on delivering quality service and customer satisfaction. Consequently, companies in the insurance sector will be able to keep customers satisfied over long periods and ultimately achieve customer loyalty. The study elucidates the pathway for insurance companies to navigate challenging times successfully by focusing on delivering quality service and nurturing customer satisfaction for long-term loyalty.

**Keywords:** Marketing strategy; Covid-19; competitive advantage; marketing mix; insurance industry

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**JEL Classifications:** L2, L26, L53

**Additional disciplines:** advertising, information and communication, insurance

### 1. Introduction

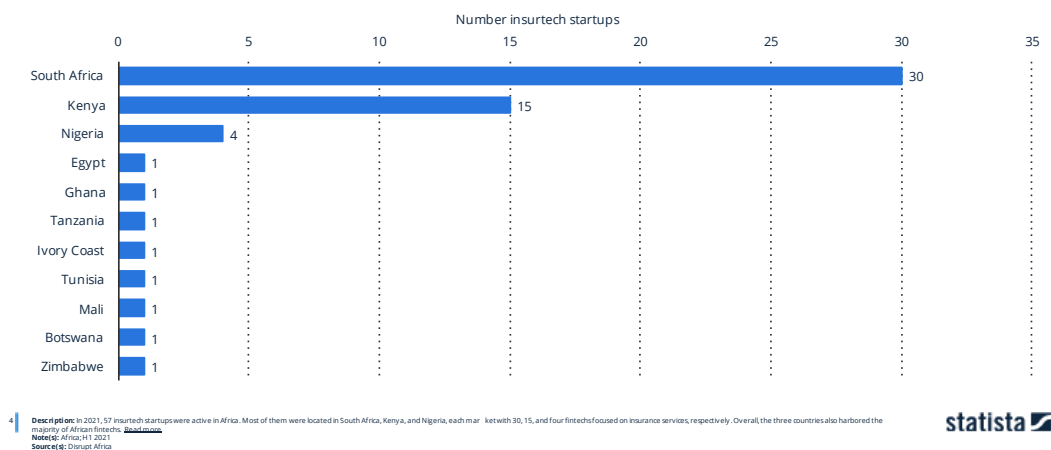
In recent times, global growth and the insurance industry have been severely impacted by the Coronavirus pandemic (Covid-19). The impact has been far more significant than the general public anticipated and has revolutionised how firms conduct business (Organization for Economic Cooperation and Development, 2020). Extant literature avers that marketing strategies play a crucial role in creating a competitive advantage for companies worldwide. Thus, companies must survive challenging times and devise strategies to gain a competitive advantage. Even though there is evidence from many studies on marketing strategies and

competitive advantage, most companies and industries examined have yet to experience the economic and environmental forces emanating from a crisis like the COVID-19 pandemic. Due to the precariousness of the economic environment, the application of previous research may not be viable in this changing environment. Therefore, a new wave of thinking is needed because yesterday's strategies may need to be revised in the present climate.

This is because the insurance sector in South Africa and elsewhere around the globe is facing significant hurdles emanating from a volatile and complex business environment. Furthermore, the insurers' and consumers' acceptance that most insurance policies do not provide coverage for the pandemic has significantly strained their reputations (Business Wire, 2020). Despite that, the development trends of the South African insurance industry have witnessed the industry's tendency to expand (Figure 1, Figure 2).

### Number of insurtech startups in Africa as of H1 2021, by country

Number of insurtech startups in Africa 2021, by country

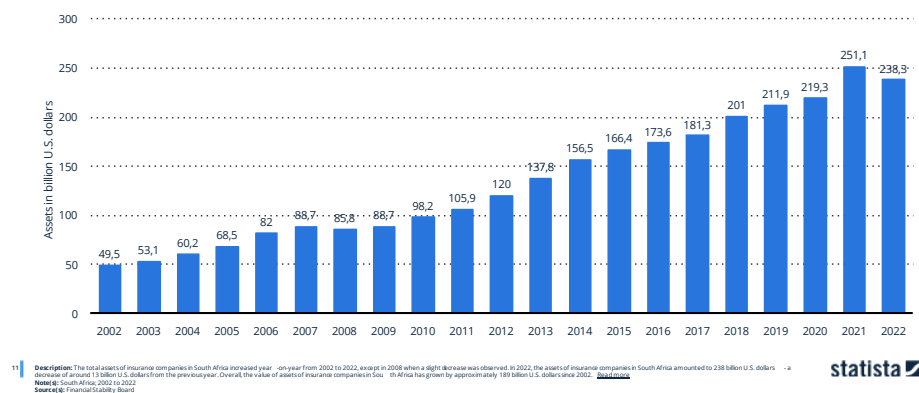


**Figure 1.** Development of South African insurance sector estimated by insurtech startups, 2021

Source: Statista <https://www.statista.com/study/46028/insurance-industry-in-africa/>

### Total assets of insurance companies in South Africa from 2002 to 2022 (in billion U.S. dollars)

Assets of insurance companies in South Africa 2002 -2022



**Figure 2.** Dynamics of total assets of insurance companies in South Africa from 2002 to 2022 (in billion US dollars)

Source: Statista <https://www.statista.com/study/46028/insurance-industry-in-africa/>

In addition, surges in petroleum prices, tax increases, and high unemployment rates have made it exceedingly challenging for individuals to buy insurance products. Moreover, the disposable income of consumers is under significant pressure, which has had a direct impact on their inclination to engage in investment and saving activities (Michel et al., 2020). Therefore, the insurance industry may encounter difficulties in the future. Given the rapid changes emanating from the COVID-19 pandemic, most studies have been theoretical and conceptual. There is still a need for empirical research disclosing consumer perceptions and attitudes.

Thus, from an empirical perspective, the study aimed to demystify the potency of marketing strategies as a tool for achieving competitive advantage in challenging times. The study could interest businesses and consumers because the COVID-19 pandemic has impacted everyone. In the long run, marketing strategies will affect the sustainability and profitability of all companies. Since the study focuses on the insurance industry, it could be used as a tool for benchmarking by companies in sectors with similar management architectures.

## 2. Literature Review

### 2.1 Theoretical Background of Porter's Generic Strategies and Competitive Advantage

Generally, most organisations have different strategies to gain and maintain a competitive advantage. Michael Porter developed generic strategies to help firms gain a competitive advantage. Moreover, previous research has shown a relationship between Porter's generic strategies and competitive advantage (Islami et al., 2020). Porter (1985), believed that the degree to which a company can develop a sustainable and secure position in an industry is a significant determinant critical to outperforming its competitors in the long term. Therefore, he claimed that generic strategies are ways companies develop a competitive advantage and create a secure position. These strategies are (i) overall cost leadership, (ii) differentiation, and (iii) focus. Porter argued that by adeptly pursuing cost leadership, differentiation, or focus strategies, businesses can attain a significant and enduring competitive advantage over their rivals.

The generic strategies allow a company to choose an alternative approach to gaining a competitive advantage (Hameed & Anwar, 2018). For instance, a cost leadership strategy enables a company to benefit by using a low-cost seller method or decreasing manufacturing costs within the industry to obtain the same profit (Firoz Suleman et al., 2019). Porter's generic cost leadership approach focuses on gaining a competitive advantage using the industry's lowest expenses and cost structure. To get a low-cost advantage, a firm must embrace a low-cost leadership attitude and low-cost production with quick distribution and replenishment, and workers must buy into the low-cost strategic approach. The corporation must be willing to discontinue any operations that do not offer value to the cost advantage framework and outsource them to other organisations that do. There are several methods for achieving cost leadership, including mass manufacturing, mass distribution, economies of scale, technology, product design, input cost, capacity utilisation of resources, and raw material availability (Ye & Lau, 2022; Natalia & Ellitan, 2019).

Differentiation occurs when a corporation strives to differentiate itself from the competition by providing distinctive goods or services that offer higher value to a wide range of clients. To surpass the competition, a business that can distinguish itself should be able to charge higher pricing and make better profits (Hales & Mclarney, 2017). A focused approach, on the other hand, focuses on a particular target or market sector. Thus, the business might use a focused approach if the differentiation and cost leadership strategies fail. This method may also be used for time-limited goods or services (Augustia et al., 2020). Despite Michael Porter's assertion, other scholars argue that generic strategies are not viable. As a result, Parnel (2006), as cited by Hales and McCartney (2017), believe businesses can choose any point along the continuum, and multiple value propositions may be possible at the same moment. Thus, in this context, the key to a successful competitive strategy is low costs, differentiation, and a focus on combining multiple strategic components into a compelling overall value offer. As a result, the definition of value encompasses the concepts of low cost, differentiation, and focus, with no mutual exclusivity involved. Organisations with more appealing value propositions are likelier to succeed than those with less appealing ones.

Through its value offer, a corporation may produce more enormous profits while providing better value to consumers. All firms must build a customer-driven marketing plan that incorporates a value proposition. “A company's value proposition is defined as the set of benefits or values that it promises to provide to consumers to meet their needs” (Kotler & Armstrong, 2014). The changes in the global business arena require entities to utilise innovation and approaches to remain competitive (Flak & Glod, 2020). Furthermore, global entities consider competitive advantage the cornerstone of their businesses because competitive advantages allow companies to operate better than competing brands. An ageing cliché emphasises that every business aims to maximise profit; hence, having a unique offering becomes the cornerstone of every successful entity (Azeem et al., 2021).

According to Kotler and Armstrong (2018), competitive advantage can be achieved if a company focuses on being economical or above average in their pricing strategy. Furthermore, a company must also consider the scope to be covered, whether narrow or broad. According to Kar and Navin (2021), a company can use the Porter (1985) model to establish possible competitive advantages and map out all the value chain activities to achieve the desired competitive advantage. Still, the service industry is complex. Scholars recommend models incorporating customer satisfaction as the core since service is known to be intangible. The value chain framework must include mapping infrastructure, services and marketing (Kar & Navin, 2021).

## 2.2 Core Competencies

According to Ceglinski (2020), a collaboration of the firms' differentiated knowledge, skills and technology must be considered to maintain long-term sustainability in a firm's competitive advantage. In addition, according to Krishnan and Islam (2019), core competencies must integrate employee and managerial skills and resources. Core competencies allow a firm to structure its daily activities and accomplish its strategic goals. According to Ceglinski (2020), “core competencies are the product of the organisation's intangible resources, which include, in particular, the company's knowledge and capabilities.” However, according to Krishnan and Islam (2019), scholars and industry experts often confuse core competencies with company capabilities. These scholars believe that company capabilities combined will map out the core competencies. If the company can have core competencies that competitors cannot significantly imitate, the competitive advantage and sustainability level will be greater. If the company can design core competencies that are difficult to replicate, unique resources, skills, processes, and strategic flexibility must be integrated.

According to Eizaguirre, Feijoo, and Laka (2019), the scope covered in most curriculums aimed at preparing future business managers or graduates for the topic of core competencies needs to be revised, even though it is essential to be thorough. The basis of core competencies must also look into the impact of different cultural and local contexts to have the company's crucial sets of activities and skills to serve its purpose of sustainability and create a competitive edge. Furthermore, Krishnan and Islam (2019) argue that a company needs to be ultra-careful and methodical when mapping out core competencies because a company may want to design unique and sustainable competitive advantages. Thus, this process must be designed so competitors cannot emulate it. This is consistent with Bertozzi, Ali, and Gul's (2017) research presented a similar viewpoint. Thus, the efficiency of these techniques will differ depending on the firm and the sector in which they operate. Because cost is inversely connected to market share, lowering costs allows a business to grow its market share.

Previous research has demonstrated that adopting merely one of these basic tactics provides a corporation with a competitive advantage. Businesses may use a focus strategy by concentrating on a particular market sector and emphasising either product distinctiveness or reduced cost. A company's success depends on selecting the most effective approach for gaining a competitive edge. Due to numerous limiting variables, a plan for one firm may not work for another. There is a threshold amount of market share over which any growth will be modest (Grant, 2016). According to Salavou (2015), service businesses with hybrid strategies (that focus strongly on low cost and differentiation) outperform firms with no strategy or confused strategists who place little emphasis on differentiation.

## 2.2 Marketing Strategies

Marketing strategy is about organising resources to satisfy the needs of a market and achieve business objectives (Sudirjo, 2023). If well thought out, strategy can assist managers in testing actions and proposing tactics that can lead to consistency, which is imperative for business success (Fifield, 2012). Another school of thought contends that a marketing strategy is a development that allows a company to concentrate its limited resources on the most profitable prospects to increase revenue and gain a competitive edge (Terho et al., 2015). The marketing mix is one of the marketing methods or frameworks used to obtain a market competitive advantage. Thus, a well-thought-out and seamless application of the marketing mix can lead an organisation to achieve superior results against competitors in the market. The marketing mix is critical for companies to understand what parts must be blended to fulfil their goals and objectives and ultimately gain a competitive edge. This technique incorporates the four Ps of marketing: product, price, place, and promotion (McCarthy, 1960).

These are the four most crucial factors that must work together to offer value to the consumer and help the company stand out from the competitors. Marketing mix components and activities must be aligned and used efficiently to achieve success. The evolution of the marketing mix traces back to the 60s, and this development has seen the 4Ps increase to more than 7. The marketing mix is still valuable for assisting businesses when structuring segmentation, positioning, and other marketing concepts (Kwok, Tang & Yu, 2020). According to Lahtinen, Dietrich and Thiele (2020), marketing mix is still a core factor in the success of a business. Service marketers have been criticising the 4 Ps because of the nature of service; for example, service cannot be touched like a product, and service is considered perishable. Furthermore, scholars have identified inadequacies in the 4Ps framework, and as a result, over 25 Ps have been added to the marketing mix.

According to Lim (2021), a company needs to be careful in structuring and controlling its marketing mix because the elements of the mix should assist the company in realising its marketing objectives. According to Nikbin, Iranmanesh, Ghobakhloo and Foroughi (2022), during COVID-19 and post-COVID, for a company to be able to sustain and improve its market position, directors must not cut costs in research and development. Furthermore, they must disinvest in products and services that are non-profitable. Though the COVID-19 pandemic era was a challenging season for most industries, it was necessary for firms, including those in the insurance sector, to structure their offering to meet the recent needs of customers. Introducing new and affordable products must be considered in order to move from current sales to desired sales. The focus must lean towards producing durability and a wide size range. To remain competitive, a company must provide better services (Nikbin et al., 2022).

The existing body of knowledge needs a comprehensive exploration of the intricate dynamics that limit the efficacy of marketing strategies, particularly in the face of challenging and unpredictable circumstances, such as those witnessed during the COVID-19 pandemic. Thus, more research is needed to provide an in-depth understanding of the factors that impact a company's competitiveness in times of crisis. This research aims to address this critical gap by exploring the nuanced complexities surrounding the effectiveness of marketing strategies during challenging times. By delving into this area of research, the study seeks to contribute valuable insights to the existing body of knowledge, offering a more nuanced perspective on the multifaceted relationship between marketing strategies and competitive advantage, especially in turbulent times. Through this investigation, the study aims to demystify the potency of marketing as a tool for creating and sustaining competitive advantage in the dynamic landscape of challenging circumstances.

## 3. Research methodology

This study used an exploratory and qualitative research design. Thus, qualitative research techniques analyse linguistic expressions, affective states, emotional experiences, auditory perceptions, and other non-numeric and non-quantifiable components. The selection of a qualitative research technique was based on recognising that different approaches would not provide a comprehensive understanding of client demands and satisfaction. Qualitative data is sometimes considered to possess a more comprehensive perspective than quantitative data due to its capacity to include data collected from many sources. According to Gall, Gall, and Borg (2007), a qualitative study enhances the participants' comprehension, perspectives, and attitudes.

Moreover, exploratory research is characterised by its inclination to address novel topics that have received little or no prior investigation, like events surrounding the COVID-19 pandemic (Brown, 2006). A purposive sampling technique was used to select 15 respondents based on their specific experiences within the insurance business in 2022. The data was gathered via interviews, deemed more reliable and appropriate due to their capacity to elicit diverse responses and provide open-ended inquiries. The interview guide was organised, enabling study participants to give all pertinent data necessary for the research objectives. The data was analysed using content analysis techniques.

## 4. Results and Discussion

### 4.1 Demographic profile of respondents

Most respondents (80%) were less than 60 years old. The rest were working adults aged 60 or older but younger than 65. In addition, 60% of the respondents were unmarried, while 20% were divorced or legally married. By March 2020, all participants had successfully met their obligations and kept their premiums current, and their short-term insurance contracts remained operational. The COVID-19 lockdown started at this point. Due to the economic slowdown, many South Africans needed help to meet their obligations, such as insurance premium payments.

### 4.2 Marketing strategies used by insurance companies

Customers' fundamental need for coverage is the foundational principle of insurance products. It also relates to the need for assurance on the part of customers in uncertain times. The term “actual product” describes the policy and its aspects. In addition to brand name, product quality and dependability, this level considers each product's specific characteristics and the insurer's reputation (Kotler & Armstrong, 2018). This research included several more recent companies that employ technological advancements to implement novel business strategies. Better business models are the outcome; this leads to a smoother and more efficient claims procedure for specific firms. Customer satisfaction is one of the most crucial factors, if not the most critical, in the short-term insurance market, as it is a customer-centric business. Companies that can reliably provide exceptional customer service will have the most incredible opportunity to gain and hold onto a competitive edge. Companies may have the largest market share and be industry leaders, but if their clients are dissatisfied and lose faith in them, their market share will gradually decline. It has been shown that competitive advantage in this sector is correlated with high customer satisfaction. Therefore, the information gleaned from the data for the marketing strategies adopted by insurance companies is discussed in detail below.

### 4.3 Price and relief measures

One of the insurance businesses is recognised as one of South Africa's most dependable, renowned, and trustworthy short-term insurers. This corporation competes on value rather than price. Respondents who purchased this company's products were aware of this and chose to pay a premium for a high-quality product that was dependable and would pay off. Customers are reminded by the company's marketing approach that a cheaper product only sometimes implies a superior product. Company Z has also been known to pay more claims than any other insurer. This is why these policyholders picked the firm and agreed to pay a higher premium, as intimated by one of the respondents who observed that *“The company offers personal and commercial clients a multi-product and multi-distribution offering which provides comprehensive cover through a wide range of value-added products. Unique benefits are offered to each targeted segment.”* (Interviewee B).

Company X is the most well-established and experienced short-term insurance in South Africa. It has been in business for around 180 years, making it the most experienced short-term insurer in the country. It does not compete based on pricing, and respondents selected the company's product because they believed it to be the most dependable and well-established short-term insurance, as suggested by one of the participants who said that *“Company X has taken out additional marketing strategies to retain customers and to make premiums more affordable for customers during the lockdown.”* (Interviewee C). Its goal is to be a reliable companion for its clients during times of uncertainty. For May and June 2020, Company X had reserved R60 million to provide a 15% premium discount to all eligible clients. In addition, the company committed to keeping premium hikes as low as possible over the next 12 months and also implemented methods such as premium deferments with

delayed repayment periods and leniency on any debit orders missed due to revenue loss from the COVID-19 lockdown.

All respondents with Company X products were aware of these relief measures and seemed happy with their current products. One customer needed help getting through to Company X customer service and wanted a better experience. *“I found it very disappointing and distressful that the lines were busy and that it took almost two weeks to hear back from the insurer. I will consider other insurers if provided with a better deal”* (Interviewee D). The lack of staff during the lockdown period affected customer satisfaction, as in the case of Company X mentioned above. Customers were aware that Company X products were not the cheapest available. Still, they opted for quality over a more affordable price, as suggested by one of the respondents who said that. *“I heard about these products through referrals and word of mouth. I took up this policy through a family broker. Referrals helped to sway my purchase decision. Advertising and media were ignored, and I remained loyal to Company X. I do not care about loyalty programs and benefits. Company X was chosen because it is a company that all my friends and family trust. I am willing to pay a higher price for a trusted product. I will remain loyal to my current insurer and have no plans on changing insurers”* (Interviewee H).

#### 4.4 Incentives

By offering cashback and other incentives for driving correctly, Company Y follows a marketing approach comparable to Company Z. The price strategy is more intricate and differs somewhat. This insurance had been promoted on television, which is how the respondents learned about it. One respondent reiterated the importance of cashback: *“Other insurers did offer me better premiums, but the cashback was considered when making my decision.”* (Interviewee L). This resulted in customers paying a lower effective premium. On the other hand, one of the participants remarked that *“Company Z offers an optional payback bonus to customers. This slightly increases the cost of cover and pays back the lower of (25% of premiums or the total of the first year's premiums after four years). This cashback is still paid even when some qualifying claims are made.”* (Interviewee G).

In contrast, Company Z only reimburses 10% of premiums if three years pass without a claim. Because Company Y provides what it requires at the most affordable cost, its clients believe it delivers a stronger value proposition. The respondents who had purchased insurance from Company Y attested that Company Z did have the lowest upfront charge and maintained their Best Price Promise. It was seen that because of the cashback, Company Y provided the lowest long-term coverage cost. *“It works out cheaper for me in the end. Once cashbacks are received, the premium becomes cheaper than other insurers currently offer. I do not want to change insurers right now. After a few years, I might reconsider once the cashbacks are in my pocket. The cashback and discounts are why I have stayed loyal to this insurer. I would lose out on my cashback if I were to cancel now.”* (Interviewee F).

*“All customers can easily attain the standard 25% cashback after 4 years. Another payback bonus is offered called the Monthly Payback Booster, which gives customers up to 75 per cent of their monthly premiums.”* (Interviewee I). There is a fee associated with the Payback Booster, which may raise the premium significantly. Compared to quotations given by Company Z, respondents have verified that their upfront premiums have risen considerably with the addition of these extra features. This particular feature led these people to choose Company Y for their insurance. This is an optional benefit that is only included in some plans. *“Company Y is one of the best offerings for people like us who understand the product well and can take advantage of the benefits and discounts. Most customers may not be aware of these optional features and may unwillingly be sold policies that only offer a standard 25% cashback after 4 years. I have comprehensive coverage and have performed all activities to qualify for the cashback. I am on a 4-star rating and qualify for cashback of 40%”* (Interviewee H).

*“The percentage of the discount will depend on a 5-star rating system which analyses driver behaviour. A 1-star rating is classified as bad driver behaviour and gets a 0% monthly cashback for their driver behaviour. A 5-star rating scales this discount up to 60%. Drivers with 1-star ratings are still allowed 10% cashback if they have coverage for household contents and buildings. An additional 5% discount is given for performing a vehicle safety check and eye test.”* (Interviewee C).

Women who combine their home and auto insurance are eligible for a discount. Through word of mouth, the responder became aware of this insurance. There is a high level of customer satisfaction. Before the lockdown, there were no significant problems with claims. There are no plans to switch insurance providers. This customer utilises the extra advantages provided by the insurance, such as Company Z, which provides free roadside help around the clock. The perks include emergency medical aid, a mobile accident detector, and towing services. Home emergencies are covered under the Home Assist benefit. Women with comprehensive insurance policies are also eligible for free tax, financial, and legal help. Legal experts and attorneys will be on hand to guide various matters. This policyholder finds excellent value in sticking with the provider and has taken advantage of all these extra incentives. In 2019, there is just one little complaint about a claim. The response is as follows. *“I chose this insurer because it offers lower premiums to women and a range of benefits that I use. A low price is not the only deciding factor when choosing my insurance. I look at the additional benefits that are provided as well. No accident claims have been made yet, but I did claim for emergency roadside assistance a few years ago. This was the only claim experience I have had with this insurer, and I was not happy with the time it took for the towing service to show up. It took almost 2 hours, which could be dangerous for women alone on the road. This is something that can be improved. I will hesitate to switch to other insurers because they may not offer me the same services and benefits.”* (Interviewee B).

However, this customer has verified that quotations have yet to be received from all insurers. The insurer was selected mainly for the value delivered to them rather than the lowest price. Although there is no wish to transfer insurers, this client has confirmed their knowledge. The consumer may rethink their decision if presented with cheaper estimates that provide comparable advantages at a lower price. When it came to processing a roadside assistance claim, a slight problem occurred. It was before the lockdown that this took place.

Additionally, this has resulted in a decrease in customer satisfaction and has made it possible for other insurance companies to approach her with a more favourable offer, as observed by one of the participants who believed that *“Existing clients from these other divisions are given an added incentive to take up Company X products. Premium discounts and incentives for being a loyalty program member are offered. Company X uses a loyalty program called Vitality Drive to reward good driving behaviour.”* (Interviewee H).

The product offered by Company X is very distinctive, and it does not need any additional payment for specific claims. In contrast to other insurers, in which a set excess is required, selecting a flexible excess as an alternative is possible. When a more considerable excess is chosen, the premium for the policy is reduced by a significant amount. The respondents have selected a more considerable excess to take advantage of the advantages associated with a lower premium. A claim will increase the burden for these customers if filed. At this point, the issue of cost is both respondents' primary worry. It is one of the most reasonably priced plans currently available and competes with other plans based on pricing. At the same time as it provides comprehensive pricing, the Classic Plan also provides improved advantages. These items are designed to cater to two distinct segments of the market. The Classic Plan emphasises the value and advantages it gives consumers more than the pricing it offers. Among the perks not included in the basic plan are free automobile rental for thirty days and a reimbursement of up to fifty per cent of the monthly gasoline spent.

Much like Company Y, Company Q delivers cashback to clients using a rating system based on five stars. On the other hand, companies Q use a cutting-edge tracking device that produces a Driver Quotient specific to each driver. The most current advancement in telematics technology for motor vehicles is called DQ-Track. The monitoring device that is provided to customers by Company Y is not free of charge. Before moving to Company Q, respondents were required to pay an extra R99 per month to monitor their automotive accounts: *“This technology collects information about driving behaviour. Data relating to acceleration, braking, speed, distance driven, and cellphone use is collected and analysed. This behaviour is then analysed to reward good driving behaviour. Driving skill is ranked in one of five levels, from Bronze to Diamond status. The telematics system assigns Vitality Drive points to each driver. These points range from 0 to 1600. Cashback on fuel expenses is capped at R800. The cashback is calculated as follows: 50% of the lower (Vitality Drive points or Actual Rand value spent on fuel for the month). Drivers with lower Vitality Drive points are given lower discounts. The amount of cashback customers receive can be up to 25% on the Essential Plan and up to 50% on the Classic plan.”* (Interviewee H)

All customers who participated in the interviews felt that their present insurance was reliable. Some clients thought businesses' treatment of their claims during the shutdown was unacceptable. *"I understand that it was beyond the company's control because of staff shortages, but I would prefer a faster claims process if such a crisis were to occur in the future."* (Interviewee K). The customers choose their insurance based on their distinct needs and preferences. These customers are classified into several market segments, each with specific and individual needs that must be met. To obtain a competitive advantage, short-term insurers must develop strategies to efficiently meet the varied needs of a broad client base.

#### 4.5 Effectiveness of Marketing Strategies

The effectiveness of marketing strategies may be evaluated using the 4 Ps of Marketing. The strategy will be classified into one of the following four groups. These tactics must align with the four Cs to achieve optimal outcomes and ensure customer satisfaction:

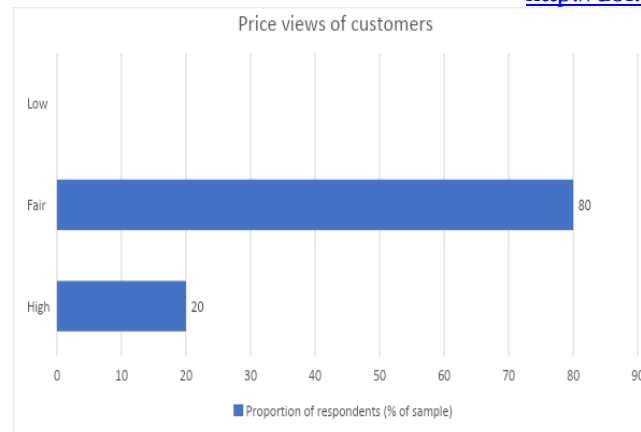
- Product - Customer solution
- Price - Customer cost
- Place - Convenience
- Promotion - Communication

*Each of these eight companies offers similar intangible products/services but has differentiated their products from the competition using different characteristics and packaging.* (Interviewee A). These organisations use product differentiation techniques, including various branding tactics. The branding initiatives included various colour combinations, names, and logos to establish distinctiveness from comparable services provided by other insurers. Each of these organisations offers diverse services tailored to specific consumer categories. Each of these products exhibits variations in terms of the risks provided and the structures of excess. All insurance providers provide aftersales support services. *"1<sup>st</sup> for Women offers free telephone support for tax, financial, and legal issues that women may experience"* (Interviewee G). The insurers, as mentioned above, do not provide these distinctive qualities.

Similarly, it is noteworthy that Companies Y and Q provide cashback incentives that are only sometimes offered by the majority of other firms examined in this research. Each of these tactics has effectively contributed to the differentiation of the product from its competitors. Companies use a wide range of advantages. These strategies aim to provide a distinctive value proposition to their clientele and establish a competitive edge. This brings us back to the overarching objective of these marketing tactics, which is to acquire a competitive edge.

The majority of these organisations, namely 6 out of 8 (75%), have implemented methods that have shown to be successful in delivering sufficient value and quality service, resulting in client retention over an extended period. These clients are unlikely to be receptive to changing their insurance provider. These goods have effectively addressed consumer needs and met the demands of their intended market segment. *"The pricing strategies recover all costs and are used as a service differentiation tool. All these strategies were formulated to generate a good return and to have sufficient reserves and premium income to pay claims."* (Interviewee H). The ongoing COVID-19 epidemic poses a significant challenge for all firms in developing strategic approaches. An excessive number of claims and insufficient earnings may give rise to several difficulties. Most of the surveyed firms, namely 75%, believed that their goods are priced at a reasonable level.

Conversely, a minority of the companies, comprising 25% of the sample, indicated that the current pricing is deemed too low and suggested an increase to cover expenditures adequately. Additionally, it is evident that most organisations, namely 75%, see reduced costs as a viable and impactful approach to marketing. Thus, one of the participants believed that *"a price increase would not be feasible right now as customers are finding it increasingly difficult to survive in this economy."* (Interviewee H). Figure 3 shows the participants' price views of the different products offered by the insurance companies".

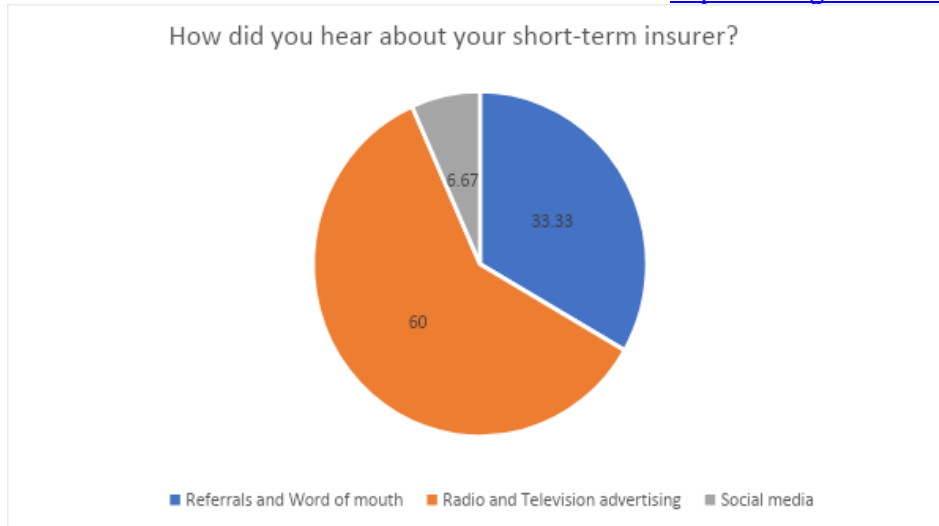


**Figure 3.** Price views of customers

Source: Authors' Construct

According to industry data collected from insurers, almost 50% of individuals possessing insurance policies saw salary reductions due to the COVID-19 pandemic commencing in March 2020. Some individuals had a period of unpaid absence lasting many months, while others faced complete job loss within the client base. Consequently, there was a decrease in income, although fixed financial obligations such as rent, mortgage payments, and insurance premiums remained constant. All these organisations are concerned about customers' potential cancellation of policies if the cost becomes too high. Policies may also terminate in the event of missing premium payments. Corporations have offered reduced premiums to their clients during the lockdown period to address this issue. The efficacy of these pricing tactics is shown by the absence of policy lapses resulting from unpaid premiums and client cancellations. According to the data shown in Figure 1, a majority of the consumers questioned, namely 12 out of 15 individuals, expressed the belief that the premiums charged are reasonable and within their financial means, accounting for 80% of the sample. 3 out of 15 consumers, accounting for 20% of the sample, believe their insurance rates are too elevated. The three consumers mentioned above had issues with their insurance before implementing the lockout measures. Therefore, it is not justifiable to attribute the inefficiencies in some of these organisations only to the lockdown.

The three dissatisfied consumers are open to exploring other insurance providers. All eight firms used a variety of promotional methods. This practice guarantees that the firms effectively convey the desired message to consumers. Advertising is the primary promotional tactic these firms use to generate client awareness. The approach mentioned above was used by most organisations, namely six out of eight, constituting a percentage of 75%, to entice clients. 33.3% (5 out of 15) of the clients in the list chose their purchase by relying on recommendations and word of mouth. The participants in this study consisted of individuals who were customers of Old Mutual and Santam goods. The influence of advertising on their purchasing decisions was shown to be negligible. A majority of 66.6% of individuals were found to be affected by advertising and/or social media while making their purchasing choices. This is seen in Figure 4, which was presented after that. This advertising method is used to effectively convey the inherent worth of the product to the target buyers. The distribution strategy should prioritise these items' timely and convenient availability to clients, as remarked by one of the participants who said, *"Unlike life insurance, which requires face-to-face meetings with customers due to the nature of the services and signatures required, short-term insurance products are not affected by outlet locations or office opening/closing times."* (Interviewee D)



**Figure 4.** Customer information regarding short-term insurer  
*Source:* Authors' construct

This feature offers a high level of convenience for consumers across various geographical regions nationwide, enabling them to initiate their policy applications by telephone quickly. This practice guarantees that the items are made available at a location that is also handy for clients. These products are classified as short-term insurance products and may be marketed and sold telephonically. 67% of the enterprises used digital distribution channels. 33% of clients purchased insurance policies via their respective insurance brokers. The four Ps of marketing applicable to these organisations have now been associated with the four Cs of consumers. A total of 15 consumers were surveyed, of whom five individuals, representing 33.3% of the sample, reported encountering issues with customer service and the claims procedure. This is seen in Figure 4, which was presented after that. The potential for clients to move to another insurer will be considered if they are presented with a more favourable proposition. Customers were duly informed that the abovementioned grievances pertain to a widespread situation that impacts the whole sector rather than being confined to a single entity.

Consequently, any organisation would have experienced comparable challenges throughout enforced confinement. The situation was met with understanding from customers. During the lockdown time, 40% of consumers complained that they had not encountered any issues with the claims procedure. The clients exhibit a high level of understanding and are willing to overlook little inconveniences. However, most consumers, namely 60%, had comparable issues for an extended duration before the lockdown. In 2019, customers expressed dissatisfaction with the suboptimal handling of their claims. They reported difficulties in accessing customer care hotlines of some well-established insurers due to excessive call volumes and unavailability. The respondents from Company Q and 1st for women observed that *“although there has been a minor issue and delays with a claim before the lockdown, I am willing to overlook it for the time being. I am just unhappy about how long it takes to get the claim approved and paid out.”* (Interviewee H)

In this study, an in-depth exploration of the short-term insurance landscape has been undertaken, encompassing the demographic profile of respondents, the diverse marketing strategies employed by insurance companies, and the overall effectiveness of these strategies in the face of the COVID-19 pandemic. Notably, the study unveils the significance of pricing strategies, relief measures, and incentives, shedding light on their impact on customer satisfaction and loyalty. Despite challenges in the claims process and customer service, companies' resilience and adaptability during the pandemic are evident, reflected in the low incidence of policy lapses. This study emphasises the alignment of effective marketing strategies with the 4 Ps of Marketing principles. It concludes by acknowledging areas for improvement, particularly in enhancing customer service and claims processing capabilities during crises.

## Conclusions

This research aimed to demystify the effectiveness of marketing techniques as a tool for gaining a competitive advantage. Marketing tactics are critical in establishing and maintaining a competitive edge. Companies with effective marketing strategies have better levels of customer satisfaction. Because customers are the lifeblood of a company, achieving customer satisfaction over the competition will ultimately lead to a competitive advantage.

However, each company's strengths and limitations must be assessed before applying any marketing technique. Some techniques may be effective in keeping one firm afloat while sinking another. This is one of the reasons why some managers are under pressure and need help figuring out where to go next. They understand that making the incorrect judgment under volatile, unexpected situations might spell doom for themselves and their staff.

Furthermore, the Covid-19 problem has made the market volatile and unpredictable for businesses. This is true for all sectors, not just short-term insurance. It has wreaked unending havoc and devastation on the economy and countless enterprises. To survive and thrive, new solutions and thinking methods will be required.

Conventional remedies will no longer work and have already resulted in the irreversible closure of several firms. These solutions cannot be implemented via a one-size-fits-all approach. It must be carefully adjusted to each company, employing management discretion and judgment. Companies and executives must welcome diversity, innovation, and change. This is now absent in certain short-term insurance companies that use antiquated technology and business procedures. The present grave scenario necessitates it, and businesses must either adapt to this new environment or die.

While this research provided valuable insights into the demystification of marketing effectiveness for gaining a competitive advantage, it is essential to acknowledge its limitations. One limitation stemmed from the specific focus on the short-term insurance industry, which may have limited the generalizability of findings to other offerings. Additionally, the study operated within the context of the COVID-19 pandemic, introducing a temporal constraint that influenced the long-term applicability of the identified marketing strategies.

The reliance on qualitative interviews, while providing in-depth perspectives, introduced subjectivity and limited the quantitative validation of the findings. The research was also constrained by the availability and willingness of participants, potentially affecting the diversity and representativeness of the sample.

For future research, it is recommended that broader industry analyses be conducted to validate the identified marketing strategies across diverse sectors. A longitudinal study could also provide insights into the sustained effectiveness of marketing tactics over time, considering the evolving nature of business environments. A mixed-methods approach could enhance the comprehensiveness of research findings by triangulating qualitative insights with quantitative data. In addition, exploring the impact of emerging technologies on marketing effectiveness and considering cross-cultural variations could further enrich the understanding of this dynamic field.

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