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From the Editorial Committee

We are giving you the next Vol. 30, No. 4(2025) issue of the scientific journal of the Faculty of Management of the Rzeszów University of Technology entitled “Modern Management Review”.

The primary objective of the journal is to promote publishing of the results of scientific research within economic and social issues in economics, law, finance, management, marketing, logistics, as well as politics, corporate history and social sciences.

Our aim is also to raise the merits and the international position of the journal published by our Faculty. That is why we provided foreign Advisory Board, as well as an international team of Reviewers to increase the value of the scientific publications.

The works placed in this issue include many assumptions and decisions, theoretical solutions as well as research results, analyses, comparisons and reflections of the Authors.

We would like to thank all those who contributed to the issue of the journal and we hope that you will enjoy reading this issue.

With compliments
Editorial Committee

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THE MEDIATING ROLE OF ORGANIZATIONAL AGILITY ON THE RELATIONSHIP BETWEEN PLANNING OF MARKETING POLICIES AND MARKETING PERFORMANCE: FIELD STUDY OF A SAMPLE OF FOOD INDUSTRY COMPANIES IN ALGERIA

The current study aimed to reveal the impact of the marketing policy planning process on the marketing performance of food industry companies in Algeria, given the presence of organizational flexibility as an intervening variable. To achieve the objectives of this study, an online survey was designed to collect primary information from the study sample. In light of this, data were collected, analyzed, and hypotheses were tested using the Statistical Package for the Social Sciences (SPSS) and path analysis using the Amos program. The study sample consisted of (373) units. Results showed a statistically significant relationship between marketing policy planning and marketing performance. The results also indicated the impact of organizational flexibility dimensions on the relationship between marketing policies planning process and marketing performance. In addition, the study presented a set of recommendations, most notably: the need to support and assist senior management. Senior management must commit to planning as a business philosophy and best practices, and middle management must see, witness, and sense this commitment.

Keywords: organizational agility, planning, marketing policies, marketing performance, food industries.

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1. INTRODUCTION

Marketing policy planning has garnered significant attention among researchers in management sciences, as it is a key determinant of a company's success or failure. This is especially true given the ongoing transformations in the global economy, characterized by trends such as globalization, the liberalization of international trade, and a surge in mergers across various business sectors. One of the most notable recent developments is the subprime mortgage crisis and its impact on corporate performance. As part of the global economic system, the Algerian economy has not been immune to the effects of these changes.

In response to these global shifts, it has become essential for Algerian companies to strengthen their performance across all areas of operation. Since marketing is inherently integrated with other business functions, companies must prioritize marketing in order to survive and continue generating economic value. This value stems from designing and marketing goods, services, and ideas that meet the evolving needs and desires of consumers. Nevertheless, the significance of marketing in ensuring corporate success has only been acknowledged relatively recently.

Given that the success of businesses that rely on organizational agility lies in their ability to align with the planning processes of various marketing policies, this requires them to place greater importance on marketing performance, which is reflected in the achievement of their objectives and gives them the ability to adapt and be organizationally agile quickly to changes in internal and external environmental factors (Croteau and Raymond, 2004).

- A study by Sangari and Razmi (2015) confirmed that the marketing policy planning process has an impact on organizational agility. Another study by Chakravarty et al. (2013) also demonstrated that marketing policies influence the formation of organizational agility and the marketing performance of an organization. Meanwhile, a study by Olszak and Zurada (2015) indicated that marketing policy planning processes significantly contribute to and influence the development and success of business organizations' marketing performance.
- Given the critical role of the food industry in Algeria – both in advancing national self-sufficiency and adapting to the transition toward a global knowledge economy – it is imperative for these companies to adopt effective marketing policies to enhance their performance. These policies must be responsive to evolving market conditions and embedded within strategic business planning, as these changes directly impact organizational success.
- Accordingly, this study aims to explore the mediating role of organizational agility in the relationship between marketing policy planning and marketing performance in Algerian food industry companies.

1.1. Study problem

Algerian food industry market is witnessing intense competition among companies marketing this type of product, with each company seeking to increase or maintain its market share. Others are seeking a foothold within this market. Marketing policy planning – comprising product policy, pricing policy, marketing communications policy, distribution policy, marketing research policy, and market segmentation policy – is the tool directed toward increasing the effectiveness of marketing performance in terms of profitability, market share, productivity, and consumer satisfaction.

The industrial sector in Algeria is largely dependent on food industries, given that food products are the most widespread and diverse in terms of the companies that produce them. They are often simple to manufacture, and their production costs are relatively low compared to other industries This increased demand for their production. These companies emerged under the protection of the Algerian state and within a monopoly market that later became an oligopoly. As the state's policy evolved towards market liberalization, the supply of food products to the market became the responsibility of private operators While the state was entrusted with regulating the market within the framework of the principle of free pricing for goods and services, as well as monitoring commercial practices and ensuring that products offered for consumption conform to legal specifications, all of this has led to a recent increase in the flow of consumer goods into the Algerian market, in various types, from different sources, and often at competitive prices.

Therefore, achieving the desired marketing objectives requires marketers to plan effective marketing policies to maintain a good relationship with the target consumer. This is achieved by adopting organizational agility in terms of (consumer agility, process agility, individual agility, and partner agility).

To highlight the significance of this study, we seek to answer the central research question: **Is the marketing policy planning process in Algerian food industry companies grounded in principles that aim to enhance marketing performance through the adoption of organizational agility strategies?**

To explore this overarching question and derive logical, evidence-based conclusions, the following sub-questions are asked:

- To what extent does the marketing policy planning process influence the marketing performance of Algerian food industry companies?
- How does marketing policy planning affect their level of organizational agility?
- What is the impact of organizational agility on their marketing performance?
- To what extent does organizational agility serve as a mediating variable in strengthening the effect of marketing policy planning on marketing performance?

1.2. Background and importance of the study

The background of any study is the main part of any scientific research. It explains to the reader the context and significance of the research study. It aims to provide a comprehensive understanding of the topic, provide an overview of previous related research, and identify knowledge gaps that the research seeks to fill. Moreover, the background helps highlight the importance of the current research and justify the need for it.

1.2.1. Study objectives

This study mainly aims to shed light on the mediating role of organizational agility in the relationship between marketing policy planning and marketing performance of Algerian agri-food companies. The specific objectives are as follows:

- To determine the direct impact of marketing policy planning determinants on the marketing performance of the companies studied. Test the impact of organizational agility determinants on the marketing performance of the companies under study.
- Test the impact of marketing policy planning determinants on organizational agility of the companies under study.
- Measure and analyze the impact of marketing policies on marketing performance in the presence of organizational agility as an intervening variable.

- Providing a set of recommendations and proposals that help decision-makers in food industry companies in Algeria activate the role of the marketing policy planning process in order to enhance their marketing performance based on organizational agility.

1.2.2. Importance of the study

The importance of the current study stems from its focus on an essential element that significantly impacts business organizations: organizational agility. This concept represents an administrative activity carried out by senior management within the organization as a form of creative output. Providing appropriate support for this activity – considering its specific characteristics – enables the organization to achieve a competitive advantage. It also highlights the importance of managers working in Algerian companies to possess the ability to respond quickly to change, which represents the prominent feature of the current era in which the organization operates.

In terms of the academic importance of the study, it is evident in its opening new avenues for researchers to view the results produced and reached by this study, adding them to the body of knowledge. It is also one of the important studies that can be referred to and benefit from, especially in the field of application. It also benefits and assists future studies related to this topic, providing the data, information, and studies they will need. Therefore, this study derives its importance from the following scientific and applied considerations:

- The importance of the research sector: The study focuses on food industry companies in Algeria. The study variables were measured among marketing managers within the same companies, in order to test the study's hypotheses and demonstrate the impact of marketing policy planning practices on improving marketing performance through organizational agility. This will enable greater focus and exploitation of these practices by food industry companies in Algeria.
- The importance of the research topic: This study will provide an overview of the variables (organizational agility, marketing policies, and marketing performance) and their interrelationships. The study variables and results can be generalized to cover many food industry companies in Algeria.
- Results: The results of this study will inform Algerian companies about how to deal with the nature of the activities involved in the marketing policy planning process and how to properly handle them, which can lead to successful and sustainable marketing performance.

1.3. Study questions and hypotheses

To underscore the importance of our current research, this study attempts to answer the following question: Is the marketing policy planning process in Algerian food industry companies based on principles that ensure organizational agility that improves their marketing performance? Based on the study's problem, its main question, and its specific objectives, the following sub-questions were formulated:

- To what extent does the marketing policy planning process (product policy, pricing policy, marketing communications policy, distribution policy, marketing research policy, and market segmentation policy) affect marketing performance (profitability, market share, productivity, and consumer satisfaction) for food industry companies in Algeria?
- To what extent does the marketing policy planning process (product policy, pricing policy, marketing communications policy, distribution policy, marketing research

policy, and market segmentation policy) affect organizational agility (consumer agility, process agility, individual agility, and partner agility) for food industry companies in Algeria?

- To what extent does the organizational agility process (consumer agility, process agility, individual agility, and partner agility) affect marketing performance (profitability, market share, productivity, and consumer satisfaction) for food industry companies in Algeria?
- To what extent is the organizational agility process for food industry companies in Algeria considered an intervening variable in enhancing the impact of the marketing policy planning process on marketing performance.
- Accordingly, based on the study's questions and model, the following main hypotheses were formulated, which will be tested and from which conclusions and recommendations will be drawn, as follows:
- The first main hypothesis: "There is no statistically significant effect of the marketing policy planning process on the marketing performance of food industry companies in Algeria at a significance level of ($\alpha \leq 0.05$)".
- The second main hypothesis: "There is no statistically significant effect of the marketing policy planning process on organizational agility of food industry companies in Algeria at a significance level of ($\alpha \leq 0.05$)".
- The third main hypothesis: "There is no statistically significant effect of organizational agility on the marketing performance of food industry companies in Algeria at a significance level of ($\alpha \leq 0.05$)".
- The fourth main hypothesis: "There is no statistically significant effect of the marketing policy planning process on the marketing performance of food industry companies in Algeria in the presence of organizational agility as an intervening variable at a significance level of ($\alpha \leq 0.05$)".

1.4. Study model

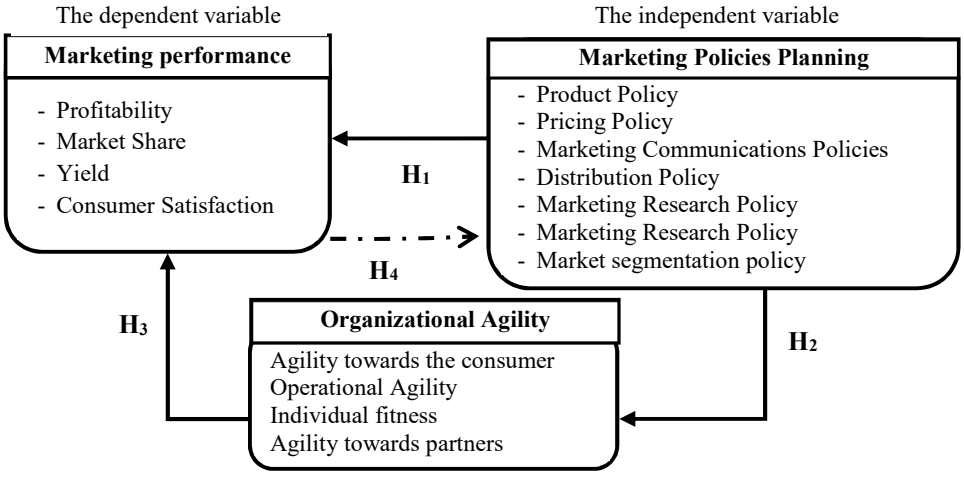

Figure 1. Study Model

Source: Generated by the researchers.

1.5. Limitations of the study

- ing levels (general manager, director, and head of department/service/department).
- Time Limits: This study was conducted from September 2024 to March 2025.
- Spatial Limits: This study included a sample of food industry companies operating within the Algerian national territory.
- Scientific Limits: The current study focused on identifying the dimensions of organizational agility through (consumer agility, operational agility, individual agility, and partner agility). Regarding the dimensions of the marketing policy planning process, we relied on (product policy, pricing policy, marketing communications policy, distribution policy, marketing research policy, and market segmentation policy). Marketing performance was measured according to the following dimensions (profitability, market share, productivity, and consumer satisfaction).

2. THE THEORETICAL FRAMEWORK OF THE STUDY

2.1. Literature review

Many theoretical and empirical studies have addressed the subject of this research, collectively contributing to the identification of a research gap that this study seeks to address. Given the limitations of space, a comprehensive review cannot be provided here; however, selected studies will be referenced as supporting evidence, as follows:

Study of (Bahrami, Kiani, Montazeralfaraj, Zadeh, Zadeh, 2016), Titled "The Mediating Role of Organizational Learning in the Relationship of organizational Intelligence And organizational Agility". Organizational learning is defined as creating, absorbing, retaining, transferring, and applying of knowledge within an organization. This article aims to examine the mediating role of organizational learning in the relationship of organizational intelligence and organizational agility. The findings of this study suggest that the improvement of organizational learning abilities can affect an organization's agility which is crucial for its survival. And (Yao-Ping Peng, Ku-Ho Lin, Peng, Chen, 2019) touched upon it "inking Organizational Ambidexterity and Performance: The Drivers of Sustainability in High-Tech Firms". Importantly, transformed high-tech firms are obliged to manage the tensions and conflicts that arise from the exploration of new knowledge and the exploitation of existing knowledge to find an appropriate balance between the two to yield synergistic effects. In this study, an original method was used to measure differences in the degree of ambidexterity. The results indicate that exploitation has a positive effect on performance, and there is an inverse U-shaped correlation between exploration/exploitation and performance however (Hadrian, Milichovský, Mráček, 2021) study came about "The Concept of Strategic Control in Marketing Management in Connection to Measuring Marketing Performance". The main objective of the study was to define key factors in individual areas that are connected to business activities and show their interconnection. And the obtained results of this study show that companies primarily use financial indicators to monitor and check their activities in the marketing area. The usage of financial indicators in connection to the marketing area is based mainly on the traditional approach of companies in the measuring process. And Study of (Vrontis et al., 2021) Titled "Strategic agility, openness and performance: a mixed method comparative analysis of firms operating in developed and emerging markets". This research finds that strategic agility is vital for firms' performance in both developed and developing markets.

Moreover, through the study it was found that while search depth amplifies the above relationship in both contexts, search breadth does it only in the context of foreign firms operating in emerging markets. The value of these findings stems from their elucidation of the role of strategic agility in emerging markets and its comparison to that of firms operating in developed countries; their insights into strategic agility's relationship with openness; their schematic culmination into a systemically and contextually depicted framework; and their prescriptive managerial implications. While (Ludviga, Kalvina, 2023), study about "Organizational Agility During Crisis: Do Employees' Perceptions of Public Sector Organizations' Strategic Agility Foster Employees' Work Engagement and Well-being?". The purpose of this paper is to examine the mediating role of a public sector organization's perceived strategic agility in relation to employee outcomes in times of crisis. They conclude that if employees are supported by leaders who sense change, make timely decisions, and act in an agile way, they will experience higher work engagement during a crisis, thus positively contributing to their well-being and organizational performance.

2.2. Key terms and concepts

- Organizational agility: It is the organization's ability to anticipate and exploit available opportunities in the surrounding environment in a proactive manner, which will help the organization adjust its position and strategies and use modern work methods to gain a competitive advantage over others (Dikici, 2024).
- Agility towards consumers: The ability of food industry companies in Algeria to sense and respond quickly to customer requirements and desires with the aim of innovation and taking proactive approaches to meet their needs and implement their suggestions (Huang et al., 2021).
- Operational Agility: The ability of food industry companies in Algeria to redesign their operations and develop and organize new work methods to provide services at a low cost and high speed, achieving excellence and creativity (Tallon, Pinsonneault, 2011).
- Individual agility: The ability of food industry companies in Algeria to develop the element of surprise, manage employee knowledge, and add capabilities to deal with changes in a turbulent market (Sherehiy, 2008).
- Agility towards partners: The ability of food industry companies in Algeria to respond quickly to business requirements with their strategic partners, and the ability to choose appropriate partners and work with them cooperatively (Park, 2011).
- Marketing Policy Planning Processes: Marketing planning refers to "the process of setting a set of achievable objectives based on the impact of various factors on the project" (Huang et al., 2021). In light of this definition, marketing planning means directing a company toward the products it will offer to its target markets in order to achieve its objectives. Policies, on the other hand, refer to a set of directives, rules, and principles that planners and implementers adhere to and are guided by at every stage of the process.
- Product Policies: McCarthy & Perreault (2000) defined a product as "a source of satisfaction of consumer needs and desires, a source of profit sought by both the company and the distributor, and extending beyond that to all dimensions that can achieve the benefits sought by the consumer". And Kotler (2000) defined it as "anything presented to the market for attention, possession, use, or consumption,

where it works to satisfy a need or desire". From the above, we find that a product may be a good, service, or idea presented in the market in a manner that attracts the attention of the consumer, who purchases or consumes it to satisfy a need. From a marketing perspective, it can be said that it is a set of benefits based on real and assumed characteristics of the consumer.

- Pricing Policy: Pricing policy and related decisions are among the most sensitive marketing policies for management, as they significantly impact a company's ability to achieve its marketing objectives (Dikici, 2024). Pricing policy is also considered "the information hub that allows consumers to infer quality, position a product, or form a brand image. Pricing policy also concerns decisions related to setting the prices of a company's products" (Huang et al., 2021). In its broadest sense, it represents all direct and indirect means influencing the price structure and its components, including the cost structure, margins, fees, and taxes that can influence the level and forces of the market.
- Marketing Communications Policies: Kotler & Keller (2009) view marketing communications as "an activity within the marketing effort that involves a persuasive communication process". Although this definition is considered a succinct one, Kotler acknowledged the great difficulty of defining marketing communications. Price, quality, and branding all constitute promotional content that can be used to entice purchasing behavior. In a comprehensive definition, (Darymple, Parsons, 2000) stated that it is "all forms of communication between a company and its audience that involve mutual understanding to achieve an appropriate purchase and build long-term trust in the company or its products". Marketing communications therefore organizes the communication process with target audiences through available means to create a response to the company's products. The consumer may express this response by making a purchase or requesting additional information.
- Distribution Policies: Kotler defined it as "the set of activities that take place from the time a commodity enters its usable form at the commercial warehouse or final converter until the time it is received by the consumer" (Kotler, 2000). From this definition, we find that many companies that are critical to the performance of distribution activity have been left out of the picture. It has been overlooked that when marketing some commodities, they must be transported by rail, ships, cars, etc. to warehouses, as these are also included in the distribution process.
- Marketing Research: The American Marketing Association defines it as "the process of collecting and analyzing data to assist company management in making decisions related to product, price, promotion, distribution, and other areas" (McCarthy, Perreault, 2000). This definition may be incomplete, as it explains the tool underlying marketing research, but it does not mention the purpose of conducting this research. Therefore, we can add that the purpose of marketing research is to increase a company's productivity, enabling it to satisfy the needs and desires of its consumers with minimal effort and at the lowest cost.
- Market Segmentation: Before delving into the definition of market segmentation, we must define the market. The American Marketing Association defines it as "the set of forces or conditions under which buyers and sellers make decisions that result in the transfer of goods and services" (Ambler, Kokkinaki, 2004). According to the American Marketing Association, market segmentation is defined as "the process of

dividing a market into distinct groups based on buyers or consumers who have distinct product or marketing mix needs" (Park, 2011). This definition demonstrates that the segmentation process is based on two elements: consumer characteristics and an appropriate marketing mix.

- Marketing performance: Marketing performance can be defined as the relationship between marketing activities and an organization's business performance (Clark, 1999). Marketing performance, in its simplest form, is "the degree of an organization's success in the marketplace, achieved through marketing activities" (Ambler, Kokkinaki, 2004). In other words, marketing performance is part of the company's performance measurement process, which includes generating a framework of metrics to monitor performance and developing and using methods by which marketing management can verify the extent to which marketing objectives are being achieved, take the necessary actions to improve performance, or modify objectives if actual performance differs from plan.
- Profitability: It represents the net results of a large number of policies and decisions and measures the efficiency and effectiveness of a company's management in generating profits through the efficient use of its assets (Kotler, Keller, 2009). Kotler (2000) referred to profitability in this regard, explaining that the purpose of adopting the modern marketing concept is to help the company achieve its goals in light of the surrounding circumstances. Undoubtedly, the most important goal a company aspires to is profit. The modern marketing philosophy believes that the best way to achieve profitability is to satisfy and meet consumers' needs better than competitors. Furthermore, the modern concept of marketing is not limited to satisfying consumers at the expense of the company's interests or vice versa, but rather requires the company to strike a balance between the consumer and its own interests.
- Market share: "It is an important measure of good performance, by which successful and unsuccessful companies are distinguished in their activity" (Kotler, 2000). In another definition, it refers to "the total sales of a company out of the total sales of companies in that market" (Kaplan, Norton, 1996). From this, we conclude that market share expresses a company's ability and efficiency to control the market in which it operates and at the expense of competitors, as the number of units sold determines competitiveness. Market share, especially with regard to targeted market segments, reveals the extent of the company's skill in penetrating the desired market. For example, a company may experience temporary success in growing sales by retaining customers in non-targeted segments, but without increasing its share in the targeted segments. In this case, the market share measure with targeted customers will monitor a financial indicator (sales) to indicate whether the prepared marketing policy is achieving the expected results.
- Productivity: is an indicator that measures outputs, whether products or services, in relation to inputs, whether workers, materials, energy, or other resources (Srevenson, 2007). We conclude from this that productivity represents the ratio of outputs to inputs.
- Consumer satisfaction: is the feeling that suggests to the consumer pleasure or displeasure (a positive or negative impression perceived by the consumer) that results when comparing the observed performance of the product with the consumer's expectations (Kotler, Keller, 2009).

3. DATA COLLECTION AND ANALYSIS PROCEDURES

3.1. Data analysis

This study will apply partial least squares structural equation modeling (PLS-SEM) to test the hypotheses with SmartPLS 3 (Hair et al., 2019). The Two-step PLS approach will be conducted consists of estimation of the measurement model and examination of the structural model. The final fitting indexes (SRMR, duls, dg) of original data meet the standardized requirements (Dijkstra and Henseler, 2015). The convergent validity, discriminant validity, and reliability of the scale are calculated for testing the measurement model (Henseler et al., 2016).

3.1.1. Descriptive statistics

It is clear from Table 1 that the arithmetic means of all variables ranged between (3.09–4.56) and were relatively very high from the point of view of the sample members, while the values of standard deviations ranged between (0.49-1.06), which are relatively large values, indicating the dispersion of the sample members' answers. The table also shows that all values of skewness were less than one, and accordingly we consider the data to be normally distributed.

Table 1. Descriptive statistics for study variables

Main variables	Subvariables	Mean	S. D	Skewness	Kurtosis	Response
Marketing Policies Planning X	Product Policy (X_1)	4.56	0.56	-0.979	-0.360	V. High
	Pricing Policy (X_2)	4.28	0.49	0.584	-1.146	V. High
	Marketing Communications (X_3)	4.39	0.68	-0.525	-1.207	V. High
	Distribution Policy (X_4)	4.53	0.45	-0.856	-0.625	V. High
	Marketing Research (X_5)	3.09	0.61	-0.097	-0.788	High
	Market segmentation(X_6)	3.5	0.88	0.251	-1.010	High
Organizational Agility Z	Agility towards the consumer (Z_1)	3.97	1	-0.559	-1.126	High
	Operational Agility (Z_2)	4.27	0.59	-0.114	-1.081	V. High
	Individual fitness (Z_3)	4.3	0.62	-0.445	-0.655	V. High
	Agility towards partners (Z_4)	3.86	0.79	-0.370	-0.700	High
Marketing Performance Y	Profitability (Y_1)	3.67	1.06	-0.285	-1.339	High
	Market Share (Y_2)	3.47	1.02	-0.208	-1.292	High
	Yield (Y_3)	4.11	0.62	-0.008	-0.711	V. High
	Consumer Satisfaction (Y_4)	4.2	0.83	-0.438	-1.477	V. High

Source: Generated by the researchers using SPSS.

3.1.2. Correlation coefficient

Table 2 shows the Pearson correlation coefficient between the variables. The results showed that all correlations between all variables are positive and significant at a significance level of ($P<0.01$).

Table 2. Correlation coefficient

Variables	X_1	X_2	X_3	X_4	X_5	X_6	Y_1	Y_2	Y_3	Y_4	Z_1	Z_2	Z_3	Z_4
X_1	1													
X_2	.640**	1												
X_3	.926**	.686**	1											
X_4	.904**	.706**	.859**	1										
X_5	.840**	.889**	.844**	.912**	1									
X_6	.797**	.914**	.844**	.821**	.949**	1								
Y_1	.944**	.764**	.919**	.946**	.920**	.880**	1							
Y_2	.820**	.887**	.866**	.841**	.939**	.958**	.904**	1						
Y_3	.882**	.844**	.910**	.860**	.930**	.946**	.918**	.973**	1					
Y_4	.897**	.817**	.901**	.945**	.967**	.926**	.947**	.912**	.924**	1				
Z_1	.922**	.804**	.932**	.924**	.937**	.919**	.980**	.921**	.932**	.964**	1			
Z_2	.898**	.775**	.923**	.909**	.911**	.902**	.950**	.875**	.887**	.962**	.979**	1		
Z_3	.809**	.899**	.819**	.898**	.971**	.939**	.880**	.926**	.910**	.951**	.902**	.896**	1	
Z_4	.935**	.703**	.944**	.894**	.857**	.844**	.972**	.861**	.883**	.910**	.976**	.960**	.816**	1

Source: Generated by the researchers using SPSS.

3.1.3. Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) was used to evaluate the model after each analysis in order to know how the variables are related to the questionnaire questions using the following goodness of fit indexes: Chi-square ratio to degrees of freedom (X2/df), goodness of fit (GFI), comparative fit (CFI), root mean square error of approximation (RMSEA). The results in Table 1 show that the goodness of fit indexes of the three models (marketing policies, organizational agility, marketing performance) meet the acceptance rule.

Table 3. Goodness-of-fit indicators

Y	Z	X	Acceptable value for matching
X2/df =1.707	X2/df =1.693	X2/df =2.328	X2/df <3
GFI=0.943	GFI=0.944	GFI=0.951	GFI > 0.90
CFI=0.91	CFI=0.921	CFI=0.925	CFI > 0.90
TLI=0.938	TLI=0.914	TLI=0.903	TLI > 0.90
RMSEA=0.053	RMSEA=0.0621	RMSEA=0.06	RMSEA < 0.08

Source: Generated by the researchers using SPSS.

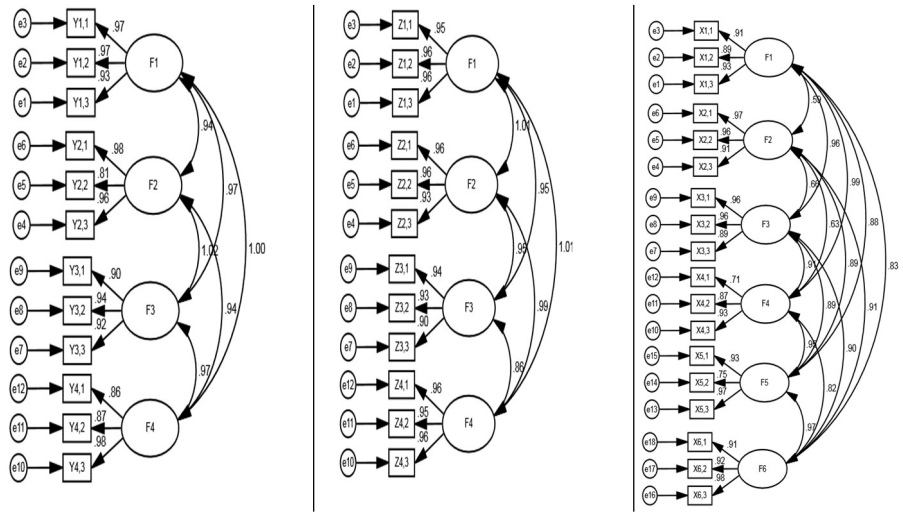

Figure 2. Path analysis goodness-of-fit indicators

Source: Generated by the researchers using SPSS.

3.2. Model validity and reliability

In research, reliability and validity are two crucial concepts used to assess the quality of a measurement or a study. Reliability refers to the consistency and stability of a measurement, while validity refers to the accuracy of a measurement. A reliable measure produces similar results under consistent conditions, while a valid measure accurately reflects the concept it is intended to measure.

3.2.1. Convergent validity

Convergent validity refers to the extent to which statements (measurement items) are consistent with each other. The following indicators were used to evaluate convergent validity: (1) Cronbach's alpha coefficient (a), where (Hair et al., 2010) indicates that the acceptable value (a) should be greater than 0.60. The results in Table 4 showed that all values of (a) are greater than 0.60, which means that the items measuring the variables are internally consistent. (2) Factor Loading, where (Hair et al., 2006) considered that the measurement items with a factor loading greater than 50 are acceptable, as the results in Table 4 show that the factor loading for all items is greater than 50 at a statistical

significance level ($p < 0.05$). (3) Composite Reliability (CR), where the results showed that the value of (CR) for all items ranges from 0.971 to 0.876, which is greater than the acceptable value of 50 proposed by (Hair et al., 2012). Accordingly, the composite reliability can be accepted for all items. Variables. (4) Average variance extracted (AVE) where (Hair et al., 2010) suggested that measurement items with an average variance extracted greater than 50 are considered acceptable as the results in Table 4 showed that the average variance extracted for all items is greater than 50.

Table 4. Convergent Validity Indices

Variable	Measurement items	Factor Loading	A	CR	AVE	P.V
X_1	X11	0.911	.919	0.936	0.829	0.000
	X12	0.892				0.000
	X13	0.929				0.000
X_2	X21	0.975	9.57	0.965	0.903	0.000
	X22	0.964				0.000
	X23	0.911				0.000
X_3	X31	0.958	9.36	0.955	0.877	0.000
	X32	0.963				0.000
	X33	0.886				0.000
X_4	X41	0.713	.812	0.876	0.705	0.000
	X42	0.865				0.000
X_5	X51	0.933	.903	0.918	0.79	0.000
	X52	0.75				0.000
	X53	0.968				0.000
X_6	X61	0.906	.951	0.955	0.876	0.000
	X62	0.916				0.000
	X63	0.983				0.000
Y_1	Y11	0.966	.956	0.968	0.91	0.000
	Y12	0.966				0.000
	Y13	0.929				0.000
Y_2	Y21	0.984	.927	0.943	0.848	0.000
	Y22	0.81				0.000
	Y23	0.959				0.000
Y_3	Y31	0.898	.914	0.944	0.849	0.000
	Y32	0.941				0.000
	Y33	0.924				0.000
Y_4	Y41	0.863	.919	0.932	0.82	0.000
	Y42	0.871				0.000
	Y43	0.978				0.000
Z_1	Z11	0.948	.967	0.969	0.913	0.000
	Z12	0.955				0.000
	Z13	0.963				0.000

Table 4 (cont.). Convergent Validity Indices

Variable	Measurement items	Factor Loading	A	CR	AVE	P.V
Z_2	Z21	0.964	.964	0.967	0.906	0.000
	Z22	0.959				0.000
	Z23	0.933				0.000
Z_3	Z31	0.935	.944	0.945	0.852	0.000
	Z32	0.933				0.000
	Z33	0.935				0.000
Z_4	Z41	0.963	.971	0.971	0.918	0.000
	Z42	0.954				0.000
	Z43	0.963				0.000

Source: Generated by the researchers using SPSS.

3.2.2. Discriminant validity

Table 5 indicates the extent of variation of the latent variables, and to verify that each latent variable is distinct from the other latent variables in the model. To measure discriminant validity, the method of (Fornell, Larcker, 1981) was used, which suggests that discriminant validity is supported if the square root of the AVE of the latent variable is greater than the correlation values between all latent variables. Table 5 shows that the square root of the AVE values for all latent variables is greater than the intercorrelations of each latent variable, and therefore discriminant validity can be accepted for all latent variables.

Table 5. Discriminant Validity

Z_4	Z_3	Z_2	Z_1	Y_4	Y_3	Y_2	Y_1	X_6	X_5	X_4	X_3	X_2	X_1	AVE	
													0.910	0.829	X_1
												0.950	0.823	0.903	X_2
											0.936	0.817	0.816	0.877	X_3
										0.840	0.866	0.827	0.785	0.705	X_4
									0.889	0.421	0.781	0.721	0.532	0.79	X_5
								0.936	0.723	0.305	0.801	0.608	0.621	0.876	X_6

Table 5 (cont.). Discriminant Validity

Z_4	Z_3	Z_2	Z_1	Y_4	Y_3	Y_2	Y_1	X_6	X_5	X_4	X_3	X_2	X_1	AVE	
							0.954	0.850	0.801	0.541	0.601	0.512	0.712	0.91	Y_1
						0.921	0.737	0.708	0.721	0.850	0.821	0.836	0.798	0.848	Y_2
					0.921	0.836	0.421	0.737	0.765	0.708	0.771	0.648	0.788	0.849	Y_3
				0.906	0.785	0.648	0.305	0.421	0.321	0.737	0.754	0.744	0.068	0.82	Y_4
			0.956	0.821	0.532	0.744	0.541	0.305	0.723	0.421	0.866	0.817	0.823	0.913	Z_1
		0.952	0.541	0.771	0.621	0.817	0.850	0.541	0.801	0.305	0.781	0.827	0.816	0.906	Z_2
	0.923	0.541	0.850	0.754	0.712	0.827	0.737	0.850	0.721	0.541	0.801	0.721	0.785	0.852	Z_3
0.958	0.708	0.850	0.708	0.866	0.798	0.721	0.421	0.850	0.765	0.850	0.601	0.608	0.532	0.918	Z_4

Note: The bolded values represent the square root of AVE

Source: Generated by the researchers using SPSS.

3.3. Hypothesis testing

After ensuring the validity and reliability of the measured model, the next step is to test the hypotheses of direct and indirect influence in the measured model. To test the hypotheses, structural equation modeling (SEM) was used.

3.3.1. First hypothesis is the direct impact of marketing policy planning on marketing performance

We conclude from Table 6 and Figure 3 that there is a statistically significant effect between marketing policy planning and marketing performance at a significance level (β=1.01, $p < 0.001$) and therefore the first hypothesis H1 was accepted. The results of the quality or goodness of fit indicators of the measured model were acceptable (X2/df= 2.018, GFI=0.901, TLI=0.936, CFI=0.922, RMSEA=0.042).

Table 6. Results of the first hypothesis test

Hypothesis	Hypothesis path	Beta Coefficient	P. Value	The result
H1	**Marketing Policy Planning ⟶ Marketing Performance**	**1.01**	**0.001**	**Acceptable**

Source: Generated by the researchers using SPSS.

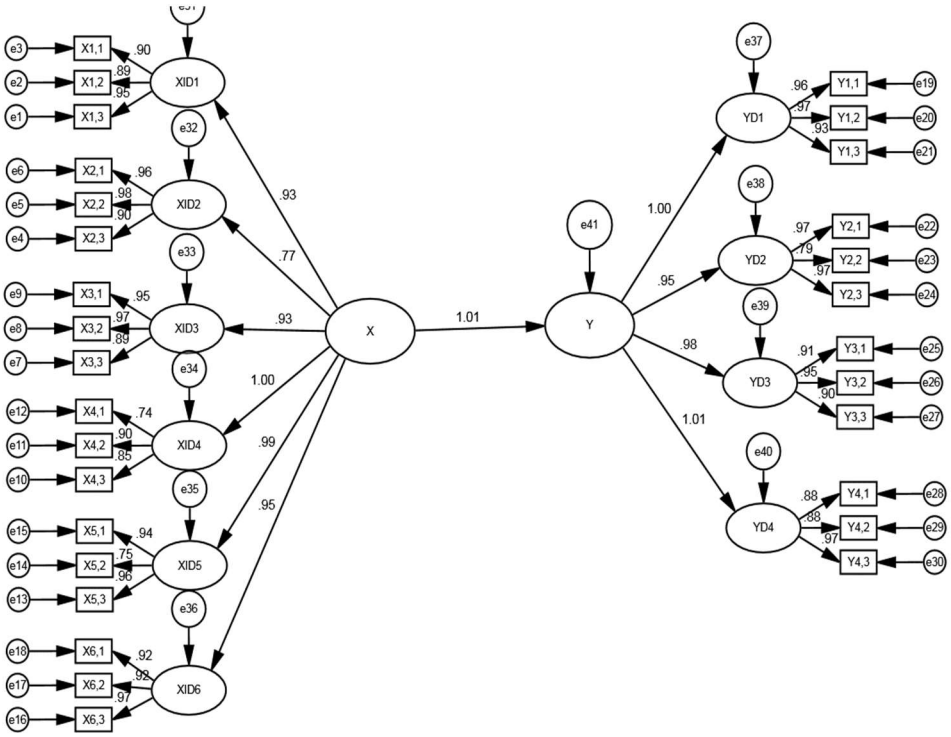

Figure 3. Model of the direct impact of marketing policy planning on marketing performance

Source: Generated by the researchers using SPSS.

3.3.2. Second hypothesis is the direct impact of marketing policy planning on organizational agility

The results in Table 7 and Figure 4 showed that marketing policy planning has a positive and significant impact on organizational agility at a significance level (β=.990, p <0.001), and thus the second hypothesis H2 was accepted. The results of the quality or goodness of fit indicators for the measured model were acceptable (X2/df=1.015, GFI=0.907, TLI=0.954, CFI=0.900, RMSEA=0.061).

Table 7. Results of the second hypothesis test

Hypothesis	Hypothesis path	Beta Coefficient	P. Value	The result
H_2	**Marketing Policy Planning ⟶ Organizational Agility**	**.990**	**0.001**	**Acceptable**

Source: Generated by the researchers using SPSS.

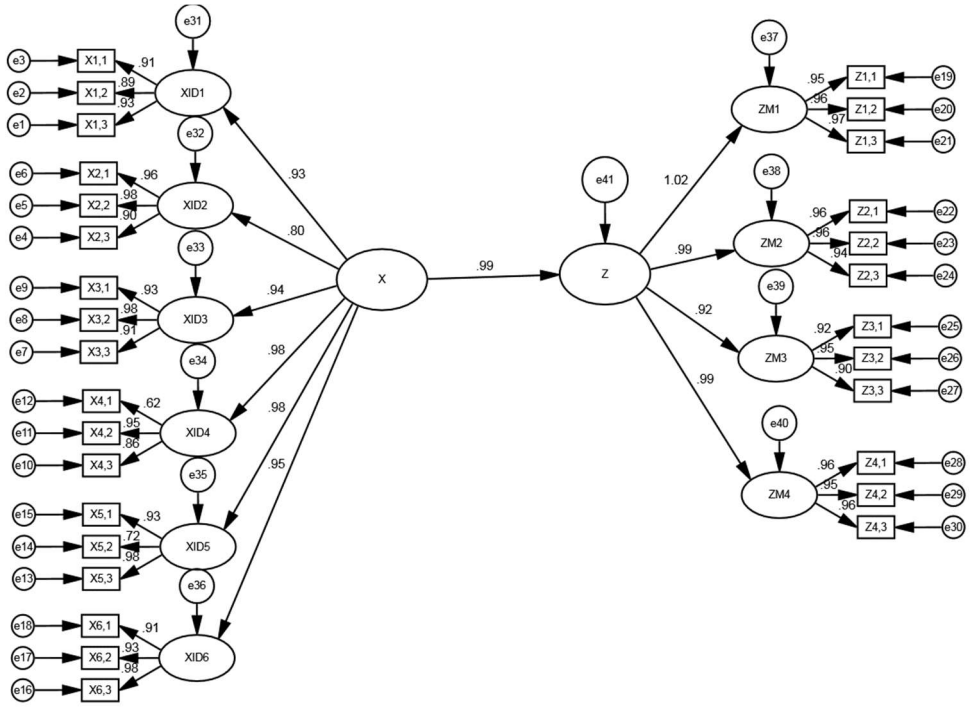

Figure 4. Results of the direct impact model

Source: Generated by the researchers using SPSS.

3.3.3. Third hypothesis: the direct effect of organizational agility on marketing performance

The results in Table 8 and Figure 5 showed that there is a statistically significant effect between organizational agility and marketing performance at a significance level (β=.980, p <0.001), and thus the third hypothesis H3 was accepted. The results of the quality or goodness of fit indicators for the measured model showed that they were acceptable (X2/df= 1.121, GFI=0.911, TLI=0.930, CFI=0.970, RMSEA=0.051).

Table 8. Results of the third hypothesis test

Hypothesis	Hypothesis path	Beta Coefficient	P. Value	The result
H3	**Organizational Agility ⟶ Marketing Performance**	**.980**	**0.001**	**Acceptable**

Source: Generated by the researchers using SPSS.

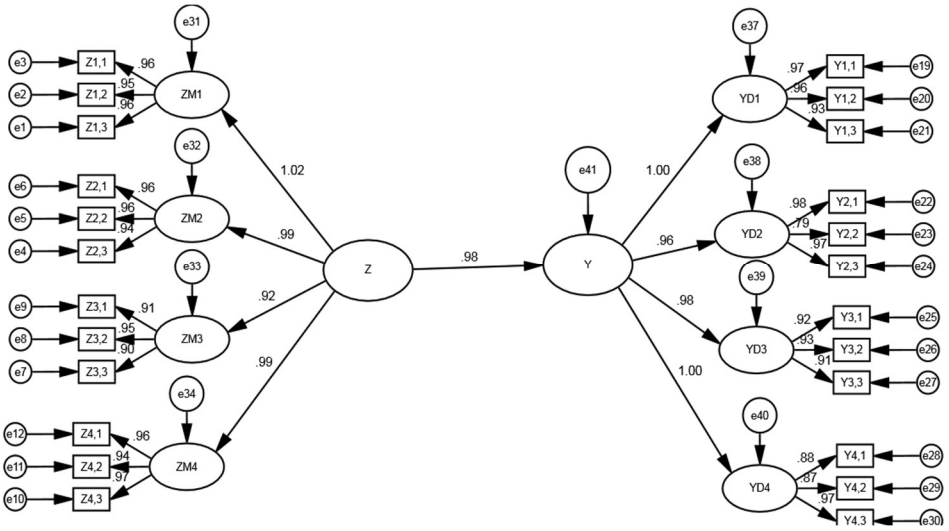

Figure 5. Results of the direct impact model of organizational agility on marketing performance

Source: Generated by the researchers using SPSS.

3.3.4. Fourth hypothesis: the indirect effect of marketing policy planning on marketing performance

The results shown in Table 9 and Figure 6 indicate that organizational agility positively and significantly mediates the relationship between marketing policy planning and marketing performance ($\beta = 0.616$, $p < 0.001$). Also, the bootstrap method was used to calculate the 95% confidence interval of the indirect effect. The results show that there is no zero between the lower and upper limits, which provides evidence to support the fourth hypothesis H4. The results of the goodness-of-fit indices of the measured model were acceptable (X2/df = 1.218, GFI = 0.925, TLI = 0.946, CFI = 0.942, RMSEA = 0.054).

Table 9. Results of testing the indirect effect hypotheses

Hypothesis	Hypothesis path	Beta Coef.	P. Value	95% LL	95% UL	The result
H4	**Marketing Policy Planning ⟶ Organizational Agility ⟶ Marketing Performance**	**.616**	**0.012**	**.522**	**.678**	**Acceptable**

Source: Generated by the researchers using SPSS.

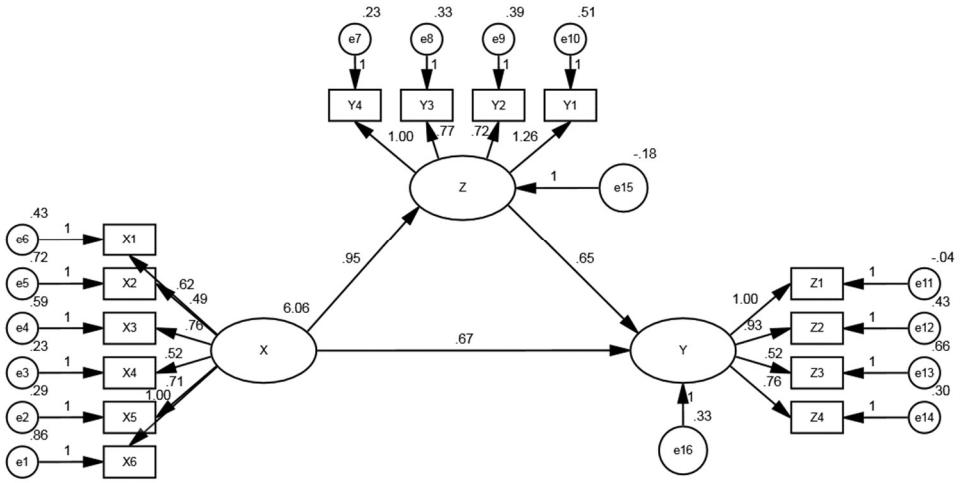

Figure 6. Results of the indirect impact model of marketing policy planning on marketing performance

Source: Generated by the researchers using SPSS.

4. CONCLUSIONS

Through our study, we reached several conclusions based on a cognitive and methodological context intertwined with the problem under study. The following are the most important findings from this study:

- The marketing planning process is closely linked to organizational agility studies, making it difficult for a marketer to design an effective marketing program that aligns with the desired marketing performance without a solid understanding of the latter.
- Marketing policies aim to achieve many objectives, which are summarized in the general or basic objectives of the company. It is worth noting here that marketing policies also contribute not only to identifying organizational agility or discovering new marketing opportunities, but also to identifying specific needs that can be translated into strong marketing performance.
- Organizational agility has received considerable attention not only among marketing researchers, but also among managers and businesspeople. On the one hand, it directly and significantly impacts the marketing policy planning process and marketing performance.
- There is a statistically significant impact of the elements of the marketing policy planning process on marketing performance in food industry companies in Algeria. There is a statistically significant effect of organizational agility elements on the marketing performance of food industry companies in Algeria.
- There is a statistically significant effect of the marketing policy planning process on organizational agility in food industry companies in Algeria.
- There is a statistically significant effect of the policy planning process on the marketing performance of food industry companies in Algeria, given the presence of organizational agility as an intervening variable.

In light of the study's findings, and in order to develop the role of marketing planning in improving the marketing performance of food industry companies in Algeria by relying on organizational agility, the researchers propose a set of recommendations, as follows:

- The need for senior management support and assistance. Senior management must have a commitment to planning as a business philosophy and best practice, and middle management must see, witness, and sense this commitment. Furthermore, senior management's support and assistance for the planning effort must be continuous and ongoing, not temporary or merely an obsessive fascination that only takes hold for a short period. Training: Marketing personnel should be trained and qualified in the marketing skills and knowledge necessary to perform the planning function. It would be preferable for the management team to attend the same training course to share a common understanding of organizational agility concepts.
- It is essential for food industry companies in Algeria to develop appropriate, capable, and effective marketing policies that are in line with current environmental conditions and changes, particularly the social and economic environment, while also maintaining targeted marketing performance and taking organizational agility into account.
- Periodic monitoring of various marketing activities, including on-the-ground distribution work, to identify distribution problems and obstacles, such as costs, time, and speed, and work to identify them appropriately to ensure the smooth running of distribution operations across various sales areas.
- Increased attention should be given to marketing personnel working in food industry companies by continuing to develop training and development policies to help them acquire skills, competencies, and experience, while enhancing their knowledge and qualifications.
- There are some limitations to this study. First, the data were collected from marketing managers or executives in Algeria. Therefore, caution should be exercised when generalizing the results. Second, the results may not be generalizable to other companies in Algeria besides those in the food industry. Third, we used a small sample size.
- There are several areas for future research, namely: (1) alignment between organizational and regulatory sectors, (2) finding ways to achieve organizational agility, (3) conducting similar studies in other regions of Algeria, (4) Conduct further comparative studies in other sectors such as the cosmetics and household appliances industry, (5) Study the relationship between organizational agility and organizational excellence.

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REFERENCES

Ambler, T., Kokkinaki, F., Puntoni, S. (2004). Assessing Marketing Performance: Reasons for Metrics selection. *Journal of Marketing Management*. https://doi.org/10.1362/026725704323080506

Bahrami, M. A., Kiani, M. M., Montazeralfaraj, R., Zadeh, H. F., Zadeh. M. M. (2016). The Mediating Role of Organizational Learning in the Relationship of Organizational Intelligence and Organizational Agility. *Osong Public Health Res Perspect*, Jun *7*(3), 190-196. https://doi.org/10.1016/j.phrp.2016.04.007

Clark, B. (1999). Marketing Performance Measures: History and Interrelationships. *Journal of Marketing Management*. https://doi.org/10.1504/IJBPM.2001.000101

Croteau, A., Raymond, L. (2004). Performance Outcomes of Strategic and IT Competencies Alignment. *Journal of Information Technology, 19*, 178-190. https://doi.org/10.1057/palgrave.jit.2000020

Darymple, J. D., Parsons, J. L. (2000). *Marketing Management* (7th ed.). John Wiley and Sons. https://books.google.dz/books/about/Marketing_Management.html?id=EVIpy99KGiEC&redir_esc=y

Dijkstra, T. K., Henseler, J. (2015). Consistent partial least squares path modeling. *MIS Q. 39*, 297-316. https://doi.org/10.25300/MISQ/2015/39.2.02

Dikici, T. (2024). Factors Shaping Organizational Agility. Exploratory research into factors that are essential in organizational agility across diverse sectors. https://hj.diva-portal.org/smash/get/diva2:1863241/FULLTEXT01.pdf

Fornell, C., Larcker, D. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of marketing research*, 382-388. https://doi.org/10.2307/3150980

Hadrian, P., Milichovský, F., Mráček, P. (2021). The Concept of Strategic Control in Marketing Management in Connection to Measuring Marketing Performance. *MPPI Journal, 13*(7), 3887. https://doi.org/10.3390/su13073887

Hair, J. F., Risher, J. J., Sarstedt, M., Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev. 31*, 2-24. https://doi.org/10.1108/EBR-11-2018-0203

Hair, J., Black, W. C., Babin, B. J., Anderson, R. E. (2010). *Multivariate Data Analysis* (7th ed.). Prentice Hall. https://www.researchgate.net/publication/237009923

Hair, J., Black, W., Babin, B., Anderson, R. (2006). *Multivariate data analysis*. Prentice Hall. https://books.google.dz/books/about/Multivariate_Data_Analysis.html?id=WESxQgAACAAJ&redir_esc=y

Hair, J., Sarstedt, M. R. (2012). An Assessment of the Use of Partial Least Squares Structural Equation Modeling in Marketing Research. *Journal of the Academy of Marketing Science, 40*, 414-433. https://doi.org/10.1007/s11747-011-0261-6

Henseler, J., Ringle, C. M., Sarstedt, M. (2016). Testing measurement invariance of composites using partial least squares. *Int. Mark. Rev. 33*, 405-431. https://doi.org/10.1108/IMR-09-2014-0304

Huang, L. H., Zhu, H. L. et al. (2021). Digital Transformation and Management of Enterprises: Research Framework and Prospects. *Journal of Management Science, 24*, 26-35. https://doi.org/10.1007/s44176-024-00032-z

Kaplan, R., Norton, D. (1996). Linking the Balanced Scorecard Strategy. *California Management Review, 39*(1). https://doi.org/10.2307/41165876

Kotler, P. (2000). *Marketing Management* (10th ed.). Prentice Hall. https://books.google.dz/books/about/Marketing_Management.html?id=r5duSQAACAAJ&redir_esc=y

Kotler, P., Keller, K. (2009). *Marketing Management* (13thed.). Prentice Hall. https://www.google.dz/books/edition/Marketing_Management/t94QngEACAAJ?hl=fr

Ludviga, I., Kalvina, A. (2023). Organizational Agility During Crisis: Do Employees' Perceptions of Public Sector Organizations' Strategic Agility Foster Employees' Work Engagement and Well-being?. *Employee Responsibilities and Rights Journal, 36,* 209-229. https://doi.org/10.1007/s10672-023-09442-9

McCarthy, E., Perreault, W. (2000). *Essentials of Marketing* (8thed.). McGraw Hill. https://books.google.dz/books/about/Essentials_of_Marketing.html?id=3IArAQAAMAAJ&redir_esc=y

Ngai, E. W. T., Chau, D. C. K., Chan, T. (2011). Information technology, operational management competencies for supply chain agility. *Journal of Strategic Information Systems. Vol. 20,* No. 3, 232-249. https://doi.org/10.1016/j.jsis.2010.11.002

Olszak, C., Zurada, J. (2015). Information technology tools for business intelligence in organization. *Polish journal of management studies, Vol. 12*, No. 1. https://doi.org/10.1080/10580530.2021.1971021

Park, Y. (2011). The Dynamics of Opportunity and Threat Management in Turbulent Environments: The Role of Information Technologies. *ERIC.* https://eric.ed.gov/?id=ED534930

Pei-Ying Huang, Ben Niu, Shan L. Pan (2021). Platform-based customer agility: An integrated framework of information management structure, capability, and culture. *International Journal of Information Management, Vol. 59*, August. https://doi.org/10.1016/j.ijinfomgt.2021.102346

Peng, M., Lin, K., Peng, D., Chen, P. (2019). Linking Organizational Ambidexterity and Performance: The Drivers of Sustainability in High-Tech Firms. *Sustainability*. https://doi.org/11.3931.10.3390/su11143931

Sangari, M., Razmi, J. (2015). Business intelligence competence, agile capabilities, and agile performance in supply chain: An empirical study. *Logistics Management*, 26(2), 356-380. https://doi.org/10.1108/IJLM-01-2013-0012

Sherehiy, B. (2008). Relationships between agility strategy, work organization and workforce agility. *M.A. Psychology. Jagiellonian university. Poland*. https://www.semanticscholar.org/paper/Relationships-between-agility-strategy%2C-work-and-Sherehiy/a02e5acd97c6124e51a88d466cce868a7ef114ea

Stevenson, W. (2007). *Operation Management,* (9th ed.). McGraw Hill. https://bookstation.org/book/Production%20Operation%20Management%20William%20J%20Stevenson-4896535

Vrontis, D., Christofi, M., Pereira, V., Tarba, S., Makrides, A., Trichina, E. (2021). Artificial intelligence, robotics, advanced technologies and human resource management: a systematic review. *The International Journal of Human Resource Management, 33*. 1-30. https://doi.org/10.1080/09585192.2020.1871398

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THE ROLE OF PHYSICAL ACTIVITY IN STRESS MANAGEMENT AMONG UNIVERSITY STUDENTS

This article examines the role of physical activity in stress management among university students. A survey conducted in 2024 among 101 students at Rzeszów University of Technology investigated the relationship between regular engagement in physical activity and the occurrence of stress-related symptoms. The data were analyzed using descriptive statistics and Pearson's chi-square tests ($\alpha = 0.05$).

The results demonstrated a statistically significant association between regular physical activity and a reduction in stress-related symptoms, particularly muscle tension and insomnia. Male students were more likely than female students to report improvements in physical performance. Furthermore, forms of physical activity perceived as enjoyable and relaxing, such as martial arts or fitness training, were associated with better physical condition and higher energy levels.

The findings indicate that regular physical activity constitutes an effective, non-pharmacological strategy for stress reduction, especially when aligned with individual preferences. The study supports the implementation of personalized physical activity programs in academic settings as a means of promoting students' psychological and physical health.

Keywords: physical activity, stress, students, physical activity as intervention, physical fitness, stress management strategies.

1. INTRODUCTION

The contemporary lifestyle, marked by dynamic changes and increasing demands, contributes to elevated levels of stress. This physiological and psychological response is an inherent aspect of human life, the intensity and consequences of which may be modulated by a range of factors, including life circumstances, as well as professional and academic environments. The pressure associated with educational responsibilities and examinations presents a significant challenge for higher education institutions, which are expected to provide students with adequate tools for coping with stress – an issue of key importance for both their psychological and physical health and academic performance.

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In response to these challenges, growing attention has been directed toward non-pharmacological stress management strategies, among which physical activity occupies a central role. The use of sport as a method for stress reduction is based on the premise that regular physical exercise has a positive impact on well-being and fosters the development of supportive interpersonal relationships. Essential to this process are psychosocial factors such as motivation to engage in physical activity, access to resources (including time, equipment, and infrastructure), and support from one's environment – family, friends, and coaches. The integration of these elements promotes regularity in physical activity and enhances the effectiveness of the applied intervention strategies.

The aim of this article is to identify the role of physical activity in stress management and to evaluate the effectiveness of different forms of sport in stress management strategies among university students. To this end, the following research questions were posed:

Does regular participation in sports activities contribute to a reduction of stress-related symptoms such as muscle tension and insomnia?

Are there differences between male and female students in the effects of sports participation on general physical performance?

Does the selection of an appropriate form of physical activity – key to effective stress management – contribute to improved physical fitness and energy levels?

The subject of analysis includes the results of a study conducted in 2024 among a group of university students, aimed at expanding the current knowledge on the role of physical activity as a supportive tool in stress management. The findings may serve as a basis for formulating recommendations for academic institutions and organizations seeking to implement non-pharmacological methods to improve psychological and physical health.

2. LITERATURE REVIEW

The literature review provides the theoretical foundation for this study, which aims to assess the role of physical activity in stress management. The scholarly literature identifies several key thematic areas that connect the concepts of stress, physical activity, and their effects on mental health and interpersonal relationships.

2.1. Definition of stress and its implication

Stress is defined as the body's response to challenges or threats that disturb its homeostasis (Grygorczuk, 2008). It is a dynamic process in which the individual undertakes adaptive actions to restore psychological and physical equilibrium. Depending on its intensity and duration, stress can have both positive and negative consequences for human health and functioning (Lazarus, 1984).

Recent studies have indicated that high levels of stress – particularly in academic environments – negatively affect emotional resilience (Ansari et al., 2024). Prolonged psychological tension may impair cognitive performance, concentration, and learning efficiency, often leading to reduced motivation and academic burnout (Maslach et al., 2001). Moreover, chronic stress has been correlated with an increased risk of mental health disorders, such as depression and anxiety (McEwen, 2004). Elevated stress levels can also manifest in physical symptoms, such as muscle tension, insomnia, and mood disturbances, making the search for effective stress-reduction strategies a high-priority topic in contemporary scientific discourse.

One of the central concepts in this context is stress management, defined as a set of strategies and techniques aimed at minimizing the negative effects of stress while

enhancing the individual's adaptive capacities (Quick et al., 1997). Among the most commonly applied stress management methods are relaxation techniques, meditation, cognitive-behavioral therapy, and physical activity – which has been shown to be particularly effective in regulating emotions and supporting the neurobiological balance of the body (Varvogli, Darviri, 2011; Basso, Suzuki, 2017).

2.2. Physical activity as a tool for coping with stress

Academic literature focused on the pertinent subjects emphasizes that regular physical activity plays a significant role in alleviating symptoms of stress. Empirical studies demonstrate that physical exercise has beneficial effects on both biological and psychological dimensions. On a biological level, physical activity increases the secretion of endorphins and modulates cortisol levels, thereby contributing to improved well-being (Mennitti et al., 2024; Enayatjazi et al., 2015). Psychological mechanisms, in turn, include mood enhancement, increased self-esteem, and the development of positive social relationships (Gracz et al., 2007; Kwilecki, 2012). Moreover, numerous studies have shown that physical activity positively influences brain neuroplasticity, which translates into improved cognitive functions such as memory, concentration, and learning ability. Regular physical exertion promotes an increase in hippocampal volume and the activity of brain-derived neurotrophic factor (BDNF), which may strengthen psychological resilience and facilitate adaptation to stressful situations (Hillman, Erickson, Kramer, 2008; Mandolesi et al., 2018).

Research indicates that sport can serve as an effective intervention in the context of stress reduction, as evidenced by numerous comparative analyses. Morga et al. (2015) observe that individuals who engage in regular sports activities report lower levels of stress and fewer associated symptoms, such as anxiety and depression. Furthermore, Dyrla-Mularczyk et al. (2019) and Kazimierczak et al. (2015) highlight that an active lifestyle has a positive impact on cognitive and social functioning, which may contribute to more effective stress management. Importantly, physical activity not only serves a preventive function but may also support therapeutic interventions. Intervention studies have shown that regular aerobic exercise – such as running, swimming, or cycling – effectively reduces symptoms of anxiety and depression, with efficacy comparable to pharmacological treatment in mild cases (Craft, Perna, 2004; Mikkelsen et al., 2017).

2.3. The impact of physical activity on interpersonal relationships

Another aspect frequently discussed in the scholarly literature is the influence of physical activity on the development of social relationships. Participation in sports activities fosters the establishment of interpersonal connections and strengthens the sense of belonging to a group. A systematic review conducted by Eime et al. (2013) demonstrated that sport has a significant impact on the formation of social bonds, which is particularly relevant in academic environments, where stress and pressure can negatively affect interpersonal interactions. Bailey et al. (2013) emphasize that sport not only enhances physical fitness but also serves as an important integrative factor, increasing levels of social support and satisfaction with interpersonal relationships.

In the context of interpersonal relationship development, physical activity undertaken in a team-based format appears especially beneficial, as it promotes cooperation, communication, and mutual trust. As noted by Eather et al. (2023), participation in sports – especially team sports – is associated with improved psychological well-being, including higher self-esteem and greater life satisfaction.

2.4. Synthesis of existing research findings

A review of the literature indicates that physical activity exerts a multidimensional influence on individual health. Both biological and psychological mechanisms support the hypothesis that regular participation in sports activities can effectively reduce symptoms of stress and enhance social functioning. Empirical findings (Mennitti et al., 2024; Enayatjazi et al., 2015; Morga et al., 2015; Kwilecki, 2012) confirm that sport plays a key role in stress-coping strategies, which is also reflected in studies examining its impact on interpersonal relationships (Eime et al., 2013; Bailey et al., 2013). Moreover, there is growing interest in incorporating physical activity as a supportive element in mental health promotion programs, particularly in high-stress environments such as academic, medical, or corporate settings. Analyses of intervention studies (Craft, Perna, 2004; Mikkelsen et al., 2017) show that exercise-based interventions are effective both in the prevention and treatment of mild anxiety and depressive disorders, as well as in improving psychological functioning. It is worth noting that the form and intensity of physical activity can be tailored to individual needs and capabilities, thereby increasing the accessibility of this type of intervention across various age and social groups.

In summary, the existing body of research provides a robust theoretical foundation for the present article, which explores the role of physical activity in coping with stress and fostering healthy social relationships within academic settings. Based on current findings, it can be assumed that physical activity serves not only a preventive but also a therapeutic function. Its significance in the context of mental and social health highlights the need for further research aimed at elucidating the specific mechanisms underlying these associations.

3. METHODOLOGY OF THE AUTHOR'S RESEARCH

The research conducted within the framework of this article aimed to assess the impact of physical activity on stress reduction among students at Rzeszów University of Technology. The sample was selected using purposive sampling, as the study targeted students participating in sports classes offered at Rzeszów University of Technology. The research was carried out in 2024 on a group of 101 students. Within the analyzed group, males constituted a slight majority (56%), while females accounted for 44% of the respondents. In terms of age, most participants fell within the 19–25 age range, with only a small proportion being older (above 25 years).

Inclusion and exclusion criteria. Inclusion criteria required being an active student of Rzeszów University of Technology and participation in university sports classes. Exclusion criteria included incomplete questionnaires and failure to confirm voluntary participation.

Data collection window and response rate. The survey was conducted between **April – June 2024**. A total of **101** invitations were distributed, and **101** valid responses were obtained, resulting in a response rate of **100%**. Participation in university sports classes during the time of the study was **elective**.

Ethical considerations. The study complied with institutional ethical standards. Participation was voluntary and anonymous. According to institutional guidelines, this non-interventional, anonymous online survey was **exempt from formal ethics committee approval**.

The research method employed was an online survey, developed and distributed via the platform www.survio.com. A proprietary questionnaire was designed specifically for the purposes of this study. It consisted of 17 questions divided into two main sections:

- Section on sports participation – the questions aimed to determine the frequency, duration, and preferred type of physical activity;
- Section on stress-coping strategies – the questions assessed participants' subjective perception of the impact of physical activity on the reduction of stress symptoms, such as muscle tension or insomnia, as well as on overall well-being and energy levels.

Respondents were able to select one or more response options and were also provided with the opportunity to submit their own suggestions. The questionnaire was preceded by a detailed instruction informing participants about the purpose of the study, the procedure for completing the survey, and the assurance of full anonymity of the collected data.

The questionnaire was made available to students in electronic form. Participants completed it independently, selecting the response options that best reflected their views and experiences. Prior to completing the survey, they were informed about the anonymous nature of the study, which aimed to enhance the reliability and honesty of their responses.

The collected data were subjected to statistical analysis using both descriptive and inferential statistics. For the purposes of this research, frequency and percentage analyses were used to present the distribution of responses across categories. To test the research hypotheses, Pearson's chi-square test of independence was applied, with a significance level set at $\alpha = 0.05$. This allowed for the assessment of relationships between regular participation in sports activities and the reduction of stress symptoms, as well as for the identification of potential differences in the perceived impact of physical activity between male and female respondents.

Given the nature of the study, which involved collecting data on the subjective experiences of students, particular attention was paid to adhering to ethical research principles. The questionnaire was anonymous, and no personal data were collected, ensuring confidentiality and the protection of participants' privacy.

4. RESULTS OF THE AUTHOR'S RESEARCH

4.1. Descriptive findings

The analysis revealed that 64% of respondents reported engaging in physical activity several times a week, 28% once a week, 6% daily, and only 2% less than once a week. The largest proportion of participants (34%) reported practicing sports for more than three years, 27% for six months to one year, 25% for one to three years, 13% for less than six months, and 2% selected the "other" category. An analysis of preferences showed that the most dominant form of physical activity was martial arts (68%), followed by fitness (42%), running (35%), and team sports such as football, basketball, or volleyball (30%). The least popular activities were dance and tennis, each indicated by 2% of respondents. Other forms of physical activity mentioned included golf, calisthenics, street workout, rugby, and skiing.

Respondents evaluated the regularity with which they engaged in specific types of physical activity (e.g., running, fitness, cycling, winter sports, team games, martial arts, hiking, swimming) using three categories: regularly, irregularly, or not at all. In terms of participation style, 51% of respondents reported exercising individually, 19% with

a partner, and 30% in a group setting. With regard to the subjective assessment of the impact of sport on stress-coping abilities, 44% of participants stated that engaging in sports activities significantly improved their ability to manage stress, 37% reported moderate improvement, 12% observed no change, and 8% were uncertain. Respondents identified a range of benefits, including increased productivity (32%), improved concentration and problem-solving ability (27%), enhanced interpersonal relationships (13%), and greater resilience to stress (26%). In addition, individual responses referred to improved mood and the perception of physical effort as a form of relaxation. According to participants, 56% believed that sports activities significantly improve overall physical condition, 40% noted moderate improvement, 3% reported no improvement, and 2% were uncertain. Regarding the reduction of stress symptoms, 40% of respondents indicated that sports activities significantly reduced symptoms such as muscle tension or insomnia, 49% reported partial reduction, 8% observed no improvement, and 4% were uncertain.

The analysis further showed that 66% of respondents believed that participation in sports activities significantly improved their overall mood and energy levels, 30% reported moderate improvement, while only 2% noticed no change and another 2% were uncertain. In this study, 73% of participants emphasized that choosing an enjoyable and relaxing form of activity is crucial, whereas 21% believed that any form of physical activity can be beneficial for stress reduction. Only 6% had no opinion on this matter.

A substantial majority (85%) of respondents indicated that participation in sports activities should be recommended for individuals experiencing stress, while 12% were undecided and 3% pointed to alternative methods. Furthermore, 84% of participants declared being aware of other stress-coping strategies. In total, 97% of respondents stated that sports activities can contribute to the development of healthy relationships with others. In the open-ended section, 74% of participants did not submit additional comments or questions regarding the impact of sports activities on stress management. The remaining 26% shared observations related to improvements in sleep quality, relaxation, and stress-coping effectiveness. Demographic analysis showed that 56% of respondents were male and 44% female. The vast majority (97%) fell within the age range of 19–25 years.

4.2. Inferential results

To verify the research hypotheses, inferential analyses were conducted using Pearson's chi-square test at a significance level of $\alpha = 0.05$. The results are presented in descriptive, tabular, and graphical formats (Figures 1–3).

4.3. Impact of regular physical activity on the reduction of stress-related symptoms

The chi-square test revealed a statistically significant association between regular physical activity and the reduction of stress-related symptoms ($\chi^2 = 31.31$, $df = 9$, $p < 0.001$, Cramér's $V = 0.56$). Effect size for this table ($df = 9$) was assessed using Cramér's V, which is recommended for contingency tables larger than 2×2. The value of Cramér's V (0.56) indicates a strong association between the examined variables (Table 1, Figure 1). Respondents who regularly participated in sports activities more frequently reported either a significant or partial reduction in stress symptoms. Percentages may not sum to 100 due to rounding and because respondents were allowed to select multiple responses.

Table 1. Results of Pearson's chi-square test of independence: Regular participation in physical activity and reduction of stress-related symptoms

	Statistic	df	p-value
Pearson's χ^2	31.31	df=9	p<0.001
Cramér's V	0.56		

Source: Author's own study.

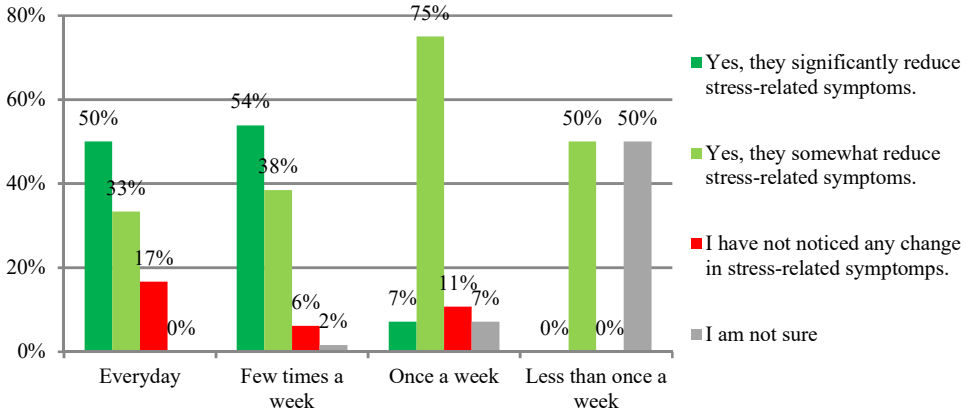

Figure 1. Regular participation in sports activities and the reduction of stress-related symptoms such as muscle tension and insomnia

Source: Author's own study.

4.4. Gender differences in the perceived impact of physical activity on physical fitness

The analysis revealed significant differences between men and women in their assessment of the impact of sports activities on physical fitness (χ^2 = 7.64, df = 1, p = 0.005). These findings suggest that men are more likely to perceive sports activity as beneficial for physical performance, which is further supported by the statistical indicators (contingency coefficient = 0.26) (Table 2, Figure 2).

Table 2. Results of Pearson's chi-square test of independence: Gender and perceived impact of physical activity on physical fitness

	Chi-square	df	p
Pearson's χ^2	7.64	df=1	p=0.005
Contingency coefficient	0.26		

Source: Author's own study.

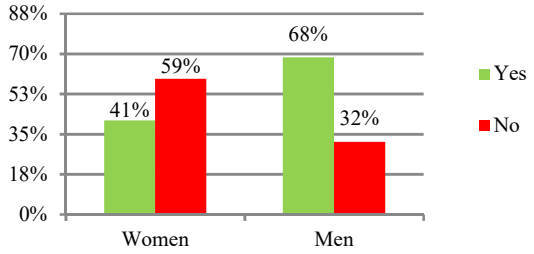

Figure 2. Assessment of the Impact of Sports Activities on Overall Physical Fitness by Gender

Source: Author's own study.

4.5. The impact of choosing sports activities on physical fitness and energy levels

The conducted analysis indicates that selecting appropriate sports activities – specifically those perceived as enjoyable and relaxing – is significantly associated with improvements in physical fitness and energy levels ($p < 0.001$). Within this group, 77% of respondents reported that engaging in such activities had a substantial positive effect on their well-being and energy.

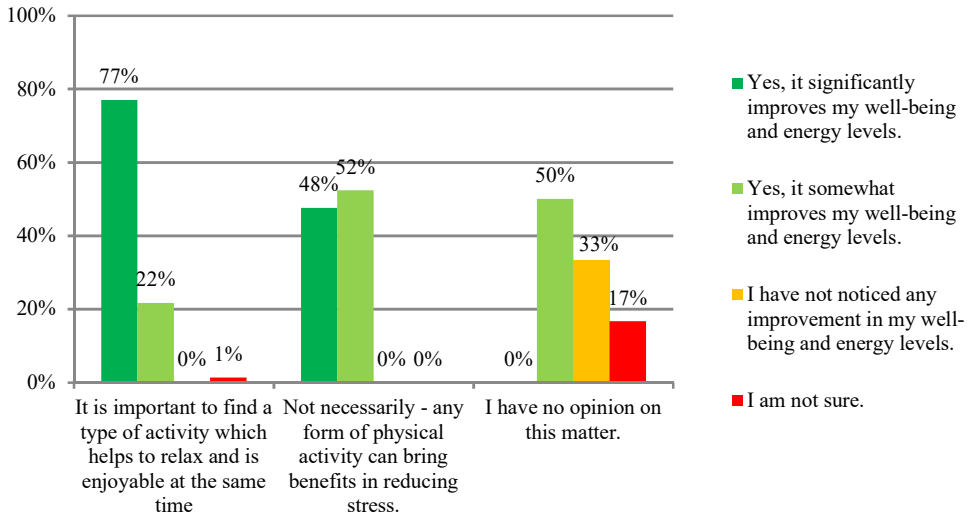

Figure 3. Selection of appropriate sports activities as a determinant of effective stress management, improved physical fitness, and increased energy levels

Source: Author's own study.

Furthermore, research indicates that activities perceived as enjoyable are more likely to be maintained over time, leading to sustained benefits in physical fitness and energy. This underscores the importance of personal preference in selecting physical activities to promote long-term adherence and health benefits.

5. DISCUSSION

The contemporary academic environment presents numerous challenges for students, often leading to elevated stress levels. Consequently, identifying effective stress-reduction methods is of paramount importance. The findings of this study corroborate existing literature, indicating that regular participation in sports activities plays a significant role in stress management.

In the present study, more than half of the respondents reported engaging in sports activities several times a week, with a substantial proportion participating consistently for periods ranging from six months to over three years. These results suggest a propensity among students for maintaining regular physical activity, aligning with the observations of Guerriero et al. (2025) and Yoon et al. (2023), who emphasize the association between regular exercise and reduced stress levels. Furthermore, Hassmén et al. (2000) found that individuals exercising at least twice weekly experience lower levels of depression, anger, cynical distrust, and stress, underscoring the positive impact of physical activity on mental health.

An analysis of physical activity preferences indicated a predilection among students for dynamic forms such as martial arts, fitness, and running, while activities requiring lower energy expenditure, like tennis or yoga, were less favored. This preference suggests that intensive physical exertion characteristic of the aforementioned activities may effectively alleviate tension and enhance mood. Literature associates prolonged martial arts training with increased self-confidence and reduced aggression, contributing to improved stress coping mechanisms (Vertonghen et al., 2010; Fabio et al., 2017; Blomqvist Mickelsson, 2020). Similarly, running has been identified as having therapeutic effects on mental health (Oswald et al., 2020). Regarding modes of participation in sports activities, the study found a majority of respondents prefer individual exercises, potentially reflecting a desire for complete control over training schedules and personal stress management strategies. Conversely, a smaller group engages in sports with partners or groups, possibly indicating a need for external motivation or challenges in finding suitable training partners. Research by Žižek et al. (2013) suggests that individual forms of activity can be effective stress-coping strategies, while Andersen et al. (2019) highlight the social benefits and positive psychological impacts of team sports.

Subjective assessments of stress reduction revealed that 44% of respondents believe sports significantly enhance their stress-coping abilities, with 8% uncertain. Reported benefits include increased productivity, improved concentration, enhanced problem-solving skills, and greater stress resilience. These findings align with Hillman et al. (2008), who documented the positive effects of physical activity on executive brain functions, including attention, planning, and decision-making. Additionally, Ratey et al. (2010) describe the phenomenon of exercise-induced brain stimulation, highlighting its role in promoting mental health and protecting against psychiatric disorders and dementia. Moreover, 56% of respondents reported significant improvements in physical fitness due to sports participation, corroborating literature that links regular physical activity with enhanced cardiovascular endurance, increased muscular strength, and improved body flexibility (Warburton et al., 2006; Kenney et al., 2022). Adaptive mechanisms resulting from consistent training lead to beneficial changes in muscle structure and circulatory function, consistent with the findings of this study.

Analysis of subjective stress reduction assessments indicated that 40% of respondents experienced substantial alleviation of stress symptoms, while 49% reported partial relief.

These outcomes may be associated with neurobiological mechanisms wherein physical activity plays a crucial role in hormonal regulation and increased endorphin levels, natural mood enhancers. Saeed et al. (2023) demonstrated that exercises of varying intensities modulate serotonin levels, including beta-endorphin secretion in the bloodstream. Furthermore, Hoosain et al. (2024) emphasize that physical training exhibits antidepressant effects and aids in regulating circadian rhythms, thereby improving sleep quality, mood, and vitality. In this study, 66% of respondents acknowledged that participation in sports activities significantly enhances well-being and energy levels, with only 2% noting no changes. Additionally, 73% emphasized the importance of selecting activities that provide enjoyment and relaxation, suggesting that personal preferences may significantly influence the effectiveness of sports interventions in mental health contexts. Scientific literature supports these observations; Basso and Suzuki (2017) found that short-term exercise sessions induce changes in neurotransmitter levels, such as norepinephrine, serotonin, and dopamine, directly improving mood and energy. Similarly, a meta-analysis by Rebar et al. (2015) concluded that regular physical activity enhances well-being by regulating the body's stress response, leading to reduced depressive symptoms and anxiety.

The finding that 85% of respondents believe sports activities should be recommended for individuals experiencing stress underscores the role of physical activity in stress management strategies. This is supported by studies from Xie et al. (2021) and Ross et al. (2023), which highlight the efficacy of exercise in reducing depressive symptoms and improving cognitive functions. Conversely, only 3% of respondents considered alternative stress management methods superior, suggesting that interventions like relaxation techniques may be less popular among the studied population, as indicated by Sabu and Kisan (2023). The accessibility of physical activity and its tangible benefits reinforce its preferential status, consistent with findings by Buecker et al. (2021).

Finally, the study revealed that 97% of respondents perceive a positive impact of sports activities on building healthy interpersonal relationships. Engagement in sports requiring cooperation and communication fosters social connections and strengthens group belonging, particularly vital in academic settings. These observations align with systematic reviews by Eime et al. (2013) and studies by Bailey et al. (2013), which emphasize the role of sports in developing social support networks and enhancing psychological well-being.

6. CONCLUSIONS

The aim of this study was to examine the role of physical activity in stress management among university students and to assess the effectiveness of different forms of physical activity as non-pharmacological stress management strategies. The conclusions are presented in direct correspondence with the three research questions formulated in the Introduction.

6.1. Does regular participation in physical activity contribute to a reduction of stress-related symptoms such as muscle tension and insomnia?

The results clearly indicate that regular participation in physical activity is significantly associated with a reduction in stress-related symptoms, including muscle tension and insomnia. The statistical analysis revealed a strong relationship between the examined variables ($\chi^2 = 31.31$, df = 9, $p < 0.001$; Cramér's V = 0.56). Students who engaged in physical activity on a regular basis more frequently reported both significant and partial reductions in stress symptoms. These findings confirm that regular physical activity

constitutes an effective, non-pharmacological strategy for alleviating stress-related physiological symptoms in academic populations.

6.2. Are there differences between male and female students in the perceived effects of physical activity on overall physical performance?

The study identified statistically significant gender differences in the perception of the impact of physical activity on overall physical fitness ($\chi^2 = 7.64$, df = 1, $p = 0.005$; contingency coefficient = 0.26). Male students were more likely than female students to report improvements in physical performance resulting from participation in physical activity. This result suggests that gender may influence the perceived benefits of physical activity and highlights the potential need for gender-sensitive approaches when designing physical activity programs for stress management in university settings.

6.3. Does the selection of an appropriate form of physical activity contribute to improved physical fitness and energy levels?

The findings demonstrate that selecting forms of physical activity perceived as enjoyable and relaxing is significantly associated with improvements in physical fitness and energy levels ($p < 0.001$). A substantial proportion of respondents (77%) reported a strong positive impact of such activities on their well-being and vitality. This underscores the importance of individual preferences in the choice of physical activity and indicates that enjoyment and personal satisfaction play a key role in maximizing the stress-reducing and health-promoting effects of physical activity.

Overall Conclusions and Practical Implications. In summary, the study confirms that regular physical activity contributes to the reduction of stress-related symptoms and supports psychological and physical health among university students. Gender differences in perceived benefits suggest the value of tailored interventions, while the strong association between enjoyable forms of activity and positive outcomes emphasizes the importance of personalization. From a practical perspective, academic institutions should promote diverse and flexible physical activity programs that accommodate individual preferences, thereby enhancing participation, long-term adherence, and the effectiveness of stress management strategies.

Limitations of the study include several important considerations. First, the research was conducted on a relatively small sample, which may affect the overall representativeness and generalizability of the results to a wider population. Second, the sample consisted solely of students from Rzeszów University of Technology, which limits the ability to extend the findings to other academic institutions or demographic groups. Additionally, the respondents were all individuals actively engaged in sports, which may have influenced the positive assessments of the impact of physical activity on stress management, thereby limiting comparisons with groups less involved in physical activity.

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REFERENCES

Andersen, M. H., Ottesen, L., Thing, L. F. (2019). The social and psychological health outcomes of team sport participation in adults: An integrative review of research. *Scandinavian Journal of Public Health, 47*(8), 832-850. https://doi.org/10.1177/1403494818791405

Ansari, S., Khan, I., Iqbal, N. (2025). Association of stress and emotional well-being in non-medical college students: A systematic review and meta-analysis. *Journal of Affective Disorders, Vol. 368*, 200-223. https://doi.org/10.1016/j.jad.2024.09.029

Bailey, R., Hillman, C., Arent, S., Petitpas, A. (2013). Physical activity: An underestimated investment in human capital? *Journal of Physical Activity and Health, 10*(3), 289-308. https://doi.org/10.1123/jpah.10.3.289

Basso, J. C., Suzuki, W. A. (2017). The effects of acute exercise on mood, cognition, neurophysiology, and neurochemical pathways: A review. *Brain Plasticity, 2*(2), 127-152. https://doi.org/10.3233/BPL-160040

Blomqvist Mickelsson, T. (2020). Modern unexplored martial arts – what can mixed martial arts and Brazilian Jiu-Jitsu do for youth development? *European Journal of Sport Science, 20*(3), 386-393. https://doi.org/10.1080/17461391.2019.1629180

Buecker, S., Simacek, T., Ingwersen, B., Terwiel, S., Simonsmeier, B. A. (2021). Physical activity and subjective well-being in healthy individuals: A meta-analytic review. *Health Psychology Review, 15*(4), 574-592. https://doi.org/10.1080/17437199.2020.1760728

Craft, L. L., Perna, F. M. (2004). The benefits of exercise for the clinically depressed. *Primary Care Companion to the Journal of Clinical Psychiatry, 6*(3), 104. https://doi.org/10.4088/PCC.v06n0301

Dyrla-Mularczyk, K., Giemza-Urbanowicz, W. (2019). Wpływ aktywności fizycznej na funkcjonowanie układu nerwowego i procesy poznawcze – przegląd badań. *Neuropsychiatria, Neuropsychologia, 14*(3-4), 84-91. https://doi.org/10.5114/nan.2019.89792

Eather, N., Wade, L., Pankowiak, A., Eime, R. (2023). The impact of sports participation on mental health and social outcomes in adults: a systematic review and the 'Mental Health through Sport' conceptual model. *Systematic Reviews, 12*(1), 102. https://doi.org/10.1186/s13643-023-02264-8

Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., Payne, W. R. (2013). A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *International Journal of Behavioral Nutrition and Physical Activity, 10*, 1-21. https://doi.org/10.1186/1479-5868-10-98

Enayatjazi, M., Sadeghi Dinani, S., Emami Hashemi, S. A. (2015). The effect of intensive exercise on beta-endorphin and serum cortisol levels in elite wrestlers. *Physical Treatments – Specific Physical Therapy Journal, 5*(3), 171-176. https://doi.org.10.15412/J.PTJ.07050307

Fabio, R. A., Towey, G. E. (2017). Cognitive and personality factors in the regular practice of martial arts. *The Journal of Sports Medicine and Physical Fitness, 58*(6), 933-943. https://doi.org/10.23736/S0022-4707.17.07245-0

Gracz, J., Sankowski, T. (2007). *Psychologia aktywności sportowej* [*Psychology of sport activity*]. The Publishing House of Physical Education Academy, 468.

Guerriero, M. A., Dipace, A., Monda, A., De Maria, A. et al. (2025). Relationship between sedentary lifestyle, physical activity and stress in university students and their life habits: A scoping review with PRISMA Checklist (PRISMA-ScR). *Brain Sciences, 15*(1), 78. https://doi.org/10.3390/brainsci15010078

Grygorczuk, A. (2008). Pojęcie stresu w medycynie i psychologii. *Psychiatria, 5*(3), 111-115.

Hassmén, P., Koivula, N., Uutela, A. (2000). Physical exercise and psychological well-being: A population study in Finland. *Preventive Medicine, 30*(1), 17-25. https://doi.org/10.1006/pmed.1999.0597

Hillman, C. H., Erickson, K. I., Kramer, A. F. (2008). Be smart, exercise your heart: Exercise effects on brain and cognition. *Nature Reviews Neuroscience, 9*(1), 58-65. https://doi.org/10.1038/nrn2298

Hossain, M. N., Lee, J., Choi, H., Kwak, Y. S., Kim, J. (2024). The impact of exercise on depression: How moving makes your brain and body feel better. *Physical Activity and Nutrition, 28*(2), 43-51. https://doi.org/10.20463/pan.2024.0015

Kaźmierczak, U., Radzimińska, A., Dzierżanowski, M., Bułatowicz, I., Strojek, K., Srokowski, G., Zukow, W. (2015). Korzyści z podejmowania regularnej aktywności fizycznej przez osoby starsze = The benefits of regular physical activity for the elderly. *Journal of Education, Health and Sport, 5*(1), 56-68. https://doi.org/10.5281/zenodo.13935

Kenney, W. L., Wilmore, J. H., Costill, D. L. (2022). *Physiology of sport and exercise*. Human Kinetics.

Kwilecki, K. (2012). *Turystyczne i relaksacyjne formy zdrowego stylu życia*. GWSH Katowice.

Lazarus, R. S., Folkman, S. (1984). *Stress, appraisal, and coping* (Vol. 464). Springer.

Mandolesi, L., Polverino, A., Montuori, S., Foti, F., Ferraioli, G., Sorrentino, P., Sorrentino, G. (2018). Effects of physical exercise on cognitive functioning and wellbeing: biological and psychological benefits. *Frontiers in Psychology, 9*, 347071. https://doi.org/10.3389/fpsyg.2018.00509

Maslach, C., Schaufeli, W. B., Leiter, M. P. (2001). Job burnout. *Annual Review of Psychology, 52*, 397-422. https://doi.org/10.1146/annurev.psych.52.1.397

McEwen, B. S. (2004). Protection and damage from acute and chronic stress: Allostasis and allostatic overload and relevance to the pathophysiology of psychiatric disorders. *Annals of the New York Academy of Sciences, 1032*(1), 1-7. https://doi.org/10.1196/annals.1314.001

Mennitti, C., Farina, G., Imperatore, A., De Fonzo, G. et al. (2024). How does physical activity modulate hormone responses? *Biomolecules, 14*(11), 1418. https://doi.org/10.3390/biom14111418

Mikkelsen, K., Stojanovska, L., Polenakovic, M., Bosevski, M., Apostolopoulos, V. (2017). Exercise and mental health. *Maturitas, 106*, 48-56. https://doi.org/10.1016/j.maturitas.2017.09.003

Morga, P., Traczyk, J., Wittenbeck, K., Zygmont, A. (2015). Przegląd badań nad wpływem aktywności fizycznej na stan psychiczny oraz somatyczny osób starszych. *Physiotherapy, 23*, 2. 42-51. https://doi.org/10.1515/physio-2015-0008

Oswald, F., Campbell, J., Williamson, C., Richards, J., Kelly, P. (2020). A scoping review of the relationship between running and mental health. *International Journal of Environmental Research and Public Health, 17*(21), 8059. https://doi.org/10.3390/ijerph17218059

Quick, J. C., Quick, J. D., Nelson, D. L., Hurrell, J. J. (1997). *Preventive stress management in organizations*. American Psychological Association.

Ratey, J. J., Hagerman, E. (2010). *Spark*. Hachette UK.

Rebar, A. L., Stanton, R., Geard, D., Short, C., Duncan, M. J., Vandelanotte, C. (2015). A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health Psychology Review, 9*(3), 366-378. https://doi.org/10.1080/17437199.2015.1022901

Ross, R. E., VanDerwerker, C. J., Saladin, M. E., Gregory, C. M. (2022). The role of exercise in the treatment of depression: Biological underpinnings and clinical outcomes. *Molecular Psychiatry, 28*(1), 298-328. https://doi.org/ 10.1038/s41380-022-01819-w

Sabu, S., Kisan, R. (2023). Effect of relaxation intervention on stress levels and cognitive skills in professional students. *Digital Journal of Clinical Medicine, 5*(5), 217-231.

Saeed, N. B., Melhem, M. B., Al-Ababneh, H. (2023). The impact of some types of physical activity on the level of releasing serotonin hormone (a comparative study). *Educational and Psychological Sciences Series, 2*(1), 119-134. https://doi.org/10.59759/educational.v2i1.121

Salomon, K. (2001). Aerobic exercise and its role in reducing depression and anxiety. *Journal of Psychiatric Research, 35*(4), 203-211.

Varvogli, L., Darviri, C. (2011). Stress management techniques: Evidence-based procedures that reduce stress and promote health. *Health Science Journal, 5*(2), 74.

Warburton, D. E. R., Nicol, C. W., Bredin, S. S. D. (2006). Health benefits of physical activity: The evidence. *CMAJ, 174*(6), 801-809. https://doi.org/10.1503/cmaj.051351

Xie, Y., Wu, Z., Sun, L., Zhou, L., Wang, G., Xiao, L., Wang, H. (2021). The effects and mechanisms of exercise on the treatment of depression. *Frontiers in Psychiatry, 12*, 705559. https://doi.org/10.3389/fpsyt.2021.705559

Yoon, E. S., So, W. Y., Jang, S. (2023). Association between perceived psychological stress and exercise behaviors: A cross-sectional study using the survey of national physical fitness. *Life, 13*(10), 2059. https://doi.org/10.3390/life13102059

Žižek, S. Š., Treven, S., Čančer, V. (2013). Individual and organizational approaches to overcoming stress. *Analele Științifice ale Universității „Al. I. Cuza" din Iași. Științe Economice/Scientific Annals of the "Al. I. Cuza", 60*(2), 357-374. https://doi.org/10.2478/aicue-2013-0020

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CONTEMPORARY MANAGEMENT OF GENERATION Z'S IMPULSIVE FAST FASHION CONSUMPTION: A RESISTANCE TO SLOW DENIM FASHION

Generation Z's (Gen Z) resistance to slow fashion reflects a significant barrier to adopting sustainable fashion (Slow fashion), which is a concern for brands operating in the Fashion industry. Despite the growing awareness of environmental issues, the purchasing of slow fashion remains low among Gen Z. Aiming to fulfill Sustainable Development Goal (SDG) 12 proposed by the United Nations, this study investigated the resistance factors to purchasing slow fashion apparel. Key variables from the Stimulus-Organism-Response model, Cognitive Dissonance Theory, and Status Quo Bias Model were adopted. A quantitative research approach and a non-probability convenience sampling were utilised, while data were collected from 184 respondents using an online self-administered survey. The latest SPSS package was used to analyse the data. The empirical findings suggest that beliefs, inertia, loss aversion, psychological commitment, and attitude influence Gen Z's resistance to slow fashion. Strategic management recommendations, limitations, delimitations, and future research avenues are provided.

Keywords: fast fashion, Generation Z, impulsive buying behaviour, resistance factors, slow fashion.

1. INTRODUCTION

The fashion industry has undergone significant changes since the 1990s and is now characterised by several trends (Liu, 2022). The current fashion retail landscape is in a continuous race to introduce and sell the latest fashion trends to meet consumer demands (Liu, 2022). While fast fashion retailers, in their pursuit of accessibility, produce garments quickly and at a minimal cost to ensure affordability (Mäkelä, 2022), with little to no investment in the creation of slow fashion clothing since it is thought to be expensive to

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maintain. Thus, fast fashion is defined as a fashion production and retail business model that is characterised by quick production cycles, frequent style changes, and mass production of low-cost clothing that is frequently of poor quality and has planned obsolescence to deliver the newest trends to customers as soon as possible at the lowest possible cost (Gouveia, Chabata, 2023). Whereas slow fashion is defined as a strategy for designing, producing, consuming quality-based fashion, and living better, by promoting awareness of the effects of clothing on communities, and the environment (Jung, Jin, 2014). Fast fashion produces garments twenty-five times faster than sustainable supply chains, which reduces the lifetime of garments and endorses impulsive purchasing intentions (Li, Zhou, Zhao, Guan, Yang, 2024). Such fashion production approach has led to an urgent unsustainable problem due to fast fashion's alarming environmental impacts.

Consequently, the consumption of fast fashion negatively impacts the environment, necessitating urgent action to align with the United Nations (UN) Sustainable Development Goals (SDGs), particularly by addressing responsible production and consumption. This study specifically focuses on SDG 12, which aims to promote sustainable practices in fashion brands' production as well as Gen Z fashion consumption (Thakker, Sun, 2023). The prevailing linear model of production and consumption strains natural resources, underscoring the need for a shift towards a more circular economy (Valenga, Stefani, Carvalho, Chiusoli, 2023). The process of circular economic practices, coupled with sustainable consumption, and green production, are vital to achieving SDG 12 (Valenga et al., 2023). Accordingly, this study aims to better understand why Gen Z consumers resist slow denim fashion as a feasible solution to promote sustainable production and consumption.

Research indicates a link between fast fashion and impulsive buying behaviours (Sembawa, 2019; Webber, Rich, 2023). Lin (2022) notes that consumers view shopping as entertainment, especially when prices are low and new items are frequently released. Fast fashion caters to this preference by providing inexpensive items quickly, faster sales, revenue generation, profitability, further fuelling impulsive purchases and the tendency to buy large quantities at once (Lin, 2022; Yasin, Julita, Hidayat, 2023). As a result, contemporary manager’s marketing strategies often involve limited-time specials to encourage quick decisions and maximise sales (Lin, 2022; Sembawa, 2019). Consequently, encouraging the consumption of fast fashion because it becomes effortlessly available and more affordable.

Gen Z are individuals born between 1995 and 2010, who have experienced rapid technological advancements during their formative years (Rojas, 2020; van Lierop, 2023). According to Yasin et al. (2023), impulse buying is prevalent among female Gen Z shoppers, often driven by emotional factors such as the 'fear of missing out' (FOMO). Additionally, Gen Z often feel social pressure to avoid repeating outfits, influencing their shopping habits (Webber, Rich, 2023). Impulsive purchases, driven by a 'need' to experience the thrill of buying, constitute a significant portion of expenses in fashion retail, more so than any other sector, due to the quick evolution of trends (Webber, Rich, 2023). As a result, fast fashion relies on trends, as many garments are discarded after only a brief period, with most items being worn only seven to ten times on average (Igini, 2023). This behaviour suggests a resistance to slow fashion among Gen Z consumers to fully acknowledge the environmental consequences of their fast fashion purchases, despite the ongoing negative environmental impact caused by fast fashion production.

2. PURPOSE OF THE STUDY

Given the prevalence of Gen Z's impulsive fast fashion consumption, this study examined the resistance elements to be taken into account due to the resistance to slow fashion, particularly, denim jean fashion purchases. Understanding the resistance factors could enable contemporary management strategies that may address them to promote sustainable consumption behaviours within the fashion industry and further contribute towards the achievement of SDG 12. Therefore, the main research objective guiding this study is:

To empirically investigate the factors that influence the resistance to slow denim jean fashion consumption.

The secondary objectives for this study were:

1. To determine if the beliefs and actions of Gen Z towards slow denim fashion would influence their attitude toward resisting the purchase of slow denim fashion.
2. To determine if inertia, loss aversion and psychological commitment of Gen Z of slow denim fashion would influence their attitude toward resisting the purchase of slow denim fashion.
3. To determine whether Gen Z's attitude towards slow denim jean purchases impacts their resistance toward slow fashion denim jeans.
4. To propose and recommend contemporary management strategies that slow fashion retailers can implement to mitigate the resistance of slow fashion denim jean purchases.

3. LITERATURE REVIEW

The goal of the literature review is to define and clarify problems, to inform the reader about a subject by summarizing, evaluating extant studies, identifying inconsistencies, gaps, contradictions, and relationships in the literature and to suggest future steps and approaches to solve the issues identified.

3.1. Fast fashion and slow fashion consumption

Globally, fast fashion has revolutionised the clothing industry by offering vast amounts of affordable clothing to consumers (Fraguito, 2023). Due to its low cost, fast fashion encourages consumers to discard clothes more quickly, sometimes even without wearing them (de Oliveira, Miranda, de Paula Dias, 2022). Mulhern (2022) reports that fast fashion clothing sales have doubled from 100 to 200 billion units per year. In 2022, the market was valued at $106 billion and is forecast to reach $185 billion by 2027, driven by high consumer demand (Illuminem, 2024). In contrast, the slow fashion market was valued at only $3.3 billion in 2023 and is expected to grow by only 9.5% between 2024 and 2032 (Global Market Insights, 2024). Although consumers are gradually adopting slow fashion, the shift is evidently occurring at a slower pace than anticipated. As a result, contemporary managers must devise practical strategies to address the unfavorable current trends in the fashion sector, since some would argue that these trends are experiencing resistance to slow fashion purchases.

3.2. Resistance to slow fashion purchasing by gen Z

Despite being environmentally aware, Gen Z faces several barriers to purchasing slow fashion. Halim, Hariyanto, Yudiarso, Setiasih, Anggraini, Parindra, and Yuniarti (2023) identified five main factors deterring Gen Z from choosing slow fashion, firstly, price

sensitivity is the most prominent factor, since Gen Z comprises students and young adults with limited income, weak purchasing power and making slow fashion apparel unaffordable. Although brand image holds some importance, Gen Z generally favour retailers offering lower prices and discounts (Halim et al., 2023; Liu, Hei, 2021). Another barrier is their tendency for impulsive buying, which is often driven by limited self-control and emotional desires (Halim et al., 2023). Fast fashion brands capitalise on this by implementing marketing tactics that entice Gen Z with limited-time promotions, an approach less common among slow fashion brands (Halim et al., 2023). Additionally, mental budgeting, although potentially beneficial for managing spending, leads Gen Z to prioritise short-term savings, often resulting in the purchase of more affordable fast fashion items.

Another major factor in Gen Z's resistance to slow fashion is perceived value. Although several Gen Z customers value the immediate satisfaction that fast fashion provides above the long-term advantages of slow fashion's ethical production and quality, the availability of lower-priced, fast fashion apparel makes sustainable alternatives less attractive. Cultural influences and social media also shape Gen Z's choices. Social media and peer influence strongly impact their purchasing decisions (Gouveia, Chabata, 2023), and fast fashion brands leverage on this by collaborating with influencers that enhance their appeal to Gen Z. More importantly, Ray and Nayak (2023) note that Gen Z consumers are increasingly skeptical of greenwashing, leading them to question a garment's sustainability and the justification of its price. Retailers often claim to uphold sustainability best practices by incorporating recycled materials, but may fail to disclose the actual percentage of recycled content in their garments, raising doubts regarding genuine sustainability claims.

3.3. Theoretical framework

This study was guided by three theoretical models that are explained further in detail in the next sub-sections.

3.3.1. Stimulus-Organism-Response model (S-O-R)

Mehrabian and Russell's 1974 development of the S-O-R model offers a profound understanding of consumer behaviour (Mishra, Shukla, Sharma, 2022; Vidyanata, 2022; Bigne, Chatzipanagiotou, Ruiz, 2020). The S-O-R model suggests that external stimuli trigger emotional reactions, resulting in consumers' behavioural responses (Mishra et al., 2022). When people encounter external stimuli, their internal emotional state changes, leading to changes in behaviour (Mishra et al., 2022). Figure 1 provides an exemplary visual representation of the S-O-R model.

Figure 1. Stimulus Organism Response (S-O-R) Model
Source: (Ligaraba, de Villiers, 2023).

The S-O-R model was applied in this study to illustrate the relationship between the stimuli associated with fast fashion consumption resistance factors from the cognitive dissonance and status quo bias theories (See Figures 2 and 3). The 'organism' represents the consumer's attitude, reflecting their emotional and cognitive responses to the 'stimuli'. The 'response' focuses on Gen Z consumers' resistance to purchasing slow-fashion denim jeans. The S-O-R model is particularly relevant in this study, as it provides a comprehensive understanding of how external stimuli influence consumers' emotional states and attitudes. Potentially leading to resistance to slow-fashion denim jeans, revealing the emotional and psychological barriers that hinder a shift towards more sustainable slow fashion choices.

The S-O-R model has its limitations, as noted by Sivasothey, Yeo, and Tan (2024), who questioned its reliability in healthcare due to potential overgeneralisation when variables are too broad. Critics also highlight the model's emphasis on stimuli while neglecting the cognitive aspects of consumer behaviour, as cognition is not solely triggered by external factors (Hochreiter, Benedetto, Loesch, 2023). Additionally, the model requires thorough consideration of perception, which influences response behaviour (Grijs, 2024). As a result, this study incorporated other theoretical frameworks, such as the Cognitive Dissonance Theory (CDT) and Status Quo Bias (SQB), to overcome the stipulated shortcomings of the S-O-R model.

3.3.2. Cognitive Dissonance Theory

Leon Festinger developed the Cognitive Dissonance Theory (CDT) in 1957 (McLeod, 2023). Cognitive dissonance refers to any situation involving conflicting beliefs, actions, or behaviours. Tueanrat and Alamanos (2023) are of the view that dissonance occurs when there is inconsistency within cognitive elements, such as conflicting knowledge, opinions, beliefs, or behaviours, causing mental discomfort and motivating individuals to take action to reduce or eliminate it.

Cognitive elements can be relevant and consonant, relevant but dissonant, or irrelevant. Dissonance arises from logical inconsistencies, cultural differences, or contradictions between opinions and general stances (Tueanrat, Alamanos, 2023). Managers ought to consider other cognitions before reaching managerial decisions (Tueanrat, Alamanos, 2023) that may have a direct or indirect impact on consumers. CDT can be applied when consumers face dissonance in their behavioural patterns (Villines, 2024). Although cognitive dissonance is an internal experience that cannot be observed, it motivates individuals to resolve experienced discomfort (Cherry, 2022).

Several studies have applied CDT to behaviours like smoking, meat consumption, household chores, and fast fashion purchases (Pericas, Gonzalez, Bennasar, De Pedro, Aguilo, Bauza, 2009; Tian, Hilton, Becker 2016; McLeod, 2023; Cherry, 2022). For instance, smokers may experience conflict knowing their habit is harmful to health, but still find it relaxing. Cognitive dissonance arises as they grapple with these conflicting beliefs (Villines, 2024). To resolve this, individuals may therefore alter their beliefs or actions (Pericas et al., 2009). Causes of cognitive dissonance include social pressures, addiction, decision-making dilemmas, and negative past experiences (Tian et al., 2023).

In context to this study, focusing on consumers who have not purchased slow-fashion denim jeans, we examined two CDT variables namely: belief and action. Belief refers to contradicting actions, where individuals hold a belief but act opposite to it (Villines, 2024). The study aimed to understand Gen Z's beliefs about slow denim fashion to gain

insights into their choice for the impulsive purchase of fast fashion. Though CDT has some shortcomings as indicated by Colthirst-Reid (2022) who pointed out that it lacks a standard definition of dissonance, often described as psychological discomfort, other studies tend to focus on variables rather than the experience of dissonance. There is also criticism regarding the assumption that belief inconsistency directly leads to dissonance (Colthirst-Reid, 2022). This study addresses some of these limitations by incorporating the Status Quo Bias model and the S-O-R model, proposing that attitudes related to beliefs and actions drive resistance to slow-fashion denim jeans. Figure 2 presents the original CDT.

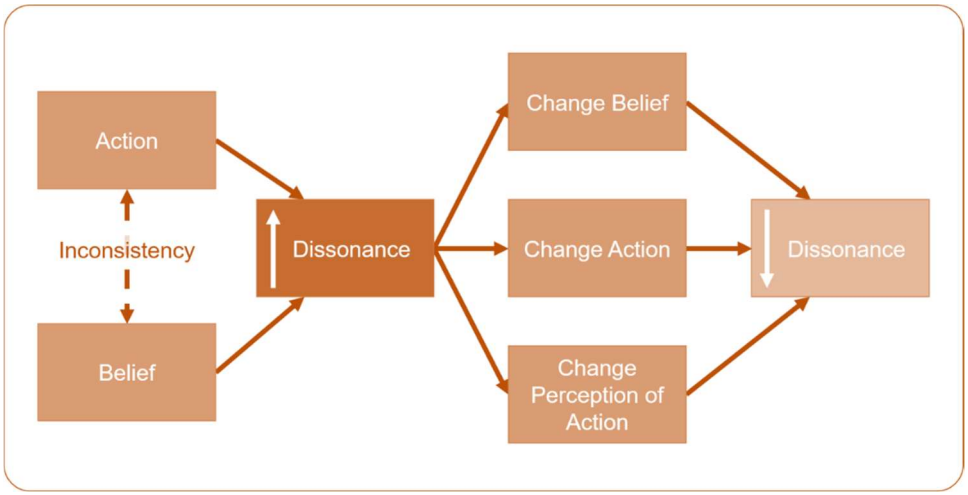

Figure 2. Cognitive Dissonance Theory

Source: (Marczewski, 2017).

3.3.3. Status Quo Bias Model

The Status Quo Bias Model (SQBM) was developed by William Samuelson and Richard Zeckhauser in 1988 (Samuelson, Zeckhauser, 1988). SQBM offers a framework for understanding why individuals often favour maintaining their current situation rather than embracing change or new experiences, even when change could lead to potential benefits rather than the current status quo (Cheng, 2023). According to Cheng (2023), the SQBM influences decision-making by predicting that individuals, accustomed to their current state, are reluctant to deviate from their established norms. Inertia, loss aversion, and sunk cost are closely linked concepts within the SQBM (Godefroid, Plattfaut, Niehaves, 2023).

Inertia, a significant factor in consumer decision-making, refers to the resistance that any physical object encounters (Butto, 2021). This resistance can diminish the desire to purchase alternatives, as noted by Butto (2021). Gen Z inertia can manifest as a reluctance to discard fast fashion habits, despite increasing awareness of the negative social and environmental impacts associated with fast fashion, preferring instead to continue with familiar consumption patterns. Whereas loss aversion, a concept introduced by Kahneman

and Tversky (1979), suggests that individuals perceive losses as more significant than equivalent gains (Godefroid et al., 2023). As a result, people often forgo potential benefits due to their fear of loss, even when the possible gain outweighs the perceived loss (Godefroid et al., 2023).

Sunk costs refer to any time, effort, or money already invested in a particular course of action (Godefroid et al., 2023). Individuals often justify their behaviours by not wanting to waste their previous investments, thus preferring to remain in the status quo (Godefroid et al., 2023). For Gen Z, while they may be comfortable purchasing fast fashion impulsively, the SQBM suggests that they would immensely benefit from purchasing slow denim apparel, yet they tend to persist with fast fashion due to psychological barriers.

Three variables were therefore adopted from the SQBM, as they are crucial to understanding the context of this study. The SQBM serves as the underpinning theory, as it suggests that individuals are more inclined to maintain their current state (purchasing fast fashion) than to try new products, such as slow denim jeans. Therefore, more variables were incorporated from the SQBM than from S-O-R and CDT, as shown in Figure 3.

3.3.4. Conceptual model of the study

This study is underpinned by the integration of the S-O-R model, SQBM and CDT to address the main research question. The S-O-R model underpins the three-tier conceptual model in Figure 3, in which the external stimuli consists of variables derived from both the SQBM and CDT, while the commonly used organism variable, “attitude”, is incorporated to capture consumers' organism reaction derived from stimuli. The outcome or response is the resistance to slow denim fashion as the dependent variable. The SQBM represents the core of this study, focusing on realising the resistance factors regarding resistance to slow denim fashion purchases that require contemporary management considerations within the fashion industry.

As presented in Figure 3, the hypotheses of this study are formulated as follows:

H1: Consumer beliefs positively and significantly influence attitudes toward the resistance of slow denim jean purchases

H2: Consumer action positively and significantly influences attitude towards the resistance of slow denim jean purchases

H3: Inertia positively and significantly influences attitude toward the resistance of slow denim jean purchases

H4: Loss aversion positively and significantly influences attitude towards the resistance of slow denim jean purchases

H5: Psychological commitment positively and significantly influences attitude toward the resistance of slow denim jean purchases

H6: Consumer attitude towards slow denim jean purchases positively and significantly influences the resistance to slow denim jean purchases

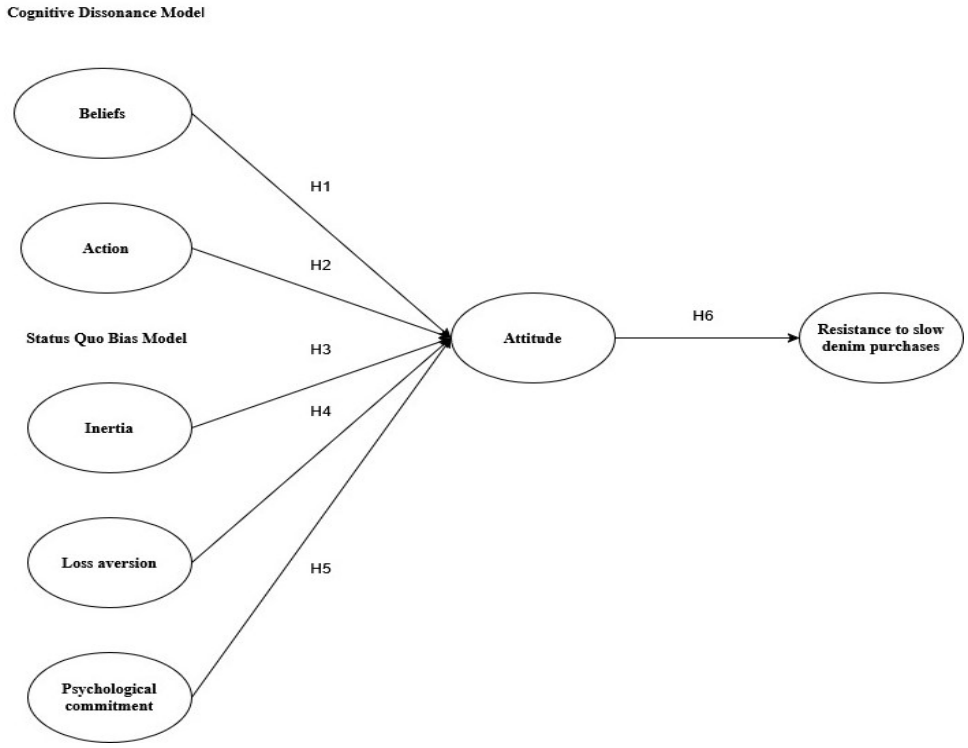

Figure 3. Study Conceptual Model
Source: (Author's compilation, 2025).

4. METHODOLOGY

A quantitative research approach and a descriptive research design aligned with this study. The population included young consumers aged 18 to 29 (Gen Z) who purchase or purchased fast fashion instead of slow denim jeans. The ages of the participants ranged from 18 to 29 years as supported by Rojas (2020), who defined people belonging to Gen Z as those born between 1995 and 2010. Due to ethical reasons, this study only included responses from those aged 18 to 29 years. Data was collected using an online survey through Survey Monkey. The online link from where respondents could access the questionnaire was conveniently distributed to all the prospective respondents through the researcher's social media platforms. A total of 184 fully completed questionnaires were obtained after six weeks of data collection, with an 82% response rate. The sample size of 184 was suitable for quantitative data analysis using the latest Statistical Package for the Social Sciences (SPSS).

5. RESULTS AND FINDINGS

5.1. Demographic results

Demographic results indicated that 76%, were within the 22-25 age group, 14% were between 18-21 years old, and 10% were in the 26-29 range – all falling within the Gen Z

age group. Among all the participants, 88% were female, and just 12% were male. No respondents identified as non-binary, third-gender, or any other gender identity. A total of 52 had completed a bachelor's degree, 48 had achieved a master's degree, indicating a higher educational achievement among respondents. Additionally, 26 respondents declared having a high school diploma or its equivalent. The remaining (58) participants attended some college but did not earn a degree. Lastly, 43% of the respondents enjoy a regular income, and the same percentage depend on sources like pocket money, scholarships, or loans, influencing their perspective on this research. Only 10% of the participants are self-employed, and 4% are either unemployed or working part-time.

5.2. Reliability and validity

Exploratory factor analysis (EFA) was implemented to determine the validity to indicate how strongly each item is related to the factor. The EFA results ranged from 0.64 to 0.79, which was higher than the recommended threshold of 0.3 stipulated by Child (2006). To ensure construct validity was accomplished, the researcher's adopted and adapted statements used in the online survey from the extant literature. Whereas Cronbach's alpha (α) coefficient was calculated to determine reliability. The Cronbach alpha values were 0.84 for beliefs, 0.97 for action, 0.90 for inertia, 0.79 for loss aversion, and 0.84 for psychological commitment. The attitude construct had a Cronbach's alpha of 0.88. According to Malhotra (2010), a Cronbach's alpha of less than 0.50 is unacceptable, those between 0.50 and 0.69 are adequate, and values above 0.70 are deemed acceptable. Since all the constructs exceeded 0.70, they were retained and considered reliable.

5.3. Regression analysis

Using SPSS, regression analysis was conducted to test the conceptual model and address the proposed hypothesis presented earlier. The results are represented in Table 1.

Table 1. Regression results

Relationship	Hypothesis	Beta Coefficient	Std. Error	t-value	p-value	Std. Coefficient	Decision
B → ATT	H_1	-0.234	0.121	-2.351	0.001	-0.228	Supported
AC →ATT	H_2	0.397	0.095	0.267	0.602	0.387	Not supported
IN →ATT	H_3	0.159	0.126	1.471	0.024	0.216	Supported
LA →ATT	H_4	-0.061	0.094	-0.497	0.030	0.398	Supported
PC →ATT	H_5	-0.328	0.118	-2.134	0.000	-0.328	Supported
ATT→ RE	H_6	0.187	0.101	-0.674	0.001	0.164	Supported

Source: Author's compilation (2025).

6. DISCUSSION OF EMPIRICAL RESULTS

Respondents' personal beliefs do not align with the adoption of slow denim fashion, contributing to a resistant attitude (Beta= -0.234, t= -2.351, p=0.001). We therefore accept the hypotheses, H1, that consumer beliefs positively and significantly influence attitude toward the resistance of slow denim jean purchases. As a result, respondents from social or religious groups may collectively resist purchasing slow denim fashion, reinforcing an overall resistant attitude among Gen Z. This finding aligns with studies by Macready, Hiekeb, Klimczuk-Kochańskac, Szumiałc, Vrankend and Grunerte (2020) and Cheung and

To (2021), who suggest that beliefs do not always lead to sustainable purchasing, particularly when there is a disconnect between the motivation to buy sustainably and actual consumer demand. However, other studies, such as that of Majeed, Aslam, Murtaza, Attila, and Molnár (2021), indicated that beliefs about sustainability can mediate the relationship between product pricing and purchase intentions. Similarly, Mai et al. (2021) emphasised that beliefs play a role in positively shaping consumer behaviour, especially regarding health and environmental concerns.

Respondents reported that actions did not directly influence their resistance to slow denim jeans; increased engagement with slow fashion could potentially enhance their purchase intentions (Beta= 0.397, t= 0.267, p=0.602); thus, H2 was not supported. While some studies, such as Edge and Hermann (2021) as well as Ortega-Egea and García-de-Frutos (2019), found support for the idea that consumer actions influence sustainable purchasing – particularly with awareness of product origins and the impact on the supply chain – this study did not find similar results. Rakib, Chang, Jones, and Jung (2022) further highlighted that consumer actions can be powerful drivers of behaviour, particularly in sustainable consumption. Macready et al. (2020) as well as Rakib, Chang and Jones (2022), argued that actions and motivations for sustainable purchasing may not always align.

Results indicate that respondents showed a preference for fast fashion, resulting in resistance to slow-fashion denim. Inertia creates a barrier to switching to slow-fashion denim, despite the potential environmental and economic benefits (Beta= 0.159, t= 1.471, p=0.024). We therefore accept the hypotheses, H3, that inertia positively and significantly influences attitude toward the resistance of slow denim jean purchases. The data showed strong alignment with previous studies, including those of Henderson, Steinhoff, Harmeling, and Palmatier (2021), who found that inertia significantly impacts purchasing behaviour, particularly in established habits. Similarly, Seth, Talwar, Bhatia, Saxena, and Dhir (2020) revealed that inertia is a key factor in resistance to changes in purchasing patterns.

Additionally, the concept of loss aversion is strong among Gen Z; they prefer avoiding potential losses over acquiring the perceived gains of slow denim fashion. This aversion contributes to their resistance, as the potential for loss psychologically outweighs any potential gain as the results of this study stipulate (Beta= -0.061, t= -0.497, p=0.030). Hence, H4 was supported. These empirical findings align with studies by Zhou, Yuen and Ye (2022) and Xu, Meng, Chen, and Zhao (2023), who indicated that loss aversion affects consumer decision-making, especially when financial trade-offs are perceived. The variation in responses further supports research by Gächter, Johnson and Herrmann (2022), who noted that factors like education and age could influence the degree of loss aversion in consumer behaviour. For Gen Z, who are relatively young and often budget-conscious, cost perceptions vary widely depending on individual financial priorities. However, it's important to note that Ortiz, Zindel and Da Silva (2023) found no effect of loss aversion on cheating behaviour, indicating the need to further explore the proposed relationship within specific and diverse contexts.

Psychological commitment, considered as emotional attachment, trust, and reliability associated with fast fashion brands, further entrenches Gen Z resistance. These emotional commitments go beyond inertia, as they reflect a deliberate preference for fast-fashion denim due to a deeper connection. Shifting consumers towards slow fashion will require significant motivational factors that challenge current attachments (Beta= -0.328, t= -2.134, p=0.000), therefore, H5 was supported. Our findings are consistent with those of Roberts-Lombard, Nemadzhilili, Coelho, and Mangope (2022), as well as Amoroso and

Ackaradejruangsri (2024), who concluded that psychological commitment significantly influences loyalty and purchase intentions. Furthermore, Cahaya, Mursitama, Hamsal and Tjhin (2023) found that psychological commitment affects consumer behaviour and leads to overall trust and commitment, particularly in e-loyalty contexts. However, in this study, the results suggest that Gen Z's psychological commitment to slow denim may vary, possibly due to competing interests and the availability of fast fashion options.

Positive attitudes can increase purchases, while negative attitudes enhance resistance (Beta= -0.187, t= -0.674, p=0.001). We therefore accept the hypotheses, H6, that consumer attitude towards slow denim jean purchases positively and significantly influences the resistance to slow denim jean purchases. Mustaphi (2024) and Anshu, Gaur and Singh (2022), highlighted that consumer attitudes do impact behaviours, especially concerning purchase intentions. Furthermore, Burgese and Cha (2024) found that resistance influences consumer behaviour regarding autonomous vehicles due to perceived complexity and risks. The result for H6, as supported in this study, proposes that other factors, such as habit or cost, may influence slower fashion purchasing decisions than negative Gen Z attitudes.

7. DELIMITATIONS AND LIMITATIONS

As with any other study, the problem of scarce resources limits the study's scope. This study was carried out in South Africa, an emerging economy, underscored by both financial and non-financial resource restrictions. Respondents were only those who fell within the Gen Z age bracket (18 to 29 years) as supported by Rojas (2020). The respondents had to be consumers of fast denim fashion and had not purchased slow denim fashion. Moreover, there were several limitations, such as this study only focused on a sample from an emerging economy (South Africa), and future studies can be conducted in other types of economies, preferably the developed world with a diverse cultural background. Since data was collected using self-reported means, the responses may be impacted by bias or false reporting. To increase accuracy, validity, and representativeness, future research should employ controlled sampling techniques, apply triangulated survey data with behavioral measures or interviews. The sample size would not allow the generalisation of the results; hence, future researchers could increase the sample size and adopt probability sampling techniques to make the results more generalisable for managerial decision-making. Future studies could attempt to use a mixed research approach to capture in-depth nuances of resistance to slow fashion consumer behaviour.

8. CONCLUSIONS

Critical recommendations that, if implemented by contemporary managers effectively, could lead to a positive shift in Gen Z consumers' attitudes and increase their purchase intentions for slow-fashion denim jeans could include emphasising key aspects of the slow fashion business model—such as sustainability, quality, transparency, ethical production, and a reduced environmental footprint to evoke positive beliefs. Moreover, contemporary business models should be aligned with UN SDG 12 to reshape consumers' perceptions. Such an approach highlights the value and necessity of slow-fashion denim, positioning it as a conscious and responsible choice. Regarding preferred action towards slow fashion purchases, managers should instill the promotion of sustainable choices by involving consumers in recycling initiatives and encouraging active participation in environmental stewardship. Slow denim brand managers should leverage digital marketing strategies and

collaborate with social media influencers to counteract consumer inertia, where individuals tend to stick with familiar fast-fashion choices. This approach can boost a brand's sustainable visibility and resonate with Gen Z consumer's future sustainable decision making.

Slow fashion brands can address loss aversion by positioning slow denim as a smart, low-risk, high-reward investment. By emphasising slow-fashion denim's long-term benefits and durability, contemporary management can reassure Gen Z consumers that their purchase will yield lasting value. To build a positive psychological commitment for slow denim, brands can create a community-focused experience that connects Gen Z consumers to the brand's sustainable mission. Engaging consumers through authentic storytelling, brand ambassadors (for example, from Levi's, Diesel, Wrangler), and partnerships with influencers who resonate with the slow fashion ethos can foster a shared purpose. Contemporary managers can devise educational campaigns, whether delivered through social media or in-store experiences, that can significantly shift Gen Z consumer attitudes by raising awareness of slow fashion's environmental benefits and quality, since they are digital natives. The campaigns can address common misconceptions about slow fashion, such as being less stylish, susceptible to greenwashing, or excessively costly.

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REFERENCES

Amoroso, D. L., Ackaradejruangsri, P. (2024). Brand commitment as predecessor to the factors of continuance intention. *Journal of Marketing Analytics,* 1-15. https://doi.org/10.1057/s41270-024-00333-y

Anshu, K., Gaur, L., Singh, G. (2022). Impact of customer experience on attitude and repurchase intention in online grocery retailing: A moderation mechanism of value Co-creation. *Journal of Retailing and Consumer Services, 64*, 102798. https://doi.org/10.1016/j.jretconser.2021.102798

Bigne, E., Chatzipanagiotou, K., Ruiz, C. (2020). Pictorial content, sequence of conflicting online reviews and consumer decision-making: The stimulus-organism-response model revisited. *Journal of Business Research, Vol. 115*(July), 403-416. https://doi.org/10.1016/j.jbusres.2019.11.031

Burgese, L., Cha, K. J. (2024). Investigating trust leap with AI: a consumer's behavioural model on autonomous vehicle acceptance. *International Journal of Technological Learning, Innovation and Development, 15*(4), 449-475.

Butto, N. (2023). The nature and origin of inertia. *Journal of High Energy Physics Gravitation and Cosmology, 7*(2), 1-12. https://doi.org/10.4236/jhepgc.2021.72044

Cahaya, Y. F., Mursitama, T. N., Hamsal, M., Tjhin, V. U. (2023). Increasing e-loyalty of banking customers through customer trust and commitment. *International Journal of Applied Economics, Finance and Accounting, 15*(2), 96-104.

Cheng, Z. (2023). The impact of status quo bias on people's choices. *Advances in Economics Management and Political Sciences, 10*(1), 111-115. https://doi.org/10.54254/2754-1169/10/20230442

Cherry, K. (2022). *Cognitive dissonance and the discomfort of holding conflicting beliefs*. https://www.verywellmind.com/what-is-cognitive-dissonance-2795012

Cheung, M. F. Y., To, W. M. (2019). An extended model of value-attitude behaviour to explain Chinese consumers' green purchase behavior. *Journal of Retailing and Consumer Services, 50*(September), 1-8.

Child, D. (2006). *The essentials of factor analysis*. 3rd ed. Continuum.

Colthirst-Reid, M. V. (2022). *Revisiting Cognitive Dissonance: A Closer Look at the Core Assumptions of a Classic Theory* (Master's thesis, The University of Western Ontario).

De Oliveira, L. G., Miranda, F. G., De Paula Dias, M. A. (2022). Sustainable practices in slow and fast fashion stores: What does the customer perceive? *Cleaner Engineering and Technology, 6*, 1-9. https://doi.org/10.1016/j.clet.2022.100413

Edge, S. M., Hermann, M. (2021). Bridging the gap between corporate sustainability commitments and consumer action: nutrition communications help consumers contribute to a more sustainable food value chain. *Nutrition Today, 56*(5), 246-252.

Fraguito, A. S. (2023). *Consumers' sustainable fashion consumption intention: a focus on circular fashion practices and slow fashion*. Master's thesis, University of Porto. https://repositorio-aberto.up.pt/bitstream/10216/155775/2/651660.pdf

Gächter, S., Johnson, E. J., Herrmann, A. (2022). Individual-level loss aversion in riskless and risky choices. *Theory and Decision, 92*(3), 599-624.

Global Market Insights, (2023). *Sustainable clothing market size*. https://www.gminsights.com/industry-analysis/sustainable-clothing-market

Godefroid, M., Plattfaut, R., Niehaves, B. (2023). How to measure the status quo bias? A review of current literature. *Management Review Quarterly, 73*(1), 1-45.

Gouveia, S., Chabata, T. T. (2023). Dynamics of social media metrics and fashion sub-culture among young South African TikTok users. *Communitas*, *28*, 38-52. https://doi.org/10.38140/com.v28i.7461

Grijs, I. (2024). *Revamping stimulus-response models: a transition to stimulus-organism-response frameworks. Medium*. https://medium.com/@ingvargrijs/revamping-stimulus-response-models-a-transition-to-stimulus-organism-response-frameworks-599ce8dd1833

Halim, L. V., Hariyanto, V. H., Yudiarso, A., Setiasih, Anggraini, E., Parindra, K., Yuniarti, N. A. (2023). *Understanding impulsive buying for fashion products in Generation Z*. University of Surabaya, Surabaya, October: 1-10. https://www.researchgate.net/publication/374367448_understanding_impulsive_buying_for_fashion_products_in_generation_z

Henderson, C. M., Steinhoff, L., Harmeling, C. M., Palmatier, R. W. (2021). Customer inertia marketing. *Journal of the Academy of Marketing Science, 49*(2), 350-373. https://doi.org/10.1007/s11747-020-00744-0

Hochreiter, V., Benedetto, C., Loesch, M. (2023). Review and analysis of the stimulus response in consumer behavior, organizational culture and leadership theory. *International Journal of Management*, *Marketing, and Decision Sciences, 3*(1), 25-36.

Igini, M. (2023). *'10 concerning fast fashion waste statistics'*. Earth.org. https://earth.org/statistics-about-fast-fashion-waste/

Illiminem. (2024). *'Behind the seams: shocking fast fashion facts you need to know'*, Illuminem Voices. https://illuminem.com/illuminemvoices/behind-the-seams-shocking-fast-fashion-statistics-you-need-to-know

Jung, S., Jin, B. (2014). A theoretical investigation of slow fashion: sustainable future of the apparel industry. *International Journal of Consumer Studies, 38*(5), 510-519. https://doi.org/10.1111/ijcs.12127

Kahneman, D., Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*, 263-291.

Li, Z., Zhou, Y., Zhao, M., Guan, D., Yang, Z. (2024). The carbon footprint of fast fashion consumption and mitigation strategies: A case study of jeans. *Science of The Total Environment*, *924*(11), 1-11. https://doi.org/10.1016/j.scitotenv.2024.171508

Ligaraba, N., de Villiers, M. V. (2023). *What's love got to do with it? The Role of Emotions in the Consumption of Energy Drinks Among Young Consumers in South Africa*. In EMCB 2023 Conference Proceedings, 159.

Liu, J. (2022). *Research on the Business Strategy and Deficiency of the Fast Fashion Industry to Enhance Development-a Case Study of Shein*. In 2022 2nd International Conference on Economic Development and Business Culture (ICEDBC 2022) (pp. 1794-1801). Atlantis Press.

Liu, Y., Hei, Y. (2021). Exploring Generation Z Consumers' Attitudes towards Sustainable Fashion and Marketing Activities regarding Sustainable Fashion. Digitala Vetenskapliga Arkivet. https://www.diva-portal.org/smash/get/diva2:1561061/FULLTEXT01.pdf

Macready, A. L., Hiekeb, S., Klimczuk-Kochańskac, M., Szumiałc, S., Vrankend, L., Grunerte, K. G. (2020). Consumer trust in the food value chain and its impact on consumer confidence: A model for assessing consumer trust and evidence from a 5-country study in Europe. *Food Policy, 92*(April), 1-15. https://doi.org/10.1016/j.foodpol.2020.101880

Majeed, M. U., Aslam, S., Murtaza, S. A., Attila, S., Molnár, E. (2021). Green marketing approaches and their impact on green purchase intentions: Mediating role of green brand image and consumer beliefs towards the environment. *Sustainability, 14*(18), 1-18. https://doi.org/10.3390/su141811703

Mäkelä, E. (2022). The rise of slow fashion. Metropolia University of Applied Sciences, October: 1-50. https://www.theseus.fi/handle/10024/788064

Malhotra, N. K., (2010). *Marketing research: an applied orientation*. 6th ed. Upper Saddle River, NJ: Pearson Prentice-Hall.

Marczewski, A. (2017). *Cognitive Dissonance*. https://www.gamified.uk/2017/07/14/cognitive-dissonance-gamification/

McLeod, S. (2023). *What is cognitive dissonance theory?* https://www.simplypsychology.org/cognitive-dissonance.html

Mishra, A., Shukla, A., Sharma, S. K. (2022). Psychological determinants of users' adoption and word-of-mouth recommendations of smart voice assistants. *International Journal*

of Information Management, 67(4), 102413. https://doi.org/10.1016/j.ijinfomgt.2021.102413

Mulhern, O. (2022). *The 10 Essential Fast Fashion Statistics*. https://earth.org/fast-fashion-statistics/

Mustaphi, B. M. (2024). Consumer Attitude and Its Implication on Marketing with Respect to Selected Brands. *International Journal of Management (IJM), 15*(1).

Ortega-Egea, J. M., García-De-Frutos, N. (2019). Mapping the influence of country-of-origin knowledge, consumer ethnocentrism, and perceived risk on consumer action against foreign products. *Journal of Consumer Behaviour, 20*(5), 1-14. https://doi.org/10.1002/cb.1923

Ortiz, J. M., Zindel, M., Da Silva, S. (2023). The effect of loss aversion and entitlement on cheating: An online experiment. *Acta Psychologica, 233*, 103843.

Pericas, J., Gonzalez, S., Bennasar, M., De Pedro, J., Aguilo, A., Bauza, L. (2009). Cognitive dissonance towards the smoking habit among nursing and physiotherapy students at the University of Balearic Islands in Spain. *International nursing review, 56*(1), 95-101. https://doi.org/10.1111/j.1466-7657.2008.00669.x

Rakib, M. A. N., Chang, H. J. J. J., Jones, R. P., Jung, K. (2022). The Effects of Brand Emotion and Action Desire on Sustainable Consumer Behavior: The Moderating Roles of Gender and Sustainability Motivation. In International Textile and Apparel Association Annual Conference Proceedings (*78*(1)). Iowa State University Digital Press.

Rakib, M. A. N., Chang, H. J., Jones, R. P. (2022). Effective sustainability messages triggering consumer emotion and action: An application of the social cognitive theory and the dual-process model. *Sustainability, 14*(5), 2505. https://doi.org/10.3390/su14052505

Ray, S., Nayak, L. (2023). Marketing sustainable fashion: trends and future directions. *Sustainability, 15*(7), 6202.

Roberts-Lombard, M., Nemadzhilili, F. H., Coelho, G. S., Mangope, O. S. (2022). Investigating the antecedents and outcome of commitment in a business-to-consumer service environment. *Acta Commercii, 22*(1), 1-15. https://doi.org/10.4102/ac.v22i1.1028

Rojas, A. (2020). *Who are the youth of today?* Generation unlimited. https://www.unicef.org/cuba/en/publications/who-are-the-youth-today-generation-unlimited

Samuelson, W., Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty, 1*(1), 7-59. https://doi.org/10.1007/BF00055564

Sembawa, A. A. (2019). Fast fashion: The impact of impulse purchasing on shoppers' post-purchase emotion (regret), re-patronage intention, and switching intention. Department of Marketing. Tuwhera open access. November, 1-144. Auckland University of Technology. https://openrepository.aut.ac.nz/handle/10292/13359

Seth, H., Talwar, S., Bhatia, A., Saxena, A., Dhir, A. (2020). Consumer resistance and inertia of retail investors: Development of the resistance adoption inertia continuance (RAIC) framework. *Journal of Retailing and Consumer Services, 55*, 102071. https://doi.org/10.1016/j.jretconser.2020.102071

Sivasothey, J. A., Yeo, S. F., Tan, C. L. (2024). Assessing the applicability and reliability of the SOR theory in the healthcare sector: A comprehensive review of recent research. *PaperASIA, 40*(1), 1–12.

Thakker, R., Sun, M. (2023). *Sustainable development goals for textiles and fashion*. Environmental Science and Pollution Research, 30(September), 1-21.

Tian, Q., Hilton, D., Becker, M. (2016). Confronting the meat paradox in different cultural contexts: Reactions among Chinese and French participants. *Appetite, 96*, 187-194. https://doi.org/10.1016/j.appet.2015.09.009

Tueanrat, Y., Alamanos, E. (2023). *Cognitive dissonance theory: A review*. Theory Hub Book. https://open.ncl.ac.uk

Valenga, A. C. V., Stefani, S. R., Carvalho, L. M. C., Chiusoli, C. L. (2023). The influence of green fashion products on the achievement of the 12 sustainable development goals for master's and doctoral students. *Revista De Administração Da UFSM, 16*(1), 1-25. https://doi.org/10.5902/1983465971311

Van Lierop, S. A. P. (2023). *Generation Z reaching adulthood in society: Perceptions of Generation Z's impact on the construction of societal challenges and organizational changes in Western Europe: A qualitative exploration*. Department of Urban Studies (US), October, 1-91.

Vidyanata, D. (2022). Stimulus-organism-response (S-O-R) model application in examining the influence of social media marketing on purchase decisions in the healthcare industry: The mediating role of brand trust. *Jurnal Aplikasi Manajemen, 20*(3), 1-18. https://doi.org/10.21776/ub.jam.2022.020.03.14

Villines, Z. (2024). *What is cognitive dissonance?* https://www.medicalnewstoday.com/articles/326738

Webber, N., Ritch, E. (2023). *The role of impulse buying on fast fashion consumers' emotions and behaviours*. University for the common good, November, 1-5.

Xu, J., Meng, Q., Chen, Y., Zhao, J. (2023). Dual-channel pricing decisions for product recycling in green supply chain operations: Considering the impact of consumer loss aversion. *International Journal of Environmental Research and Public Health, 20*(3), 1-15. https://doi.org/10.3390/ijerph20031792

Yasin, H., Julita, J., Hidayat, R. (2023). The effect of social media on Gen Z, impulse buying and lifestyle in purchase decisions. *Journal of International Conference Proceedings, 6*(3), 201-211. https://doi.org/10.32535/jicp.v6i3.2559

Zhou, Q., Yuen, K. F., Ye, Y. (2022). The effect of brand loyalty and loss aversion on competitive trade-in strategies. *Total Quality Management & Business Excellence, 33*(9-10), 1084-1112. https://doi.org/10.1080/14783363.2021.1933423

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DATA MONETIZATION FOR DRIVING INNOVATION IN SMES: A STUDY OF SELECTED REGISTERED SMES IN NIGERIA

Purpose: This paper aims to examine the influence of data monetization dimensions on SMEs innovation: a study of registered SMEs in Kwara state. Specifically, it examined: the effect of data relevance, data quality and data visualization on SMEs innovation.
Methodology: Descriptive survey research design was adopted to study 782 registered SMEs in Ilorin. Sample of 265 SMEs were administered structured questionnaire. Data collected was analyzed using PLS-SEM.
Result: Findings revealed that Data Relevance has the strongest effect on SMEs Innovation (β=0.377, t=6.144, p<0.000), followed by data visualization (β=0.347, t=4.443, p<0.000), and data quality (β=0.213, t=3.185, p=0.002).
Contribution: Data monetization is vital for SMEs Innovation in Kwara State. It is important that managers should focus on developing unique and appealing data visualization, data relevance, and data quality that can ensure a strong data monetization for their SMEs innovation.

Keywords: data monetization, SMEs innovation, data relevance, data quality, data visualization.

1. INTRODUCTION

The relationship between technological advancements and the economic performance of Small and Medium Enterprises (SMEs) has been an area of growing interest, particularly as emerging markets like Nigeria increasingly depend on SMEs for job creation and poverty reduction. In Kwara State, Nigeria, SMEs have been recognized for their potential to drive economic diversification and improve GDP growth (Bashir, Ondigo, 2018). However, these enterprises face significant challenges in leveraging new technologies and business models for sustainable growth. Recent studies suggest that enhancing digital capabilities, particularly in data management and analytics, could offer a pathway to innovation and improved performance for SMEs in the region (Bashir, Ondigo, 2018; African Scholar Publications, 2021).

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For SMEs to fully harness the potential of data-driven innovation, they must overcome barriers such as inadequate IT infrastructure and fragmented data systems. Many SMEs in Kwara State still grapple with basic data management challenges, including difficulties in locating and maintaining data within their systems. These challenges not only hinder operational efficiency but also limit their ability to expand into international markets, where robust data systems and compliance with complex cross-border regulations are increasingly essential (World Economic Forum, 2023). Addressing these issues requires strategic investments in IT solutions and stronger data governance frameworks (World Economic Forum, 2023).

Moreover, access to financing remains a critical barrier for many SMEs in Kwara State. Despite the important role these enterprises play in the local economy, their growth is often stifled by limited access to financial products tailored to their needs. Studies have shown that financial institutions are often hesitant to extend credit to SMEs due to perceived risks, leaving many enterprises without the capital needed to invest in innovative technologies or scale their operations (Dalhat, Hassan, 2016). This highlights the need for more inclusive financial models that cater specifically to the unique challenges faced by SMEs in developing markets (Dalhat, Hassan, 2016; Oluitan, 2014).

Given the multifaceted challenges faced by SMEs in Kwara State, future research and policy interventions must focus on improving access to both technological and financial resources. Such efforts are essential for enabling these enterprises to become engines of innovation and economic growth in the region. Promoting the adoption of digital platforms and improving access to affordable credit could help unlock new opportunities for SMEs, allowing them to compete in a rapidly evolving global market (African Scholar Publications, 2021).

Small and medium-sized enterprises (SMEs) face significant challenges in innovation, particularly when it comes to the relevance of data. In the context of open innovation, ensuring that the data used aligns with strategic goals can be problematic for SMEs, as they often struggle with inadequate resources to manage and process large volumes of data. When data relevance is overlooked, SMEs may fail to derive actionable insights, leading to inefficient decision-making and misaligned innovation efforts (Jia, 2023). Moreover, many SMEs rely on outdated or irrelevant data sources, making it difficult to anticipate market shifts and customer demands, which ultimately hampers their competitive edge in rapidly evolving industries (Millers, Gaile-Sarkane, 2021).

The issue of data quality also presents significant barriers for SMEs aiming to innovate. Poor-quality data, characterized by inaccuracy, inconsistency, and incompleteness, can undermine the decision-making processes in these businesses. Without access to reliable data, SMEs risk investing resources into innovations that do not meet market needs or fail to deliver value. As Ning Jia (2023) highlights, the challenge of integrating high-quality data from both internal and external sources is a common bottleneck for SMEs, exacerbating the difficulty of fostering sustainable innovation. Poor data quality can further lead to flawed analysis, thus stalling progress in adopting new technologies or refining business models (Millers, Gaile-Sarkane, 2021).

Data visualization also poses problems, as SMEs often lack the expertise and tools to translate complex datasets into meaningful visual formats that inform strategic innovation decisions. Effective data visualization is crucial for identifying patterns and trends, but SMEs frequently rely on basic, inadequate tools that fail to communicate data insights effectively. This hampers their ability to act on innovation opportunities swiftly and confidently, particularly in fast-paced sectors where timely decisions are critical (Millers,

Gaile-Sarkane, 2021). Furthermore, inappropriate visualization techniques can mislead decision-makers, creating a disconnect between data interpretation and business goals, leading to misguided innovations.

Despite the recognized potential of data as a strategic asset, SMEs in Kwara State face significant challenges in effectively leveraging data monetization practices to drive innovation. While existing literature establishes theoretical linkages between data utilization and innovation outcomes, there is limited empirical evidence examining how specific dimensions of data monetization, particularly data relevance, data quality, and data visualization, individually and collectively influence innovation performance in Nigerian SMEs. This gap is particularly critical given the unique operational constraints, resource limitations, and infrastructural challenges faced by SMEs in emerging economies. Therefore, the fundamental problem this study addresses is: To what extent and through which specific dimensions does data monetization influence innovation outcomes in registered SMEs in Kwara State, Nigeria?

Specifically, this study examines the influence of three key dimensions of data monetization, data relevance, data quality, and data visualization, on SMEs innovation through a quantitative, hypothesis-testing approach.

2. LITERATURE REVIEW

2.1. Concept of Data Monetization

Data monetization refers to the process of generating measurable economic benefits from data. It encompasses a variety of practices where data is transformed into marketable products or services, thereby creating value. Organizations often leverage both internal and external data sources to enhance their decision-making processes, improve customer experiences, and develop new revenue streams. As data becomes a critical asset, businesses across sectors are increasingly focusing on strategies that facilitate the effective use and commercialization of data, such as data analytics, data sharing, and collaborative ventures. The significance of data monetization is highlighted by its potential to drive innovation and competitive advantage in the digital economy (Bertini, 2021; Gupta, 2023).

The monetization of data is not without its challenges and considerations, particularly regarding privacy, security, and ethical implications. As organizations seek to capitalize on data, they must navigate complex regulatory landscapes and consumer expectations regarding data usage and consent. Additionally, companies need to invest in robust data management and analytics capabilities to unlock the full potential of their data assets. The ability to extract actionable insights from data can significantly influence operational efficiency and market positioning, underscoring the importance of a strategic approach to data monetization (Cugini, Ruggieri, 2020).

2.2. Concept of SMEs Innovation

Innovation among small and medium-sized enterprises (SMEs) is critical for fostering competitiveness and sustainable growth in today's dynamic market environment. SMEs are increasingly recognized for their role in driving innovation, contributing to economic development, and enhancing productivity. By adopting innovative practices, SMEs can differentiate themselves from larger competitors, respond more effectively to market demands, and leverage technological advancements. This innovation can manifest in various forms, including product development, process improvements, and the adoption of new business models. Notably, the agility and adaptability of SMEs often enable them to

implement innovative strategies more rapidly than larger firms (Hossain, Ahsan, 2021; Marzouk, 2022).

The innovation landscape for SMEs is shaped by numerous external and internal factors, including access to financing, collaborative networks, and the regulatory environment. Government policies that promote entrepreneurship and provide support for research and development can significantly influence the innovation capabilities of SMEs. Furthermore, the ability to form partnerships and engage in collaborative ventures can enhance SMEs' access to resources and knowledge necessary for innovation. As SMEs navigate these complexities, their success in innovation can lead to enhanced market positioning, increased competitiveness, and long-term sustainability (Fajria et al., 2020).

2.3. Effect of Data Monetization on SMEs Innovation

Data monetization has emerged as a crucial strategy for small and medium enterprises (SMEs) aiming to foster innovation and maintain competitiveness in rapidly evolving markets. By effectively leveraging data, SMEs can unlock new revenue streams, optimize existing operations, and enhance customer experiences. The capacity to analyze and monetize data enables SMEs to gain valuable insights into consumer behaviors and market trends, which can drive innovation in product development and service offerings. Furthermore, utilizing data-driven approaches allows SMEs to identify unique market niches, thus fostering a culture of continuous innovation and responsiveness to market demands (Nasrollahi et al., 2021; Sadraei et al., 2021).

Data monetization facilitates the establishment of strategic partnerships and collaborations, which are essential for innovation. SMEs can share insights and data analytics with other businesses, leading to co-innovation opportunities that may not be possible in isolation. This collaborative approach can enhance the overall innovation ecosystem by creating synergies among various stakeholders, including customers, suppliers, and technology partners. Additionally, the integration of advanced data analytics tools supports SMEs in refining their innovation strategies, allowing them to experiment with new ideas and iterate rapidly based on real-time feedback. Consequently, the transformative potential of data monetization is pivotal in enhancing SMEs' innovation capabilities and competitive positioning in the market (Nasrollahi et al., 2021; Sadraei et al., 2021).

2.4. Effect of Data Relevance on SMEs Innovation

The relevance of data plays a critical role in fostering innovation among small and medium-sized enterprises (SMEs). When SMEs access and utilize relevant data, they can better identify market trends, consumer preferences, and operational efficiencies, which are essential for innovative practices. According to Chen et al. (2021), relevant data enhances decision-making processes by aligning business strategies with market demands, ultimately leading to the development of innovative products and services. This connection between data relevance and innovation can help SMEs maintain competitiveness in an increasingly dynamic business environment (Wang et al., 2022).

Moreover, SMEs that leverage relevant data are positioned to respond swiftly to changing market conditions, thereby fostering a culture of innovation. As noted by Trivella et al. (2022), access to relevant information allows SMEs to identify opportunities for collaboration and partnerships, which can drive innovation. By integrating relevant data into their operational frameworks, SMEs can enhance their agility, leading to faster innovation cycles and improved responsiveness to customer needs (Johnson & Smith,

2020). This dynamic interplay underscores the importance of data relevance as a catalyst for innovation in SMEs.

Thus, we propose the first hypothesis as follows:

H1: Data Relevance has a positive influence on SMEs Innovation.

2.5. Effect of Data Quality on SMEs Innovation

Data quality significantly impacts innovation within SMEs, as it directly influences decision-making and strategic initiatives. High-quality data provides SMEs with accurate insights, enabling them to make informed choices that support innovation. According to Bag et al. (2020), organizations with robust data quality frameworks are better equipped to harness insights that lead to the development of new products and services. Poor data quality, on the other hand, can misguide decision-making processes, leading to missed opportunities for innovation (Gupta, Singh, 2021).

Furthermore, data quality affects the operational efficiency of SMEs, which is crucial for fostering a culture of innovation. As highlighted by Zhang and Zhao (2022), the ability to trust the data used in innovation efforts can enhance employees' confidence in their decision-making processes, resulting in a more proactive approach to innovation. Consequently, SMEs that prioritize data quality are more likely to achieve successful innovation outcomes, as they can leverage accurate and reliable information to drive strategic initiatives (Hossain et al., 2023). This alignment of data quality with innovation efforts underscores its importance in the SME landscape.

Thus, we propose the second hypothesis as follows:

H2: Data Quality has a positive influence on SMEs Innovation.

2.6. Effect of Data Visualization on SMEs Innovation

Data visualization plays a pivotal role in enhancing innovation among SMEs by transforming complex data sets into intuitive visual formats that facilitate understanding and analysis. By employing effective data visualization techniques, SMEs can quickly identify trends, patterns, and outliers within their data, which can spur innovative thinking and problem-solving. According to Ranjan et al. (2021), visualization tools enable SMEs to present data in a way that is easily digestible for stakeholders, fostering collaborative discussions around innovative ideas and strategies. This enhanced comprehension can significantly improve the decision-making process, thereby driving innovation forward.

Data visualization encourages a culture of data-driven decision-making within SMEs, which is essential for fostering innovation. As noted by Liu and Wang (2022), when SMEs implement data visualization strategies, they empower employees at all levels to engage with data, promoting a collaborative environment conducive to innovation. The ability to visualize data allows teams to brainstorm, experiment, and iterate on ideas more effectively, ultimately leading to the creation of innovative solutions that address market needs (Fischer et al., 2020). This synergy between data visualization and innovation highlights the importance of visual analytics in the SME sector.

Thus, we propose the three hypothesis as follows:

H3: Data Visualization has a positive influence on SMEs Innovation.

2.7. Theoretical Review

Resource-Based View (RBV)

The Resource-Based View (RBV), developed by Birger Wernerfelt in 1984 and expanded by Jay Barney in the early 1990s, emphasizes that a firm's competitive advantage

stems from its unique resources and capabilities. This perspective highlights that firms, especially SMEs, can achieve sustainable innovation and differentiation by leveraging their internal data resources effectively (Barney, 1991; Taneja et al., 2020). The RBV operates on several assumptions: resources are unevenly distributed, certain resources can lead to superior performance, and firms can adapt their resources in response to changing environments (Eisenhardt, Martin, 2000; Grant, 1991).

Despite its strengths, the RBV faces criticisms regarding its static nature and neglect of dynamic capabilities necessary for firms to adapt to market changes (Teece, 2007; Mazzola et al., 2018). Nevertheless, it effectively explains how data monetization can drive innovation in SMEs by framing data as a critical resource that can enhance decision-making, operational efficiency, and market differentiation (Koufteros et al., 2021). Studies have shown that SMEs leveraging their data for innovation can better navigate competitive environments, confirming the relevance of the RBV in understanding the role of data monetization in fostering innovation (Arora et al., 2023; Taneja et al., 2020).

2.8. Empirical Review

A recent investigation by Anderson and Lee (2024) surveying 312 SME leaders identified key barriers including limited technical expertise, data quality issues, and privacy concerns. Their research emphasized the need for robust data governance frameworks and strategic partnerships to overcome these obstacles. This is supported by Martinez and Kumar (2023), who documented how successful SMEs typically adopted a phased approach to data monetization, starting with internal optimization before expanding to external commercialization opportunities.

A comprehensive study by Roberts and Chen (2023) involving 245 European SMEs found that companies implementing data monetization strategies experienced a 27% increase in product innovation rates and a 32% improvement in process efficiency. Their mixed-methods research, which combined surveys with in-depth interviews, revealed that successful data monetization enabled SMEs to create new revenue streams while simultaneously enhancing their innovation capabilities. This aligns with findings from Kumar et al. (2023), whose systematic review of 87 SMEs in the Asia-Pacific region demonstrated that firms actively monetizing their data assets were 2.3 times more likely to introduce innovative solutions compared to those that did not leverage their data commercially.

Zhang and Wilson (2022) conducted a longitudinal study of 156 tech-focused SMEs and discovered that companies with structured data monetization programs reported 41% higher R&D productivity and a 35% faster time-to-market for new products. Similarly, research by Thompson et al. (2022) examining 193 manufacturing SMEs found that data monetization initiatives led to improved decision-making processes and enhanced product customization capabilities, with participating firms experiencing an average 29% increase in customer satisfaction scores.

3. METHODOLOGY

A descriptive survey design was employed in this study to gather information from a population of participants and describe the phenomenon. The population of this study consisted of the total number of registered SMEs in Ilorin which are 782. To determine the appropriate sample size, Simple random sampling was used to select SMEs. Using Taro Yamane's sample size determination formula, the final sample size was calculated to be

265 SMEs participants. The main tool utilized in this study to collect information was a structured questionnaire.

Construct validity was employed in this study to examine the questionnaire's validity and determine whether the report's notion of measuring the effect of data monetization on SMEs Innovation is accurate. A Cronbach Alpha analysis of the questionnaire's internal consistency items will be carried out. To evaluate the impact of the independent factors on the dependent variable, structural equation modeling, or SEM, was employed.

3.1. Operationalization of Variables and Measurement Justification

The operationalization of data monetization in this study is grounded in both theoretical frameworks and empirical literature on data analytics capabilities. Following the Resource-Based View (RBV) and building on empirical studies by Kumar et al. (2023) and Roberts, Chen (2023), data monetization is conceptualized as a multidimensional construct comprising three key dimensions:

Data Relevance captures the strategic alignment and applicability of data to organizational goals. This dimension is measured through three indicators derived from Chen et al. (2021) and Wang et al. (2022):

- **Market Trend Reflection (MTR):** Assesses whether data captures current market dynamics,
- **Business Objective Alignment (BOA):** Measures how well data supports strategic goals.

Data Quality reflects the integrity and reliability of data, critical for innovation outcomes as established by Bag et al. (2020) and Zhang, Zhao (2022). Its indicators include:

- **Accuracy and Precision (AP):** Measures correctness of data values,
- **Validity and Authenticity (VA):** Evaluates trustworthiness of data sources.

Data Visualization represents the capability to transform complex data into accessible formats that facilitate understanding and action, as theorized by Ranjan et al. (2021) and Liu, Wang (2022). Its indicators are:

- **Intuitive Dashboard Design (IDD):** Measures ease of understanding visual presentations,
- **Interactive Data Exploration (IDE):** Assesses capability for dynamic data analysis.

These six indicators were adapted from validated scales in prior studies and customized to the Nigerian SME context through expert review and pilot testing.

SMEs Innovation (Dependent Variable) is measured using a multi-item scale adapted from Hossain, Ahsan (2021) and Marzouk (2022), capturing various dimensions of innovation outcomes:

- **Product Innovation (PI):** Introduction of new or significantly improved products/services,
- **Process Innovation (PRI):** Implementation of new or significantly improved operational processes,
- **Technological Innovation (TI):** Integration of new technologies into business operations.

These three indicators comprehensively capture the innovation construct as it manifests in SMEs, distinct from the data monetization dimensions which represent the independent variables influencing these innovation outcomes.

3.2. Model Specification

SMEs innovation is the dependent variable in this study report, whereas data monetization is the independent variable. Since structural equation modeling (SEM) will be employed in the report, the following model will be used:

SI = f (Data Relevance [MTR + BOA] + Data Quality [AP + VA] + + Data Visualization [IDD+ IDE])

Where:
SI= SMEs Innovation.
MTR= Market Trend Reflection.
BOA= Business Objective Alignment.
AP= Accuracy and Precision.
VA= Validity and Authenticity.
IDD= Intuitive Dashboard Design.
IDE= Interactive Data Exploration.

4. RESULTS

4.1. Response Rate

To gather the necessary data for this investigation, a questionnaire was employed. 251 replies in all, or 94.7% of the anticipated sample size, were recorded; 14 responses are needed to reach the estimated sample size. Therefore, the data used in this study consists of the legitimate replies.

Descriptive Analysis of Responses and Normality test

Table 1. Descriptive Analysis and Normality Test

	Mean	Standard Deviation	Excess Kurtosis	Skewness	Number of Observations Used
Data Quality 1	2.880	1.192	-0.864	-0.037	251.000
Data Quality 2	3.343	1.310	-1.025	-0.290	251.000
Data Relevance 1	3.434	1.290	-0.902	-0.459	251.000
Data Relevance 2	3.223	1.220	-0.692	-0.315	251.000
Data Visualization 1	3.243	1.377	-1.146	-0.316	251.000
Data Visualization 2	3.462	1.354	-0.900	-0.583	251.000
SMEs Innovation 1	3.797	1.363	-0.401	-0.918	251.000
SMEs Innovation 2	3.944	1.382	-0.036	-1.148	251.000
SMEs Innovation 3	3.896	1.388	-0.158	-1.091	251.000

Source: SmartPLS Output, 2025.

The mean and standard deviation of the variables/indicators utilized in the study are displayed in Table 1 and were obtained from the questionnaire used for the study. The study looked at data monetization and innovation in SMEs. A number of important indicators were evaluated, each of which provided insight into a distinct facet of the two topics. For both academics and practitioners, the mean scores, standard deviations, and number of observations utilized for each indicator offer insightful information and

important consequences. The comparatively high mean score (above 3) for the questions indicates that respondents believe data monetization and SMEs' innovation are significantly related. Each example has a low standard deviation, which suggests that the replies deviate little from the mean. These descriptive findings highlight how data monetization affects SMEs' innovation in a variety of ways. These highlight how important it is for SMEs to innovate through successful data monetization.

According to the distribution's normality results, the sample size is more than 100, meaning that an absolute skewness value of +1.0 or less is required for the data to be considered normal. Additionally, for a typical peakedness, kurtosis should have an absolute value of ±3.0 since any value below that threshold might be serious and cause worry. According to the normality results, every variable fell below the ±1.0 absolute value barrier, and the kurtosis results likewise fell within the ±3.0 absolute value. The results of the normality test indicate that all of the data entered for the study are normally distributed and suitable for additional analysis and deductions. This suggests that any variable utilized to measure data monetization have moderate mean with low deviation from the mean and the variables are all normally distributed indicating the usefulness of the variables in determining the causality between data monetization and SMEs innovation.

4.2. Assessment of Measurement Model

To assess the effect of data monetization on SMEs innovation, the variables used to measure data monetization are data relevance, data quality, and data visualization against SMEs innovation.

Figure 1. A path model of data monetization and SMEs innovation

Source: SmartPLS Output, 2025.

The structural route model evaluated the impact of data monetization on the innovation of SMEs, as seen in Figure 1. Three independent variables data quality, data relevance, and data visualization and one dependent variable SMEs' innovation are included in the model.

According to the model's findings, SMEs' innovation is significantly boosted by all three independent factors. This indicates that data monetization is crucial for companies as it may boost the creativity of SMEs. The particular impacts demonstrate that every independent variable has a significant impact on the innovation of SMEs. This implies that companies should concentrate on creating data monetization in order to boost the creativity of SMEs.

Table 2. Construct Reliability and Validity

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Data Quality	**0.760**	**0.819**	**0.694**
Data Relevance	**0.751**	**0.889**	**0.801**
Data Visualization	**0.825**	**0.919**	**0.850**
SMEs Innovation	**0.946**	**0.965**	**0.903**

Source: Authors Compilation (SmartPLS 3.3.3 Output) 2025.

Important statistical metrics pertaining to the validity and construct reliability of the four latent variables in this investigation are shown in Table 2. These metrics aid in evaluating how well these variables quantify the fundamental ideas they are meant to reflect. Cronbach's Alpha and Composite reliability are the two main measures used to assess construct dependability. Cronbach's Alpha assesses a latent variable's internal consistency by determining the extent to which each item is related to every other item. Good quality is shown by the internal consistency scores of the four latent variables, which are above 0.7. Since these values are far higher than the widely accepted cutoff limit of 0.7, they suggest that the items within each variable are reliable markers of the related structures. Composite reliability is another construct reliability statistic that takes into account both internal consistency and the relationships between the items and the latent variable. All of the variables in this study show strong composite dependability, providing a more trustworthy measure of reliability, with all values over 0.7. The latent variables' high values suggest that they are trustworthy predictors of the constructs they stand for.

The table also displays the Average Variance Extracted (AVE), which evaluates each latent variable's convergent validity. The degree to which items in a variable measure the same underlying notion and are connected to one another is known as convergent validity. All of the AVE values in the table are higher than the suggested cutoff of 0.5. This suggests that each latent variable's items are converging nicely and measuring their respective constructs as a whole. The findings imply that this study's latent variables have high construct validity and reliability. The choice of these variables as valid and dependable measures in the research study is supported by their strong composite reliability, high internal consistency, and good convergent validity.

Table 3's findings from the discriminant validity study show that the latent variables of data visualization, data relevance, SMEs' innovation, and data quality all exhibit high evidence of discriminant validity. Whether these constructs are separate and not strongly associated with one another is determined by discriminant validity. It is clear from examining the correlations between these variables that the off-diagonal values the correlations between other variables are significantly lower than the diagonal values, which represent the correlations of each variable with itself. This supports the notion that each

latent variable is unique and measures a separate feature of the overall construct by indicating that each latent variable has a stronger relationship with itself than with the other constructs. The association between SMEs' innovation and themselves is larger than that between their innovation and data quality, relevance, and visualization. Likewise, there is a stronger association between data quality and itself than there is between it and the other factors. For other variables, however, the same holds true in their particular circumstances.

Table 3. Discriminant Validity

	Data Quality	Data Relevance	Data Visualization	SMEs Innovation
Data Quality	**0.833**			
Data Relevance	0.599	**0.895**		
Data Visualization	0.723	0.635	**0.922**	
SMEs Innovation	0.689	0.724	0.740	**0.950**

Source: Authors Compilation (SmartPLS 3.3.3 Output) 2025.

These findings demonstrate that the latent variables in this analysis measure unique concepts rather than merely variations of the same underlying construct. This implies that the measuring approach is appropriate for the study's goals since it successfully distinguishes between these crucial elements: data quality, data relevance, data visualization, and SMEs' innovation.

4.3. Multicollinearity

This evaluates the independent variable's correlation. The purpose is to determine whether two independent variables are not associated and yielding same results. In this study, the expected association between the independent variables is evaluated using the variance inflation factor (VIF).

Table 4. Inner VIF Values

	Data Quality	Data Relevance	Data Visualization	SMEs Innovation
Data Quality				**2.254**
Data Relevance				**1.798**
Data Visualization				**2.418**
SMEs Innovation				

Source: Authors Compilation (SmartPLS 3.3.3 Output) 2025.

The VIF values for the latent variables pertaining to SMEs' innovation are shown in Table 4. Positively, the VIF levels for data visualization, data relevance, and data quality are all well below the 10-point cutoff. It implies that these latent variables do not exhibit significant multicollinearity. Put otherwise, these variables are not significantly associated with one another, hence multicollinearity is not a major problem when they are included in this study.

4.4. Test of Hypothesis One

The coefficient of determination, or R-squared, is a metric used to assess how well a model fits data, and it is displayed in Table 5. Approximately 67.6% of the variability seen in the dependent variable (SMEs innovation) can be explained by the independent or latent variables included in the model, according to the SMEs innovation model's R-squared score of 0.676. This suggests that the model captures and explains the observed variations in the buying experience. The corrected R-squared value is 0.676. This results in a more careful evaluation of the model's degree of fit. The modified R-squared value is almost the same as the conventional R-squared value, indicating that the inclusion of the independent variables in the model is unlikely to cause overfitting or excessive complexity. This implies that even when taking into account any problems relating to model complexity, the explanatory power of the model is still strong. According to the R-squared and modified R-squared values, the SMEs innovation model explains the variability of SMEs' innovations rather well, and adding more latent variables doesn't seem to degrade the model's performance.

Table 5. Coefficient of Determination Score

	R Square	R Square Adjusted
SMEs Innovation	0.676	0.672

Source: Authors Compilation (SmartPLS 3.3.3 Output) 2025.

In statistical analysis, the effect size, which is commonly represented as f-square and is shown in table 6, quantifies the strength of the correlation or influence of independent variables on a dependent variable. This study evaluates how much each latent variable affects “SMEs innovation”. Every independent variable has a value greater than 0.02, which is regarded as a minor effect size. This implies that every variable has a moderate effect size, meaning that they all significantly affect the innovation of SMEs. Stated differently, variations in any of the factors can account for a moderate amount of the variation in SMEs' innovation.

Table 6. Assessment of the Effect Size (f2)

	Data Quality	Data Relevance	Data Visualization	SMEs Innovation
Data Quality				0.062
Data Relevance				**0.244**
Data Visualization				**0.154**
SMEs Innovation				

Source: Authors Compilation (SmartPLS 3.3.3 Output) 2025.

The null hypothesis that data monetization has no discernible impact on SMEs' innovation was tested using the bootstrap route coefficient analysis shown in table 7. The findings show that data monetization elements such as data visualization, data relevance, and data quality have a major impact on SMEs' creativity. The association between data visualization, data relevance, and data quality and SMEs' innovation is statistically

significant, according to an analysis of the path from these factors to SMEs' innovation. Strong evidence to reject the null hypothesis is suggested by the T statistics being more than 1.96 and the p-values being less than the traditional significance level of 0.05. Thus, data monetization characteristics including data visualization, data relevance, and data quality all have a big impact on SMEs' innovation.

Table 7. Bootstrapping Results Showing Path Coefficient for Structural Model

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Data Quality -> SMEs Innovation	0.213	0.218	0.067	3.185	**0.002**
Data Relevance -> SMEs Innovation	0.377	0.379	0.061	6.144	**0.000**
Data Visualization -> SMEs Innovation	0.347	0.340	0.078	4.443	**0.000**

Source: Authors Compilation (SmartPLS 3.3.3 Output) 2025.

5. DISCUSSION

This study examined the influence of data monetization dimensions (data relevance, data quality, and data visualization) on SMEs innovation among registered SMEs in Kwara State. Three hypotheses were tested, each predicting positive relationships between specific data monetization dimensions and innovation outcomes (H1, H2, and H3). According to the study's findings, SMEs' innovation is statistically impacted by all three of the factors data visualization, data relevance, and data quality. The findings provide strong support for all three hypotheses. Data Relevance demonstrated the strongest effect on SMEs Innovation ($\beta = 0.377$, $t = 6.144$, $p < 0.000$), followed by Data Visualization ($\beta = 0.347$, $t = 4.443$, $p < 0.000$), and Data Quality ($\beta = 0.213$, $t = 3.185$, $p = 0.002$). These results confirm that all three dimensions of data monetization significantly and positively influence SMEs innovation, with statistical significance well below the conventional threshold ($p < 0.05$).

These results show that these factors have a major impact on SMEs' innovation, rejecting the null hypothesis that data monetization has no significant impact on SMEs' innovation. Effective data monetization not only improves operational efficiency but also stimulates creativity by providing managers with actionable insights, according to study by Nasrollahi et al. (2021). Because it creates an atmosphere that stimulates creativity and quick response to market shifts, a well-structured data monetization strategy is therefore crucial for SMEs to innovate. In order to keep SMEs competitive in their particular markets, this flexibility may result in the creation of new goods and services.

6. CONCLUSIONS

The study came to the conclusion that the innovation of registered SMEs in Kwara state was positively impacted by data visualization, data relevance, and data quality – all of which are components of data monetization. These elements make it possible for SMEs to turn unprocessed data into insights that can be used to inform innovative solutions.

Businesses may develop a culture of innovation and constant development that meets consumer needs by giving priority to these components.

This study examined the influence of data monetization dimensions on innovation outcomes among registered SMEs in Kwara State, Nigeria. The empirical findings provide robust evidence that data relevance, data quality, and data visualization all significantly and positively influence SMEs innovation, collectively explaining the variance in innovation outcomes.

6.1. Key Findings and Theoretical Contributions

The results make several important contributions to theory and practice. First, data relevance emerged as the strongest predictor of innovation, confirming theoretical propositions from the Resource-Based View that strategically aligned resources generate superior performance outcomes. This finding extends Chen et al.'s (2021) work by demonstrating that in resource-constrained contexts like Nigerian SMEs, the strategic fit of data is even more critical than its volume or sophistication.

Second, data visualization demonstrated substantial influence, supporting the theoretical premise that cognitive accessibility of information enables faster and more effective decision-making (Ranjan et al., 2021). For SMEs with limited analytical capabilities, the ability to transform complex data into intuitive visual formats serves as a crucial capability bridging the gap between data possession and data utilization.

Third, while data quality showed the weakest (though still significant) effect, this finding suggests that in emerging market contexts, perfect data quality may be less critical than data relevance and accessibility. This nuances existing data quality literature, which predominantly focuses on developed market contexts where high-quality data infrastructure is assumed.

6.2. Recommendations

Managers of Kwara State's registered SMEs should concentrate on creating distinctive and enticing data visualization, data relevance, and data quality that will guarantee a robust data monetization for their SMEs' innovation in order to boost SMEs' innovation. This may be accomplished by incorporating user-friendly features that improve the purchasing experience and regularly performing market research to determine consumer preferences. Additionally, by putting feedback systems in place, companies may use client data to constantly enhance their offers. Additionally, giving staff members continual training and development opportunities will provide them the tools they need to efficiently use resources. Managers will be able to monitor progress and make data-driven choices to increase efficiency by establishing performance measures. Organizations should spend money on sophisticated analytics solutions that enable real-time data interpretation in order to improve data visualization even further. Furthermore, encouraging a cooperative atmosphere where team members may exchange ideas can improve the caliber of data used for innovation.

6.3. Practical Implications

For SME managers in Kwara State and similar contexts, these findings suggest a clear prioritization strategy: invest first in ensuring data relevance to strategic objectives, second in developing visualization capabilities that make data accessible to decision-makers, and third in improving data quality. This sequencing is particularly important given the resource constraints typical of SMEs in developing economies.

For policymakers, the findings underscore the importance of programs that build SME capabilities in data analytics and visualization, rather than focusing solely on data infrastructure. Government support programs should emphasize training in strategic data utilization and affordable visualization tools.

6.4. Limitations

Several limitations should be noted. First, this study focused exclusively on Kwara State, limiting generalizability to other regions with different economic and technological contexts. Second, the cross-sectional design precludes causal inference—while our model suggests influence, longitudinal studies are needed to establish causation. Third, we measured innovation outcomes through self-reported perceptions rather than objective metrics like patent counts or revenue from new products, which may introduce common method bias despite statistical remedies applied.

6.5. Future Research Directions

Future research should extend this framework to other Nigerian states and African contexts to test generalizability. Longitudinal studies tracking SMEs over time would provide stronger causal evidence and reveal how data monetization capabilities evolve. Additionally, qualitative studies exploring the mechanisms through which data monetization influences innovation could provide richer theoretical insights. Finally, comparative studies examining how data monetization effects differ across industry sectors would offer valuable nuance to these findings.

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REFERENCES

African Scholar Publications. (2021). *Enhancing digital capabilities in SMEs: The role of data management and analytics*. African Scholar Publications. https://www.africanscholarpublications.com

Anderson, J., Lee, S. (2024). Key barriers to data monetization in SMEs: A survey of leaders. *Journal of Small Business Management*. https://doi.org/10.1111/jsbm.12345

Arora, A., Kumar, S., Patel, R. (2023). Data monetization and innovation in SMEs: A resource-based perspective. *International Journal of Innovation Management*, 27(2), 235-250. https://doi.org/10.1142/S1363919623500121

Bag, S., Yadav, G., Kumar, A. (2020). Data quality frameworks in SMEs: An essential factor for innovation. *Journal of Business Research*, *109*, 423-431. https://doi.org/10.1016/j.jbusres.2019.10.003

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120. https://doi.org/10.1177/014920639101700108

Bashir, A., Ondigo, D. O. (2018). The impact of technological advancements on the economic performance of SMEs in Nigeria. *Journal of Business and Economic Development, 3*(1), 1-10. https://doi.org/10.11648/j.jbed.2018.03.01.11

Bertini, M. (2021). Data monetization strategies: Generating economic value from data. *Journal of Business Strategy, 42*(3), 32-40. https://doi.org/10.1108/JBS-07-2020-0131

Chen, L., Wang, J., Zhang, Y. (2021). The impact of relevant data on SMEs innovation: Insights from decision-making processes. *Journal of Business Research*, *124*, 275-283. https://doi.org/10.1016/j.jbusres.2020.09.022

Cugini, A., Ruggieri, R. (2020). Navigating the challenges of data monetization: Privacy and ethical considerations. *International Journal of Information Management, 50*, 18-25. https://doi.org/10.1016/j.ijinfomgt.2019.06.004

Dalhat, M. N., Hassan, S. (2016). Financing small and medium enterprises in Nigeria: Barriers and opportunities. *International Journal of Business and Management, 11*(10), 203-212. https://doi.org/10.5539/ijbm.v11n10p203

Eisenhardt, K. M., Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10-11), 1105-1121. https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E

Fajria, R., Ibrahim, M., Ghazali, M. (2020). The role of government policies in promoting innovation among SMEs in developing countries. *Journal of Small Business Management, 58*(4), 674-688. https://doi.org/10.1111/jsbm.12429

Fischer, J., Ranjan, J., Thompson, G. (2020). The role of data visualization in promoting innovation: A study of SMEs. *International Journal of Information Management*, *50*, 177-185. https://doi.org/10.1016/j.ijinfomgt.2019.06.012

Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *California Management Review*, *33*(3), 114-135. https://doi.org/10.2307/41166664

Gupta, A. (2023). Leveraging data for competitive advantage in SMEs: The case for data monetization. *Journal of Business Research, 147*, 211-221. https://doi.org/10.1016/j.jbusres.2022.10.021

Gupta, P., Singh, A. (2021). Poor data quality and its impact on innovation: Evidence from SMEs. *Journal of Small Business Management*. https://doi.org/10.1111/jsbm.12345

Hair, J. F., Risher, J. J., Sarstedt, M., Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2-24.

Hossain, M. N., Ali, M. J., Rahman, M. (2023). Data quality and its impact on innovation outcomes in SMEs. *Technological Forecasting and Social Change*, *176*, 121123. https://doi.org/10.1016/j.techfore.2021.121123

Hossain, M., Ahsan, M. (2021). Innovation as a catalyst for SME growth: Insights from Bangladesh. *Journal of Entrepreneurship in Emerging Economies, 13*(2), 221-234. https://doi.org/10.1108/JEEE-07-2020-0315

Jia, N. (2023). The importance of data relevance in SME innovation. *Journal of Small Business and Enterprise Development, 30*(1), 50-65. https://doi.org/10.1108/JSBED-03-2022-0070

Johnson, K., Smith, L. (2020). The interplay of data relevance and innovation in SMEs. *Small Business Economics*, *54*(3), 699-715. https://doi.org/10.1007/s11187-019-00276-4

Koufteros, X., Vickery, S. K., Jayaram, J. (2021). The impact of data monetization on innovation capabilities in SMEs. *Decision Sciences*, *52*(3), 636-658. https://doi.org/10.1111/deci.12448

Kumar, A., Sharma, S., Gupta, M. (2023). Data monetization in SMEs: Systematic review and future directions. *Journal of Business Research*, *139*, 289-300. https://doi.org/10.1016/j.jbusres.2021.09.023

Martinez, P., Kumar, S. (2023). Phased approaches to data monetization in SMEs: A comprehensive analysis. *International Journal of Entrepreneurship and Small Business*, *48*(4), 489-506. https://doi.org/10.1504/IJESB.2023.126543

Marzouk, M. (2022). Adapting to change: Innovation strategies for SMEs in the construction sector. *International Journal of Construction Management, 22*(1), 31-41. https://doi.org/10.1080/15623599.2021.1877758

Mazzola, P., Furlan, A., Camuffo, A. (2018). Dynamic capabilities and innovation: A resource-based view. *European Management Journal*, *36*(6), 747-758. https://doi.org/10.1016/j.emj.2018.04.001

Millers, D., Gaile-Sarkane, E. (2021). Data quality issues in SMEs: Barriers to innovation and competitive advantage. *Journal of Innovation and Entrepreneurship, 10*(1), 1-15. https://doi.org/10.1186/s13731-021-00155-3

Nasrollahi, N., Sadraei, S., Rahmani, J. (2021). The role of data monetization in fostering innovation in SMEs. *Journal of Innovation and Entrepreneurship*, *10*(1), 12-27. https://doi.org/10.1186/s13731-021-00220-3

Oluitan, A. O. (2014). Barriers to access to finance for SMEs in Nigeria: A review of the literature. *International Journal of Business and Social Science, 5*(4), 67-76. https://ijbssnet.com/journals/pdf

Ranjan, J., Fischer, J., Liu, W. (2021). Data visualization techniques and their impact on innovation in SMEs. *Information & Management*, *58*(7), 103515. https://doi.org/10.1016/j.im.2021.10351

Roberts, A., Chen, H. (2023). The effects of data monetization on product innovation: Evidence from European SMEs. *Research Policy*, *52*(1), 103917. https://doi.org/10.1016/j.respol.2022.103917

Sadraei, S., Nasrollahi, N., Rahmani, J. (2021). Enhancing innovation capabilities through data monetization in SMEs. *International Journal of Innovation Management*, *25*(5), 2150023. https://doi.org/10.1142/S1363919621500236

Taneja, S., Kumar, V., Jha, S. (2020). Leveraging data as a resource for competitive advantage in SMEs: An RBV perspective. *Journal of Business Research*, *120*, 97-104. https://doi.org/10.1016/j.jbusres.2019.01.047

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319-1350. https://doi.org/10.1002/smj.640

Thompson, M., Wilson, G., Zhang, R. (2022). The impact of data monetization on decision-making and customer satisfaction in manufacturing SMEs. *Journal of Manufacturing Technology Management*, *33*(2), 321-339. https://doi.org/10.1108/JMTM-07-2020-0287

Trivella, A., Toffoli, R., Khosravi, P. (2022). The importance of data relevance in fostering innovation: A study of SMEs. *International Journal of Entrepreneurial Behavior & Research*, *28*(4), 843-857. https://doi.org/10.1108/IJEBR-06-2021-0362

Wang, Y., Zhang, L., Li, X. (2022). Data relevance and its role in the innovation process of SMEs. *Journal of Small Business Management*. https://doi.org/10.1111/jsbm.12345

World Economic Forum. (2023). *Harnessing data for SME growth: Overcoming challenges in the digital era*. World Economic Forum. https://www.weforum.org/reports/harnessing-data-for-sme-growth

Zhang, R., Wilson, H. (2022). Structured data monetization programs and their impact on R&D productivity: A longitudinal study. *Research Technology Management*, *65(*4), 34-44. https://doi.org/10.1080/08956308.2022.2031875

Zhang, Y., Zhao, X. (2022). Data quality and innovation: Evidence from small and medium-sized enterprises. *Journal of Business Research*, *139*, 375-384. https://doi.org/10.1016/j.jbusres.2021.09.021

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OPTIMIZING PROCESS EFFICIENCY: CASE STUDIES IN BREAD MAKING PRODUCTION

The paper examines the influence of job design on production process efficiency. Although optimization brings significant benefits, it also faces numerous challenges, primarily due to the high robustness of existing technology and workforce needs.
The research methodology treats real-life Case Studies from a bakery plant located in North Macedonia. The data gathered by the pilot period (Case Study 2) was summarized and compared with the data gathered during the regular plant operating (Case Study 1). Both data sets collected in different plant departments were compared regarding relevant operational criteria.
Based on the quantitative data analysis, the operations design of Case Study 2 resulted in a 7% reduction in overall production costs. By analyzing real-life Case Studies, this paper can serve as a valuable guide in striving to enhance overall efficiency and contribute to companies within the relevant industry sector.

Keywords: optimization, task allocation, workforce, process.

1. INTRODUCTION

In today's increasingly dynamic business environment, manufacturing industries are coping with the challenges of producing goods of the right quality and quantity, and most importantly, at minimum cost to enhance competitiveness in the market. The current traditions in the design of production processes may not be adaptable to future challenges that organizations face. Yet, adopting effective concepts brings numerous benefits alongside barriers and difficulties due to the high robustness of the existing technology and workforce availability, especially in emerging economies. Rapid changes in demands and requirements, both internal and external, frequently trigger plans for change in different manufacturing areas, including the food processing industry. Process design, as a core of operations management, ensures that the process runs smoothly and that the goals are met entirely within an organization, and then implements ways to improve it (Wolniak, 2020). It cannot be denied that process design is a critical element of successful optimization in striving to develop efficient and profitable manufacturing operations.

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Technically, manufacturing process design is a specific and extremely complex activity for any operations manager. Process design is a comprehensive methodology that integrates all essential manufacturing options and relevant aspects and considerations. Since processes are managed at the operational level, process design must cover a more detailed set of objectives, primarily focusing on the flow of operations. These include reducing bottlenecks, delays, and idle time on the one hand, and maximizing resource utilization, inventory, capacity, demand, and product quality on the other.

The necessity of workforce utilization and appropriate task allocation, as one of the factors that influence the total cost of production, is worth emphasizing (Tausch, Kluge, 2022). Each process activity must decide on the balance between workforce utilization. Division of labor or task allocation is the dominant job design model in most mass-produced products, such as mass food production. Task allocation involves a specific and comprehensive analysis of the available workforce. Although machines are designed to perform specific tasks within a production process, employees can perform various tasks based on their skills, availability, and workload (Sheveleva et al., 2023). In that context, it is essential to consider all relevant issues influenced by process duration, the types of tasks, the resource needs, and resource consumption, as well as the available workforce (Galeazzo, Furlan, 2020).

Speaking about the available workforce, the manufacturing workforce shortage has been weighing on the food industry for several years, and it is showing no signs of letting up. The bakery industry, in particular, has been suffering. This industry is deficient in employees in all areas of production with baking-industry-specific technical skills. Automation reduces the workforce requirements and associated costs along the production line. Automated production machinery allows manufacturers to have fewer employees on the line, which is especially advantageous for repetitive tasks. Another important characteristic of manufacturing systems is their variabilities, which lead to complex changes in the functional states of jobs and resources (Suchintita et al., 2023).

This paper aims to analyze the possible variants in selecting the proper bread-making process design. Focusing on this process, task allocation has become one of the design process priorities. In the context of preventing employee overload, it is essential to balance the workload. Operations managers play a key role in distributing tasks among employees and, more importantly, in ensuring that each worker operates at optimal capacity.

This approach can improve overall productivity in the bread-making process because when allocating tasks, operations managers need to consider various factors, such as the type and complexity of the task, the estimated time required for completion, the quality of the products, and the availability of equipment for maintenance. By considering these factors, operations managers can create a balanced workload for employees in the bakery department.

Therefore, the main research question of this study is addressed by investigating how job design and specifically task allocation, influence process efficiency. For that sake, the research in the paper includes the examination of the essential aspects of the design of the process, through two scenarios presented in the form of Case Studies. In this regard, a post-process approach in one food processing company is used, where the outcome of the task allocation towards the efficient execution of the process is mainly analyzed. Additionally, the paper aims to confirm the role of workforce task allocation, through a comprehensive discussion of specific scenarios.

Following this introduction, the rest of the paper is organized as follows. The next section presents a literature review focusing on operations management, process design,

and task allocation topics. In the third section, the methodology of the research framework is explained. In the fourth section, a detailed description of the production process is given, where workflow activities are mapped and the cost analysis of consumed resources is presented. In the last section, the Case Studies results are presented and discussed. Lastly, a conclusion is provided, including the suggested further avenues of investigation and research limitations.

2. LITERATURE REVIEW

Numerous researchers confirmed that the transformation role of operations management is directly responsible for many decisions and activities within the organization related to the design (Wolniak, 2020; Peinado et al., 2018; Oladejo et al., 2019; Lewis, 2019; Slack, Brandon-Jones, 2019). According to Gembalska-Kwiecień et al. (2018), operations management is a function integrated into the organization specifically to improve performance and the financial bottom line.

Task allocation, as a fundamental aspect of operations design, plays a critical role in determining the efficiency, adaptability, and overall performance of production processes (Wang et al., 2024; Wieland, Hammes, 2014; Tausch, Kluge, 2022; Zandieh, Adibi, 2010). In this sense, Hacker and Sachse (2014) confirmed that task allocation is normally a preparatory task carried out during the planning activities and aligned with the process design. Task allocation determines the overview of the full task as well as how free one feels in fulfilling the own tasks (Akyazi et al., 2020; Van den Broeck, Parker, 2017; Agnetis et al., 2014; Maman, 2017; Parker et. al., 2017). In line with Fast-Berglund and Stahre (2013), task allocation should be seen as complementary between man and machine rather than dividing tasks solely to one resource. According to Dvorak and collaborators (2023), a task description is provided based on which a standardized time for operations is considered and the link between the task description, and the product state must be created. Numerous researchers, such as Sheveleva et al. (2023), Joo et al. (2022), Petzoldt et al. (2022), and Calzavara et al. (2024), stated that the task allocation problem is of critical importance in the manufacturing industry, and determines the effectiveness and efficiency of advanced manufacturing systems. Moreover, Cheng and collaborators (2019) argued that the proper task allocation approach can give an optimized arrangement of existing resources, and enable the manufacturing system's flexibility, thus improving both economic performance and social benefits. Generally speaking, the performance of process execution is highly related to the effective allocation of task resources, and inappropriate allocation can lead to low resource utilization, high cost, time delay, and low equality (Goel et al., 2023; Stanojeska, 2022; Zhao et al., 2020; Huang et al., 2022; Arias et al., 2018; Sedighi, 2017; Pufahl et al., 2021).

According to Goryńska-Goldmann and collaborators (2021), the baking industry is deficient in employees in all areas of production with baking-industry-specific technical skills. Automation reduces the workforce requirements and associated costs along the production line (Kumar, 2019). Automated production machinery allows manufacturers to have fewer employees on the line, which is especially advantageous for repetitive tasks (Hecker et al., 2010; Naegele Inc. Bakery Systems, 2019). Drozd and collaborators (2023) stated that in the contemporary business environment, growing competition in the baking industry causes an ever-growing demand for solutions that would increase the reliability of all manufacturing processes. Additionally, the manufacturing workforce shortage has been weighing on the food industry for several years, and it is showing no signs of letting up

(Drozd, 2020; Patel et al., 2019; Babor et al., 2021). In the same context, Clark (2009) and Martin and collaborators (2020) argued that the workforce is always important, especially in circumstance when an expansion is considered and when workforce supply may be tight and costs may have increased.

It can be concluded that the issue related to job design, and specifically task allocation in the baking industry, is still a vague area worth researching. More importantly, this issue is expected to become more critical given the ongoing trend of decreasing the workforce, especially in developing countries.

It can be concluded that the issue related to job design, and specifically task allocation in the baking industry, is still a vague area worth researching. More importantly, this issue is expected to become more critical given the ongoing trend of decreasing the workforce, especially in developing countries.

Yet, there exists no similar review in the domain of process optimization through task allocation in the bread-making production process, utilizing automated production lines. By investigating real-life Case Studies, this research brings unique value in the current domain. The identified gap in the literature sources of knowledge was the major trigger to conduct this manuscript's research. In that direction, the hypothesis of this research is:
H1: Optimally designed task allocation has a significant impact on cost reduction and process efficiency improvement in bread-making production.

3. RESEARCH FRAMEWORK

The type of research conducted in the paper is descriptive, aimed at analyzing the different organizational approaches in the bread-making process. The study relies on primary data**,** collected through two qualitative methods: observation and documentation**.**

The documentation method involved the analysis of internal records and formal documentation obtained from five key departments: Production, Maintenance, Procurement, Human Resources (HR), and Finance. These sources provided required information related to operational procedures, workforce allocation, resource consumption, maintenance schedules, and cost structures.

The observation method was applied through direct monitoring of activities in the production process under different organizational setups. Two case studies were examined:

- Case Study 1: *The production process is carried out on parallel production lines operated within a single shift*.
- Case Study 2: *The production process is carried out on a single production line operating over two shifts*.

This two-case approach provides a basis for comparative examination of task delegation, utilization of resources, and process performance across different production configurations to build a pragmatic ground for identifying opportunities for improving job design and production planning.

The period of research conducted by observation was January to March 2025. Actually, the onsite observation method was accomplished in the pilot period of 30 days, while the production process was organized as it is explained in Case Study 2. Data gathered in the pilot period specific to Case Study 2 was summarized, and compared with data from the regular production operations of in Case Study 1, during the previous 30 days.

Both data sets were compared regarding the relevant criteria, like workflow, total throughput time, costs, quality, time for preventive maintenance, available workforce and

workload, efficiency, warehousing capacity, and other relevant factors. Those data were carefully analyzed, and based on them, the right managerial decisions were made. In general, the research methodology applied in the paper encompasses qualitative analysis and comparative quantitative analysis.

For the purposes of this research, the bread-making process is described in detail, including a flowchart; workflow activities are mapped, and the needed resources are outlined in the following sections.

3.1. Description of the bread-making process

Food processors typically expect automation to be a key driver of throughput increasing and achieving industrial-scale production volume (Ahmed, Rahman, 2012). Boosting process throughput and reducing the risk of workforce turnover are influential reasons many bakery plants are looking to automate their production lines. The research in this paper was conducted in a food processing company, consisting of bread-making plants, milling plants, and pasta production plants. Specifically, this research is focused on the bakery plant equipped with two automatic production lines with the same capacity and performance properties. The capacity of each of those production lines is 1400 loaves of bread/hour. Actually, the capacity of the production line is determined by the capacity of the baking tunnel oven.

The rest of the equipment integrated into the production lines is sized to meet the continuity of the production flow and allow a continuous flow of the process. In essence, if the specified capacity of the tunnel oven is to bake 1400 units per hour, the capacity of the machines connected in the line must be matched to the capacity of the tunnel oven. Synchronization of the workflow eliminates the risk of non-value-added effects such as defects, bottlenecks, and downtime. The discussion presented in the following part of the paper refers to the stated production line capacity of 1400 units/h.

The automated production line is supported by the pressure-type pneumatic conveying system that utilizes positive-pressure gas as the driving force to transport flour through pipelines. The main raw material used in the production process is wheat flour, which is obtained in the Mill plant. The conveying system allows efficient, safe, and reliable transport from the Mill plant facility located on the same site, overcoming issues faced by traditional mechanical conveying methods. The dosing and weighing systems provide precise weighing, individual dosing parameters, and reliable functioning. The compact design of storage and weighing systems can be customized according to production needs. Flour silos offer many unique benefits for the indoor storage of bulk flour and numerous dry bulk materials. The weighing of different ingredients is carried out as per the formulated recipe in appropriate ratios. The formulation for bread varies from bakery to bakery, depending on factors such as the cost of ingredients and consumer preference concerning the quality of bread (Stanojeska, Cepujnoska, 2014). The remaining raw materials (yeast, salt, flour improvers, and other ingredients for different types of products) are added directly to the batch after prior weighing on the scales. The water is dosed automatically in the mixers for dough formation. Dough kneading enables the main ingredients to be dosed and improves efficient homogenization in the dough. The mechanical-physical process of mixing and kneading triggers chemical and microbiological processes, resulting in high-quality dough for further processing (Muscalu et al., 2017). Kneading is performed in mixing bowls of an industrial mixer, under operating conditions (number of revolutions, mixing time) following the product

specification. A dough ball divider is one of the most important pieces of baking equipment used in commercial bread-making setups (Alam, 2020). Its primary role is to separate prepared dough into equal-sized pieces. When the dough piece exits the divider, it is irregular in shape, having sticky cut surfaces through which gas can easily diffuse (Trinh et al., 2016). The function of the rounder is to shape it into a ball and impart a thick continuous surface skin that will retain the gas and ease the handling or machinability of the dough. Dividing and rounding dough causes a drop in its pliability, elasticity, and extensibility, and thus, the dough may tear easily. It is necessary to let the dough piece rest while fermentation proceeds to restore these properties so that it recovers from strains and stresses caused by previous operations (Bhatia, 2016). This is known as intermediate proofing, which is a short rest period between dough dividing and the final moulding. Dough moulding is the terminal step of the dough makeup stage. It is a continuous operation, where the moulder receives pieces of dough from the intermediate proving and shapes them according to the bread variety. A dough piece that has undergone the processes of sheeting and moulding appears degassed and lacks volume. The loaves travel to a second prover that is set at a high temperature and with a high level of humidity. Dough rising is a complex microbiological process, tightly connected with the chemical and physical characteristics of raw materials (Mondal, Datta, 2008). Dough fermentation causes a dough volume increase and also affects the bread structure and flavor. Here, the dough regains the elasticity lost during fermentation and the resting period. From the prover, the loaves enter a tunnel oven. The temperature and speed are calculated so that when the loaves emerge from the tunnel, they are completely baked and partially cooled. During bread baking, due to the CO_2 thermal expansion, bread volume still increases a bit, a crust is formed on the surface, bread gets its final shape and volume, it is colored, and gets additional flavor through the baking process (Williamson, Wilson, 2009). On the other side, steam boilers for bakery tunnel ovens have been installed in the production department, both in the air conditioning of the fermentation chambers and in the supply of equipment to provide clean steam to the ovens. Cooling takes place at ambient temperature (Purlis, 2012). The cooled products (29–31°C) are sent for further processing in the packaging department. Bread has to be cooled before slicing and wrapping to facilitate slicing and prevent condensation of moisture in the wrapper. The desirable temperature during slicing is 30°C. Cooling facilitates in redistribution of moisture from the center to the crust, softening this layer. The internal temperature of the bread should be reduced to 35–40°C towards the end of the cooling cycle and this is normally achieved by applying an external air temperature of 24°C at a relative humidity of 85%, with an air movement. Bread is normally packaged at the legal limit of 38–42% moisture (Bhatia 2016). The process of packaging of final units is executed through the semi-automated process equipment. Therefore, the packed units are warehoused and arranged in special storage containers according to the distributor's orders. The products are shipped to the retailer to fulfil the client's demands.

The discussed process steps are present in the flowchart (Figure 1). The monitoring and control of the quality is covered throughout the entire process. The positions for taking samples and quality control in the laboratory are presented by the acronym QC (quality control).

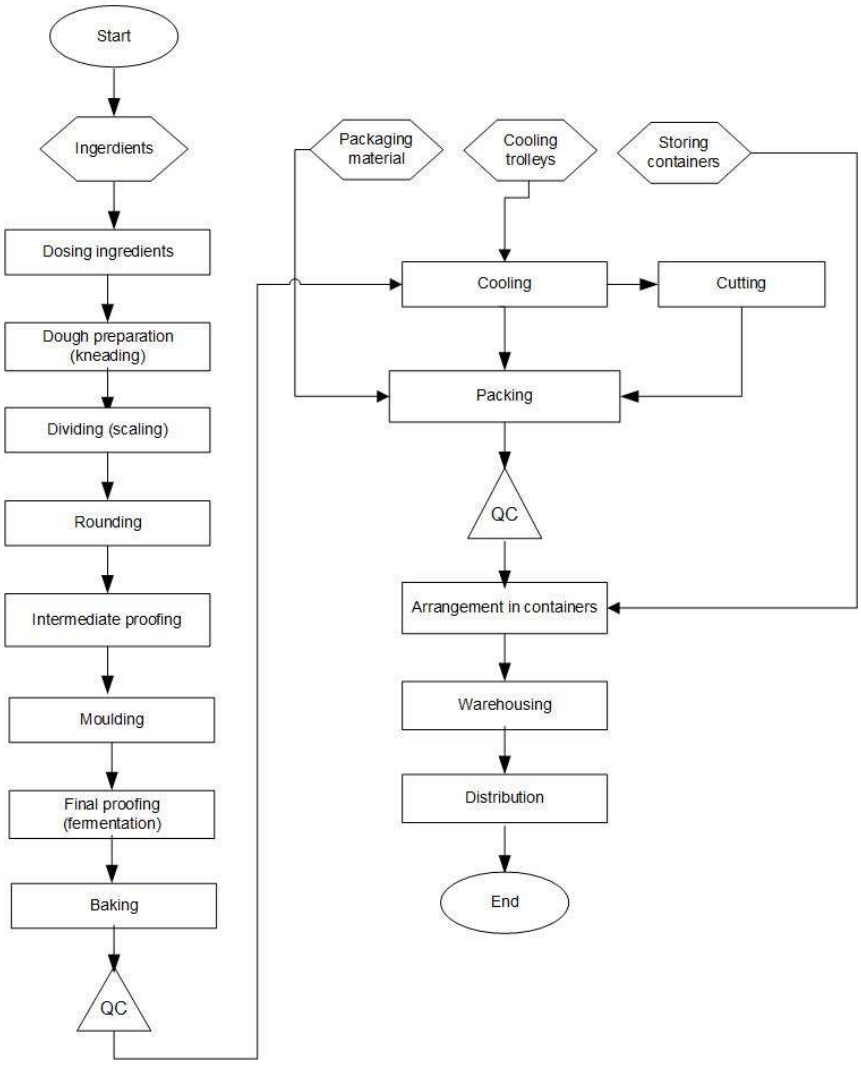

Figure 1. Flowchart of the bread-making production

Source: Author's work based on general bread-making process phases.

3.2. Mapping workflow activities

According to the demand, the current capacity of the plant is 19.600 units/ day. The question is how many hours are needed to produce the required products using the available resources, equipment, energy, and stuff. For that sake, a mapping of the process activities is provided. The mapping aimed to show the duration of each of the every single process activities in the workflow. According to the presented flowchart (Figure 1), the initial activities like dosing flour in chambers, preparing the other ingredients, and reaching the required working conditions (temperature, pressure, humidity), take place before the production process starts. The reaching of required working conditions includes the

generation of steam by the boiler house. As shown in Table 1, the duration of the process performed on the single production line is 2 hours and 23 minutes.

Table 1. Duration of process activities performed on the production line

Type of process activity	Type of equipment	Start time (min)	End time (min)	Activity duration (min)
Dosing ingredients	Dosing and weighing systems	00:00	00:15	15
Dough preparation	Mixing bowls	00:15	00:17	2
Dough resting	Mixing bowls	00:17	00:27	10
Dough dividing	Divider	00:27	00:37	10
Rounding	Conical rounder	00:37	00:52	15
Intermediate proofing	Intermediate proofing chamber	00:52	01:04	12
Long loaves moulding	Moulder	01:04	01:12	8
Final proofing	Fermentation chamber	01:12	01: 55	43
Baking	Tunnel oven	01:55	02:23	28

Source: Production Department data compiled and analyzed by the author.

After baking is complete, activities such as cooling, cutting, packaging, and storage follow, which are performed on several semi-automatic machines, and the estimated duration is given in Table 2.

Table 2. Duration of process activities performed out the production line

Type of process activity	Type of equipment	Start time (min)	End time (min)	Duration of activity (min)
Cooling	Cooling trolleys	02:23	02:53	30
Slicing	Cutting machines	02:53	03:27	35
Packing	Packing machines	03:27	03:52	25
Units crate stacking	/	03:52	03:53	1
Arrangement in containers	/	03:53	04:13	20
Distribution	Vehicles	04:13	...	

Source: Production Department data compiled and analyzed by the author.

However, the duration of the process performed on the single production line is 2 hours and 23 minutes, while the duration of the activities after baking completion is 1 hour and 51 minutes. To notify, the distribution time is not subject to analysis because the distribution of the products is the responsibility of external companies. If the necessary time to fulfill the required working conditions of 1 hour is added to the total time of 4 hours and 13 minutes, the length of time needed to complete the process is obtained, which is 5 hours and 13 minutes. Regularly, to fulfill the targeted capacity, the production process is taken on the single production line, in two working shifts, continuously and without downtime, which means that over 14 hours (the duration of one work shift is seven hours), the production cycle is repeated a few times.

3.3. Key resources for production execution

For the needs of the production process, specifically for the fermentation and baking activities, the steam produced in the boiler house is used. Moreover, the electricity is used for other equipment integrated into the production line. The third resource is water, which is included in the composition of the products. The consumption of those basic resources necessary is given in Table 3. The consumption of resources is calculated for a production capacity of 1400 products/hour, when the line operates in two shifts (14h/day), throughout the year.

Table 3. Annual consumption of required resources and cost distribution

Type of resource	Annual consumption	Cost distribution
Electricity	634831 KWh	84 %
Fuel for steam boiler house	405 t	15 %
Water	1240 m^3	1 %

Source: Production Department data compiled and analyzed by the author.

According to the presented data (Table 3), it can be concluded that the consumption of fuels accounts for the highest percentage of total costs (84%), followed by electricity costs (15%).

4. JOB DESIGN IN THE BREAD-MAKING PROCESS

Within the limits of available production and demand levels, the process of job design is established according to the operational requirements of each stage of production. Job positions are designed based on the technical specifications and functional interdependences of the equipment, rather than upon the details of a single production line. In automated manufacturing processes, not every machine requires constant monitoring by employees. Actually, employees' roles are more focused on supervision, process coordination, and quality assurance. Peripheral activities such as cutting, packaging, boiler operation, and warehousing remain non-automatic and thus require sole manual posts.

From a job design perspective, the whole process, starting from the preparation of raw materials to the delivery of the product, requires a combination of monitoring, control, and maintenance functions distributed among various operator posts. These job positions reflect the higher task specialization and process integration principles characteristic of automated manufacturing systems. Consistent with this, job positions such as Supervisor, Operator on flour silos, Operator on kneading mixer, Operator on divider, Operator on fermentation chamber, and Operator on tunnel oven reflect the primary activities of the automated line, whereas job positions in the boiler house, packaging, and warehouse comprise supportive, non-automated work. Yet, the further research addresses only the job positions related to the automated production line. For purposes of analysis, two scenarios are used to determine efficiency and the utilization of the workforce:

- Two parallel production lines operated within a single shift - Case Study 1.
- One production line operating over two shifts - Case Study 2.

4.1. Case Study 1

In the context of the first scenario, when the production process is performed on a single line in two work shifts, the task allocation is organized by the needs of the operation. As stated above, the production process consists of several operations, for the execution of which the required number of employees is: one operator responsible for dosing the raw materials, one operator responsible for carrying out the mixing process of the ingredients, one operator for dividing the dough into pieces of a certain weight, one operator responsible for monitoring the fermentation process, one operator for monitoring the baking process and one responsible for controlling the entire process and for recording the relevant data. This means the total number of operators required to execute the working tasks on one production line and in one shift is a total of six operators. The layout of the job design and task allocation is presented in Figure 2.

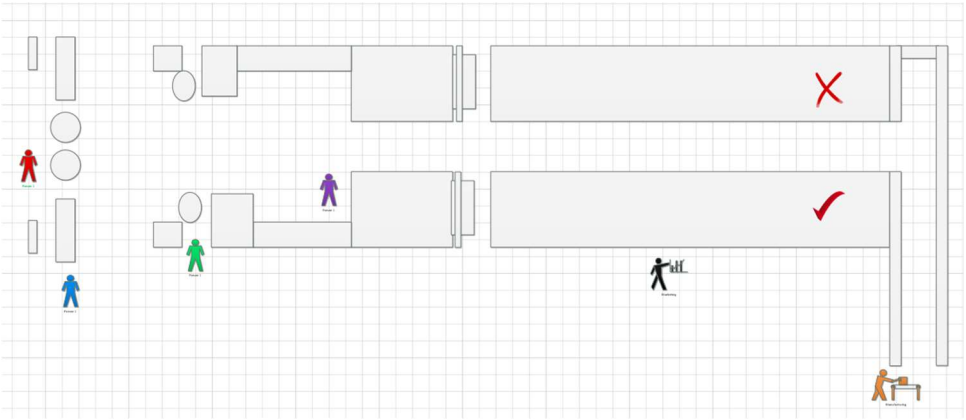

Figure 2. The layout of task allocation for a single production line operating in one shift
Source: Author's illustration.

To fulfill the requested capacity, it is necessary to organize production in two shifts, which means that the number of operators must be doubled, or 12, with six of them carrying out the process in one shift, and the remaining six operators being responsible for carrying out production in the second shift. The layout of this scenario is presented in Figure 3.

To analyze the production costs and in the direction of optimization, in the next step, an analysis of oil consumption was performed. Namely, if the process is carried out on one production line in two shifts, oil consumption is 10% lower compared to production carried out on two production lines. This is quite expected because, during the initial start-up of the two burners with which the two automatic lines are equipped, oil consumption is the highest. Guided by this conclusion, the production process in the bakery products production department regularly takes place on one line in two shifts.

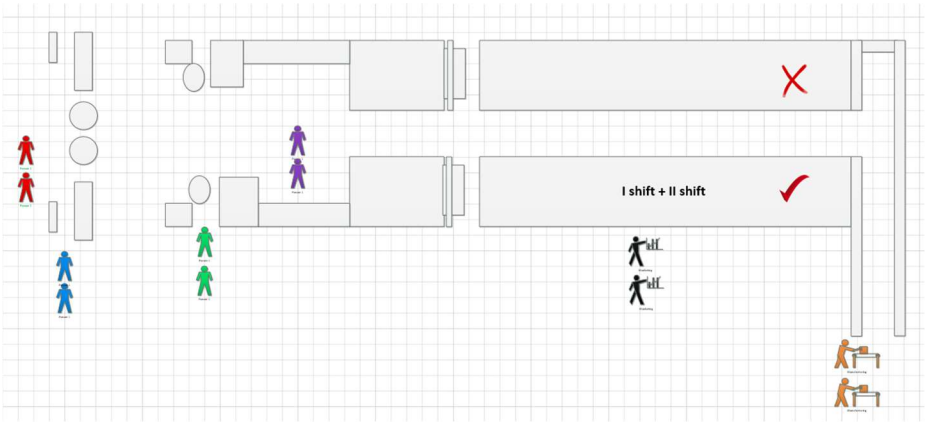

Figure 3. The layout of task allocation for a single production line operating in two shifts
Source: Author's illustration.

4.2. Case Study 2

The second scenario, which means using both production lines and working in one shift, is not practiced precisely because it requires an increased oil consumption of 10%, due to the use of two burners to start the two tunnel ovens. However, a test period was conducted in which the second scenario was applied, which is working with both production lines in one work shift. In this regard, a detailed and separate analysis of the required work positions was conducted. As in the previous case, the same job positions previously listed were considered, but in this case, it was taken into account that the production machines on both lines are in operation simultaneously.

For each job position, the possibilities for performing job tasks in parallel on both production lines have been considered. Starting from the very beginning of the process, only one operator can be in charge of dosing raw materials. In fact, the dynamics of dosing raw materials allows for the simultaneous execution of tasks, and accordingly, one operator can meet the requirements of both lines efficiently. Regarding the second job position, due to the continuous flow of mixing dough batches, two employees are required to perform the tasks on both machines for mixing the ingredients. The next job position is dividing the dough into pieces of a given weight. An operator is required on each of the machines that are part of the production lines. This means that two operators are required for the smooth execution of this operation. The next phase is fermentation. Given that the operator responsible for controlling the quality of fermented products and monitoring operating parameters can independently monitor both chambers in parallel, only one employee is sufficient for this activity. Next comes the final process phase, which is the baking phase, which takes place in a tunnel oven. The ovens are equipped with sensors for operating parameters (temperature, pressure), and the quality of the baking process is monitored visually through special openings for that purpose, in all three baking zones. At the end of baking, the final products emerge and are collected in special baskets for that purpose. Since this is a fairly large capacity, two employees are required for efficient collection of the products, who are dedicated to each of the conveyor belts that serve to transport the baked products from the two ovens. The production supervisor has the task of controlling the operation of the production line, collecting data, and, of course, recording it in the form

of a report. Regarding the physical distance between the two production lines, such control can be effectively carried out by only one supervisor.

Generally speaking, the total number of employees required to carry out the production process on two lines simultaneously in one shift is nine operators. The layout of the task allocation in the second scenario is presented in Figure 4.

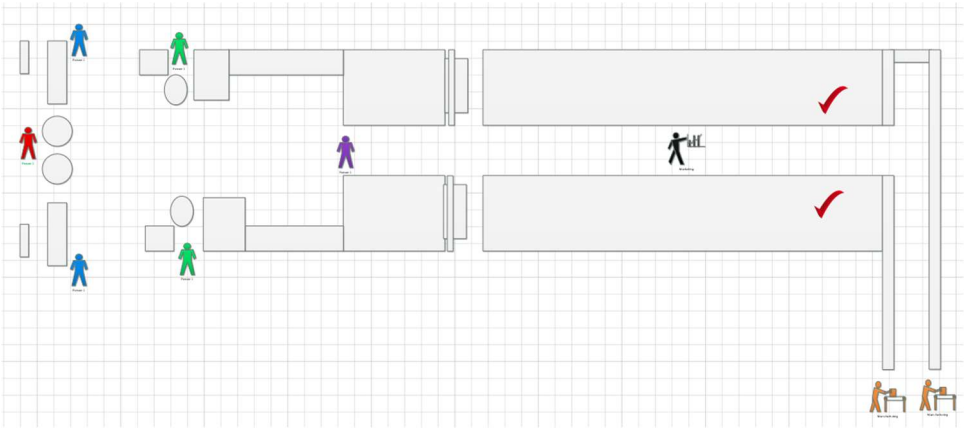

Figure 4. The layout of task allocation for both production lines operating in one shift

Source: Author's illustration.

4.3. Comparative analysis

An explicit overview of the comparison of the required number of employees in both scenarios is presented in Table 4.

Table 4. The comparison of the required number of employees in both scenarios

Job position	Number of employees	
	Case Study 1: Using of 1 production line in 2 shifts	Case Study 2: Using of 2 production lines in 1 shift
Operator on flour silos	2	1
Operator on kneading mixer	2	2
Operator on divider	2	2
Operator on fermentation chamber	2	1
Operator on tunnel oven	2	2
Supervisor	2	1
Total no. of operators	12	9

Source: Production Department data compiled and analyzed by the author.

It is clear that the Case Study 2 - operating two lines in parallel in a single shift, utilizes less employee and has nine employees, unlike twelve employees to operate two lines within two shifts. This variation in numbers indicates the potential for increased optimization of workforce utilization by proper scheduling and concurrent operation of the production capacities. This type of task allocation facilitates productivity among the employees by concentrating surveillance and operational duties in a single shift, minimizing downtime

and replicated effort. The surplus employees may be transferred to other sections, enabling more effective and adaptable use of human resources. Before this reorganization may be put into effect, certain other operational factors need to be considered, like equipment maintenence and fuel consumption.

Regarding equipment maintenance, the responsible manager from the maintenance department stated that operating two production lines simultaneously eliminates the possibility of transferring production in the event of a defect from one production line to the other production line. In fact, the attitude of the responsible manager is that one line should be in operation, and the other line should serve as a backup option in the event of a defect or downtime. But on the other hand, operating two production lines simultaneously leaves the possibility of preventive and regular maintenance of the machine equipment within the lines, precisely because production, instead of lasting 14 hours in two shifts, takes place in 7 hours in one shift. Thus, the maintenance department has more time to control the correctness of the equipment, perform preventive maintenance, or possibly intervene. However, the convenience of transferring production to the backup line in the event of a defect is lost. After a detailed analysis of the facts and arguments, the position of the equipment maintenance department is that the option of running out production on both lines simultaneously is completely acceptable.

In terms of fuel consumption, a comprehensive analysis was carried out by monitoring fuel consumption during the pilot period when operating two lines in one shift (Case Study 2). The data obtained in terms of oil consumption were compared with data from existing records generated from operating one line in two shifts (Case Study 1). As expected, the calculations indicate an increased fuel consumption of 10% when operating with two production lines (Case Study 2) compared to operating with one production line (Case Study 1). However, as previously stated, in Case Study 2, three fewer operators were engaged. If we compare the costs related to salaries for 12 and 9 employees, of course, we have a difference of 25% higher costs if the production is organized according to scenario 1. In that context, if we compare the sum of fuel costs plus employee salary costs in Case Study 1 with the sum of the same costs in Case Study 2, it is determined that the difference is 7%, in favor of Case Study 2. Specifically, the production costs using both lines in one shift, with nine employees and higher oil consumption, are 7% lower than the costs of production utilizing a single production line in two shifts, with 12 employees.

In general, these results confirm that optimizing task allocation and aligning human resources with technological capabilities can yield significant improvements in efficiency. In other words, the stated hypothesis is confirmed.

5. CONCLUSION

The research in this paper is focused on bread-making process optimization from the perspective of job design and adequate task allocation. For that sake, the two real scenarios in the specific baking plant located in North Macedonia were analyzed. The plant is equipped with two fully automated production lines with identical performance features and capacity. Case Study 1 refers to running a process using a single production line during two shifts, but Case Study 2 refers to the utilization of both production lines during one shift. In both scenarios, the quality of the produced units and the production volume are equal. The dilemma, of which one of the presented scenarios should be accepted, is put under question. For this purpose, a deeper analysis was conducted in terms of resource consumption costs and engaged workforce costs. In that context, a comprehensive

explanation of the process workflow was enabled due to the close relation with a treated issue. In that context, a comprehensive explanation of the process workflow was enabled due to the close relation with a treated issue. Moreover, the mapping of the time intervals in terms of the duration of any single activity contained in the process was identified. In further, the analysis of the resources was provided and the impact of the main energetic resource was discussed regarding both scenarios.

Based on the collected data generated from different departments in the factory, one can conclude that running operations on both production lines in one shift leads to decreased costs for salaries and increased costs for fuel consumption. The total cost calculations indicate that the scenario discussed in Case Study 2 is more cost-effective than the scenario discussed in Case Study 1.

This research highlights that job design, particularly task allocation, is a critical factor in optimizing production processes. Studying this aspect is valuable for developing more efficient and successful production processes. By analyzing real-life Case Studies from a bakery plant in North Macedonia, this paper can serve as a valuable guide in striving to enhance overall efficiency and contribute to companies within the relevant industry sector.

5.1. Research limitations

The few limitations of this research are underlined.

First, due to company confidentiality requirements, principally on compensation levels of employees and cost of resources, they were not exposed to public presentation. For reporting in this paper, data were provided only for computation in percentages. Although this ensured respecting organizational procedures, it limited the level of quantitative analysis.

Second, the analysis is limited to two case study scenarios, which represent real alternatives in the company, and both are applied in a single industrial environment. The applicability of research findings to other production environments with different structures is limited.

Third, the study does not utilize advanced modeling techniques, which would confirm the proposed perceptions into task allocation strategies and job design.

5.2. Further avenues of investigation suggested

Future research can build on the current research by expanding the sizes of the datasets, crossing a range of industries, and utilizing sophisticated analysis techniques. With the dynamic nature of the production costs and the constant need for adaptive workplace design and task assignment, the future research can engage sophisticated modeling techniques like simulation, which would also confirm the proposed insights into task assignment strategies and work design.

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REFERENCES

Agnetis, A., Murgia, G., Sbrilli, S. (2014). A job shop scheduling problem with human operators in handicraft production. *International Journal of Production Research, 52*(13), 3820-3831. https://doi.org/10.1080/00207543.2013.831220

Ahmed, J., Rahman, M. S. (2012). *Handbook of food process design*. Blackwell Publishing Ltd. https://doi.org/10.1002/9781444398274

Akyazi, T., Goti, A., Oyarbide, A., Alberdi, E., Bayon, F. (2020). A guide for the food industry to meet the future skills requirements emerging with Industry 4.0. *Foods, 9*(4), 492. https://doi.org/10.3390/foods9040492

Alam, S. T. (2020). Automated bread maker: Implementing techniques of product design process. In *Proceedings of the International Conference on Industrial & Mechanical Engineering and Operations Management*, Dhaka, Bangladesh, December 26-27. IEOM.

Aljohani, K. (2023). Optimizing the distribution network of a bakery facility: A reduced travelled distance and food-waste minimization perspective. *Sustainability, 15*(4), 3654. https://doi.org/10.3390/su15043654

Arias, M., Munoz-Gama, J., Sepúlveda, M., Miranda, J. C. (2018). Human resource allocation or recommendation based on multi-factor criteria in on-demand and batch scenarios. *EJIE, 12*(3), 364-404. https://doi.org/10.1504/EJIE.2018.092009

Babor, M., Senge, J., Rosell, C. M., Rodrigo, D., Hitzmann, B. (2021). Optimization of no-wait flowshop scheduling problem in bakery production with modified PSO, NEH and SA. *Processes, 9*(11), 2044. https://doi.org/10.3390/pr9112044

Bhatia, S. (2016). *Food biotechnology*. CRC Press.

Calzavara, M., Faccio, M., Granata, I., Travisani, A. (2024). Achieving productivity and operator well-being: A dynamic task allocation strategy for collaborative assembly systems in Industry 5.0. *International Journal of Advanced Manufacturing Technology, 134*, 3201-3216. https://doi.org/10.1007/s00170-024-14302-3

Calzavara, M., Faccio, M., Granata, I., Travisani, A. (2024). Achieving productivity and operator well-being: A dynamic task allocation strategy for collaborative assembly systems in Industry 5.0. *International Journal of Advanced Manufacturing Technology, 134*, 3201-3216. https://doi.org/10.1007/s00170-024-14302-3

Cheng, Y., Sun, F., Zhang, Y., Tao, F. (2019). Task allocation in manufacturing: A review. *Journal of Industrial Information Integration, 15*, 207-218. https://doi.org/10.1016/j.jii.2018.08.001

Clark, J. P. (2009). Process and equipment selection. In *Practical design, construction and operation of food facilities* (pp. 85-122). Academic Press, Elsevier Inc.

Drozd, R., Wolniak, R., Piwnik, J. (2023). Systemic analysis of a manufacturing process based on a small scale bakery. *Quality & Quantity, 57*, 1421-1437. https://doi.org/10.1007/s11135-022-01408-7

Drozd, R. (2020). Functional model of the impact of factors on product quality in the baking industry. *Science Didactics Equipment, 3*, 173-180.

Dvorak, J., Wurster, M., Carl May, M., Lanza, G. (2023**).** A systematic approach to task assignment and production planning in disassembly with employee skills. *Procedia CIRP, 120*, 958-963. https://doi.org/10.1016/j.procir.2023.09.107

Fast-Berglund, Å., Stahre, J. (2013). Task allocation in production systems – Measuring and analysing levels of automation. *IFAC Proceedings Volumes, 46*(15), 435-441. https://doi.org/10.3182/20130811-5-US-2037.00032

Galeazzo, A., Furlan, A. (2020). Developing operational problem solvers: The role of job design decisions. *Total Quality Management & Business Excellence, 32*(15-16), 1768-1785. https://doi.org/10.1080/14783363.2020.1771176

Gembalska-Kwiecień, A., Skotnicka-Zasadzień, B., Wolniak, R., Bujna, M. (2018). Creating participation of employees in improving work safety in enterprise. In *XV International Conference Multidisciplinary Aspects of Production Engineering (MAPE 2018)* (pp. 689-694). Wydawnictwo PANOVA.

Goel, K., Fehrer, T., Röglinger, M., Wynn, M. T. (2023). Not here, but there: Human resource allocation patterns. In C. Di Francescomarino, A. Burattin, C. Janiesch, S. Sadiq (Eds.), *Business Process Management. BPM 2023. Lecture Notes in Computer Science* (Vol. 14159). Springer, Cham. https://doi.org/10.1007/978-3-031-41620-0_22

Goryńska-Goldmann, E., Gazdecki, M., Rejman, K., Kobus-Cisowska, J., Łaba, S., Łaba, R. (2021). How to prevent bread losses in the baking and confectionery industry? Measurement, causes, management, and prevention. *Agriculture, 11*(1), 19. https://doi.org/10.3390/agriculture11010019

Hecker, F., Hussein, W., Becker, T. (2010). Analysis and optimization of a bakery production line using ARENA. *International Journal of Simulation Modelling, 9*(4), 208-216. https://doi.org/10.2507/IJSIMM09(4)4.175

Hacker, W., Sachse, P. (2014). *Allgemeine Arbeitspsychologie: Psychische Regulation von Tätigkeiten*. Hogrefe, Göttingen.

Huang, E. Y., Paccagnan, D., Mei, W., Bullo, F. (2022). Assign and appraise: Achieving optimal performance in collaborative teams. *IEEE Transactions on Automatic Control, 68*(3), 1614-1627. https://doi.org/10.1109/TAC.2022.3156879

Ihde, S., Pufahl, L., Lin, M. B., Goel, A., Weske, M. (2019). Optimized resource allocations in business process models. *International Conference on Business Process Management* (pp. 55-71). Springer. https://doi.org/10.1007/978-3-030-26643-1_4

Joo, T., Jun, H., Shin, D. (2022). Task allocation in human–machine manufacturing systems using deep reinforcement learning. *Sustainability, 14*(4), 2245. https://doi.org/10.3390/su14042245

Kumar, P. P. (2019). Goal programming through bakery production. *International Journal of Scientific & Technology Research, 4*, 3722-3725.

Lewis, M. (2019). *Operations management: A research overview*. Taylor & Francis Group. https://doi.org/10.4324/9781351034982

Maman, Z. S., Yazdi, M. A. A., Cavuoto, L. A., Megahed, F. M. (2017). A data-driven approach to modeling physical fatigue in the workplace using wearable sensors. *Applied Ergonomics, 65*, 515-529. https://doi.org/10.1016/j.apergo.2017.02.001

Martin, N., Depaire, B., Caris, A., Schepers, D. (2020). Retrieving the resource availability calendars of a process from an event log. *Information Systems, 88*, 101463. https://doi.org/10.1016/j.is.2019.101463

Mondal, A., Datta, A. (2008). Bread baking – a review. *Journal of Food Engineering, 86*(4), 465-474. https://doi.org/10.1016/j.jfoodeng.2007.11.014

Muscalu, G., Voicu, G., Istudor, A. (2017). Bread dough kneading process optimization in an industrial environment, using a device for dough consistency control. *UPB Scientific Bulletin, Series D: Mechanical Engineering, 79*(3), 225-236.

Naegele Inc. Bakery Systems. (2019). *Automating industrial bakery production lines: Benefits and tips*. https://www.naegele-inc.com/wp-content/uploads/2020/06/Naegele-automating-industrial-bakery-production-web.pdf

Oladejo, K., Abolarinwa, A., Salawu, S. O., Lukman, A. F. (2019). Optimization principle and its application in optimizing landmark university bakery production using linear programming. *International Journal of Civil Engineering and Technology (IJCIET), 10*(2), 183-190.

Patel, A., Devraja, H., Sharma, P., Singh, R. (2019). *Food technology II. Technology Division NDRI*, Karnal-132001. https://agrimoon.com/wp-content/uploads/FOOD-TECHNOLOGY-II.pdf

Peinado, J., Graeml, A. R., Vianna, F. (2018). Operations management body of knowledge and its relevance to manufacturing and service organizations. *Revista de Gestão, 4*, 373-389. https://doi.org/10.1108/REGE-03-2018-0049

Petzoldt, C., Niermann, D., Maack, E., Sontopski, M., Vur, B., Freitag, M. (2022). Implementation and evaluation of dynamic task allocation for human–robot collaboration in assembly. *Applied Sciences, 12*(24), 12645. https://doi.org/10.3390/app122412645

Pufahl, L., Ihde, S., Stiehle, F., Weske, M., Weber, I. (2021). Automatic resource allocation in business processes: A systematic literature survey. *arXiv preprint arXiv*:2107.07264, 1-28. https://doi.org/10.48550/arXiv.2107.07264

Purlis, E. (2012). Baking process design. In *Handbook of Food Process Design*. Blackwell Publishing Ltd.

Sheveleva, L., Jones, M., Harris, I. (2023). It does not matter how hard you work: The importance of task allocation for worker productivity. *Economics Letters, 227*, 111115. https://doi.org/10.1016/j.econlet.2023.111115

Slack, N., Brandon-Jones, A. (2019). *Operations management*. Pearson.

Stanojeska, M. (2022). An implementation of digital technologies to improve productivity and reduce non-value adding activities in the production process. *AICEI*, 198-207. https://doi.org/10.5281/zenodo.7643579

Stanojeska, M., Cepujnoska, V. (2014). A model of statistical process control of quality and cost optimization in milling industrial processes. *Journal of Hygienic Engineering and Design, 7*, 87-95.

Suchintita, D. R., Tiwari, B. K., Garcia-Vaquero, M. (2023). The fundamentals of bread making: The science of bread. In *Traditional European breads: An illustrative compendium of ancestral knowledge and cultural heritage* (pp. 1–40). Springer International Publishing. https://doi.org/10.1007/978-3-031-23352-4_1

Tausch, A., Kluge, A. (2022). The best task allocation process is to decide on one's own: Effects of the allocation agent in human-robot interaction on perceived work characteristics and satisfaction. *Cognitive Technology & Work, 24*, 39-55. https://doi.org/10.1007/s10111-020-00656-7

Trinh, L., Campbell, G. M., Martin, P. J. (2016). Scaling down bread production for quality assessment using a breadmaker: Are results from a breadmaker representative of other breadmaking methods? *Food and Bioproducts Processing, 100*, 54-60. https://doi.org/10.1016/j.fbp.2016.06.004

Van den Broeck, A., Parker, S. (2017). *Job and work design*. In Parker, Morgeson, & Johns.

Wang, J., Yu, D., Liu, C. (2024). *Task allocation for maximum cooperation in complex structured business processes*. Knowledge-Based Systems, 299, 111989. https://doi.org/10.1016/j.knosys.2024.111989

Williamson, M. E., Wilson, I. (2009). Development of an improved heating system for industrial tunnel baking ovens. *Journal of Food Engineering*, *91*(1), 64-71. https://doi.org/10.1016/j.jfoodeng.2008.08.004

Wolniak, R. (2020). Main functions of operation management. *Production Engineering Archives*, *26*(1), 11-14. https://doi.org/10.30657/pea.2020.26.03

Zandieh, M., Adibi, M. A. (2010). Dynamic job shop scheduling using variable neighborhood search. *International Journal of Production Research*, *48*(8), 2449–2458. https://doi.org/10.1080/00207540802662896

Zhao, W., Pu, S., Jiang, D. (2020). A human resource allocation method for business processes using team faultlines. *Applied Intelligence*, *50*, 2887-2900. https://doi.org/10.1007/s10489-020-01686-4

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MODELING THE DETERMINANTS OF BREAD QUALITY IN THE TECHNOLOGICAL PROCESS

The aim of the article is to present the determinants of bread quality within the technological process, along with a model illustrating their interrelations. Based on a review of the literature as well as the authors' own research conducted in bakeries, individual determinants of bread quality in the technological process were characterized and categorized into three primary groups: raw material factors, technological factors, and organizational-technical factors. All identified determinants constitute a functional whole, forming the basis for the development of a functional model of bread quality determinants in the technological process. This model serves as a theoretical tool for research purposes. Using the results of studies carried out in bakeries located in the Pomeranian Voivodeship, a model was also developed to demonstrate the impact of implemented innovations in the technological process on the remaining determinants of bread quality.

Keywords: technological process, quality determinants in the bread technological process, improvement of bread quality.

1. INTRODUCTION

Bread in Poland is a fundamental component of the daily diet. When approached rationally, it can play an invaluable role in regulating the human digestive system and provide a significant portion of the body's daily energy requirements (approximately 25-30%). In addition to its nutritional function, bread can also serve pro-health purposes, and it is precisely such products that are of interest to today's consumers (Drozd, Wolniak, 2023).

Driven by the popularity of a healthy lifestyle, consumer interest is increasing in wholegrain breads, breads with added seeds, products with reduced salt content, high-protein breads, and those with specialized compositions (Galanakis, 2020).

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Ensuring the availability of high-quality bread that guarantees both nutritional value and health safety should be a priority for producers (Van der Spiegel et al., 2005).

Consumer awareness continues to grow. People are increasingly attaching importance to the health-promoting qualities of food, including bread. Changes in dietary habits, consumer behaviors, and purchasing models have led modern customers to show interest in bread products that meet specific dietary needs (Lubczyńska, 2002), such as:

- with increased fiber content;
- high-protein varieties intended for people with diabetes;
- starch-based (gluten-free) products;
- low-sodium options, e.g., for individuals with obesity, hypertension, or certain heart and kidney conditions.

In the technological process, it is crucial to identify the stages at which the quality of the product is vulnerable to change. Can these changes be eliminated, or are there preventive measures necessary to ensure the production of safe food? What factors influence the quality of the product? (Luning, 2005).

The subject literature-both international and Polish-does not provide unequivocal opinions regarding the specific factors that influence product quality in the technological process. Based on the literature (which will be cited in the characterization of individual factors) and the authors' own observations resulting from interactions with bakery enterprises, three primary groups of factors shaping bread quality in the technological process have been identified: raw material factors, technological factors, and organizational-technical factors. Within these three groups, eight specific determinants of bread quality operate.

In response to the ongoing transformations in the bakery sector, particularly concerning the automation and robotization of production lines, empirical research was conducted in 51 bakeries located in the Pomeranian Voivodeship between 2020 and 2023. The aim of this research was to assess the influence of one of the technological process factors-namely, innovation-on the remaining determinants of bread quality.

2. CURRENT STUDIES – CHARACTERISTICS OF BREAD QUALITY DETERMINANTS IN THE TECHNOLOGICAL PROCESS

2.1. Raw material factors

Raw material factors that shape the quality of bread are currently influenced by the growing popularity of a healthy lifestyle among consumers, who prefer high-quality products made from high-quality raw materials. The most important raw material factors related to bread quality in the technological process include: the quality of the raw materials used in production, properly established bread yield standards, and the composition of the raw materials (Drozd, 2022).

According to the professional literature, raw materials accepted into the warehouse of a production facility should possess high nutritional and health quality as well as appropriate technological suitability. All raw materials accepted into a bakery's warehouse should be checked primarily for organoleptic properties, expiration dates, declared weight conformity, packaging damage, and appropriate storage conditions during transport (Soares Geraldes et al., 2023).

The basic raw materials for bread production are: flour, water, yeast, salt, and fats. These materials must meet the recommended standards, including (Ambroziak, 2002):

- wheat flour – high gluten content and quality, high falling number, high sedimentation index, high water absorption capacity;
- rye flour – high falling number, appropriate granulation;
- solid fats – uniform consistency throughout the mass and even coloring;
- clarified oils.

The quality of flour, as the primary raw material, is greatly influenced by agroclimatic conditions, the genetic properties of cultivated cereal varieties, proper selection during grain procurement, and milling technology (Cappelli, Cini, 2021). Depending on the storage conditions, flour's technological suitability and health quality may either improve or deteriorate. The optimal storage conditions for flour are temperatures between 15 and 18°C with relative air humidity ranging from 65 to 70%. Flour-mainly wheat flour-is stored in silos, but it may also be kept in sacks. Bakery facilities usually have several silos, which are equipped in various ways, including control systems with scales and strain gauge sensors. Thanks to such systems, bakeries can fully control the delivery and consumption of flour during the technological process. Additionally, the use of sieve systems and airtight silo containers guarantees high quality and cleanliness of the raw material. The internal tanks of silos, due to the cyclical aeration of flour (the so-called flour massage), ensure good flour maturation properties (Djonovic et al., 2024).

The quality of flour in bakery production has a decisive influence on the course of technological processes. Baking value-meaning the quality of the flour-is a set of features that determine how it behaves during baking. These include the ability to produce and retain gas, the color of the flour and its tendency to darken, and granulation (milling coarseness).

Another factor that shapes the quality of bread during the technological process-and simultaneously affects raw material costs in the baking industry – is the proper determination of bread yield standards while maintaining high product quality. The average bread yield standard, known as "baking output", refers to the number of kilograms of bread obtained from 100 kg of flour. Every bread producer is obligated to establish an average yield standard for each type of bread based on a control bake. When setting the average bread yield standard, it is recommended to follow allowable bread composition standards that ensure good flavor. Bread yield standards should be periodically reviewed and adjusted. An appropriate raw material composition-that is, the formulation-is a basic requirement for producing high-quality bread. The formulation should ensure the intended nutritional value and desirable taste qualities of the bread, using proper technology. These parameters are achieved through the correct selection of basic raw materials and substances that enrich nutritional value or enhance and improve the final product (Zgodavova et al., 2020).

Each bakery product should be manufactured based on a formulation, and its basic quality parameters should be defined by an appropriate standard, such as a Polish Standard or an Internal Company Standard. An Internal Company Standard is developed when a product, based on a proprietary formulation, differs in parameters from the PN. The internal formulation should include all elements of the reference formulation and must also be approved by the bakery manager or owner (Drozd, 2019b).

The shape and unit weight (grammage) of bread are not mandatory, as current Polish Standards allow for the production of bread in various shapes and weights.

2.2. Technological Factors

The next group of factors shaping the quality of bread is directly related to the production technology (technological factors). Proper bread quality can be ensured through the selection and stability of optimal process parameters, including controlled process efficiency (Linzalone, Lerro, 2022).

The technological parameters that particularly affect bread quality include: temperature, fermentation time, yield and degree of multiplication (acidification) of individual dough preparation phases, dough mixing time and intensity, proofing time of dough pieces, and baking time and temperature. The values of these parameters can be modified only within certain limits.

Baking of bread should be conducted with great care. It is a process through which bacteria, molds, and yeasts present in the bread-originating from raw materials, fermentation, the environment, etc.-are destroyed, provided that the appropriate time and temperature have been applied (Martinez-Monzo, 2022).

In every technological process, particularly in food production, controlled process efficiency is essential. This means the systematic monitoring, evaluation, and analysis of all process phases, as well as in-process quality control of semi-finished products.

A decisive influence on the course of process efficiency and on the quality of the bread produced is exerted by the monitoring and assessment of: temperature, phase yield, degree of acidification, and fermentation time (Kot, 2010).

Temperature depends on the yield and time of bread production. For each type of bread, appropriate conditions of time and temperature should be established. At lower temperatures, acidification occurs more slowly, and a significant amount of acetic acid is produced.

The quantitative ratio of acetic acid to lactic acid significantly determines the aroma and taste of bread. The addition of water at an appropriate temperature ensures the desired temperature of the production phase. The use of a specific baking temperature depends on other technological parameters such as consistency, fermentation time, flour quality, and formulation. In large bakery plants, following the example of some EU countries, the internal temperature of the product leaving the oven is adopted as an additional criterion for proper baking (Rosell, 2021).

The degree of acidification, also known as the multiplication of the phase, refers to the ratio of the mass of flour in the prepared phase to the mass of fermented flour introduced from the previous phase. In baking, the applied multiplications depend on the fermentation time of the phase, the quality of the raw material, and the production scheme. A higher degree of acidification, meaning a lower multiplication, is more favorable for yeast, whereas the opposite is true for bacteria. It is possible to regulate the yield of the phase, temperature, degree of acidification, and fermentation time of the phases, thereby influencing the development of microorganisms – yeast and bacteria.

The fermentation time depends on the yield of the phase, temperature, and degree of acidification. It is directly related to changes in acidity. The starting point for developing a fermentation schedule is the assumed fermentation time, and the other parameters are then adjusted accordingly. The fermentation time is thus connected to the changes in acidity (Patel et al., 2022).

In the technological process, so-called technological defects in bread can occur. These defects are mainly caused by inadequate quality of flour and auxiliary raw materials, errors in the technological process, and improper storage conditions. Preventing technological

defects depends primarily on the experience and qualifications of employees, as well as their knowledge of technology and raw material quality (Ambroziak, 2002). Technological defects in bread can be divided into two groups: external appearance defects (shape, volume, crust) and internal defects (crumb texture, taste, aroma).

Producing bread of very good or good quality is a significant opportunity for bakers, especially when working with flour that has poor baking properties. Therefore, the first step is to assess the baking value of the flour, and then to adjust the optimal parameters of the technological process. If technological modifications and the use of natural additives prove ineffective, the use of improvers is permitted (Cauvain, 2003).

Thus, in bakery enterprises, controlled process efficiency is essential. It allows-and even necessitates-the regulation of temperature, degree of acidification, and fermentation time of individual phases, as these operations directly benefit the quality of the final product. Managing the technological process to obtain the desired quality of the final product is based on continuous in-process quality control of semi-finished products. Such control is indispensable because if technological inconsistencies are detected, it is still possible to prevent poor bread quality by altering conditions such as fermentation duration, temperature, or phase yield. Testing of semi-finished products is therefore necessary during both trial baking and regular production. Information from quality control must reach decision-makers promptly. Results delivered with a delay merely document past events and are no longer helpful in process management. Instrumental methods of analysis are generally faster than chemical methods and easier to automate. For this reason, they are increasingly used in laboratory quality control (Mitelut et al., 2021).

The organoleptic method takes into account such quality indicators as: external appearance, aroma, structure, and the maturity of fermentation phases. Each semi-finished product, depending on its degree of maturity, is characterized by a specific scent (Rustamovich, 2022).

The physicochemical method for semi-finished products includes checking: temperature, moisture content, acidity, consistency, and the final proofing time of dough pieces. It is recommended to measure temperature using an electronic meter equipped with a sensor adapted for bakery applications (Rosell, Santos, 2010).

The quality and freshness period of bread are determined by baking conditions; therefore, it is very important that the bakery's technological and laboratory staff monitor the weights of dough pieces and ensure the correctness of baking (Drozd, 2019b).

2.3. Organizational and technical factors

Among the organizational and technical factors shaping bread quality in the technological process, significant influences include: employee qualifications, machine reliability, innovations in the technological process, and hygienic and sanitary conditions.

To ensure the proper execution of processes within an enterprise, appropriate resources are necessary. At the forefront of these resources are employees, followed by infrastructure, the working environment, and the necessary information (Szczepańska, 2011). In the bread production process, the role of employees is crucial (Obłój, 2001). Under a strict technological regime, bread quality depends not only on employee qualifications but also on their engagement-particularly in phases involving temperature regulation, acidification levels, and fermentation time. The role of the technologist is also critical and responsible. Their knowledge and involvement may, for instance, prevent the proliferation of harmful microorganisms. It is equally essential to uphold hygienic behavior standards among employees. According to technologists, the most difficult issue is preventing foreign

objects from entering the production area due to personnel contamination (Dan Pop et al., 2018).

Even if bread has good quality after baking, it is disqualified by most consumers if it shows any signs of staleness during consumption. Customers highly value fresh bread. Therefore, bread deliveries to retail networks are made daily, and for this reason, bakery machines must be maintained in full technical efficiency and reliability (Drozd, 2019a).

There is consensus in the professional literature that machine reliability affects bread quality. However, innovations introduced into the technological process (e.g., production lines, machines) are not explicitly listed as factors influencing bread quality. Nevertheless, there are formulations in the literature suggesting that bread quality and its technological parameters are influenced by raw materials, the knowledge and skills of the baker, and high-quality machines and equipment (Gupta et al., 2021).

Long-term improvement in machine reliability cannot be achieved through continuous repairs. Investment in new machines tailored to the demands of a competitive market is essential. It is increasingly evident that without the implementation of innovations, achieving a sustainable competitive advantage becomes virtually impossible. Innovations are currently the most effective means of attaining long-term market success.

Technological process innovations often determine the feasibility of product innovations and are frequently present in the background of such developments.

Hygienic and sanitary conditions in bakeries have a significant impact on the quality of bread during the technological process. These conditions pertain particularly to machines, personnel, storage of bread, packaging, and transportation.

The conditions under which bread is stored immediately after baking also influence its quality. First and foremost, bread should be cooled to a temperature of 30°C in conditions that prevent secondary contamination (from raw materials, equipment, people, or the environment) in clean rooms where personnel movement is restricted (Gupta et al., 2022).

A comprehensive assessment of the quality of all types of bread after baking is conducted through a scoring evaluation. This includes an organoleptic assessment while also taking into account physicochemical indicators expressed as point values. The scoring evaluation involves assigning numerical values to each quality characteristic (indicator) based on an established point scale (Luning et al., 2005). The total score obtained in this evaluation forms the basis for classifying the quality of the bread.

Bread that does not achieve the minimum number of points is disqualified. It is also a fact that evaluating only the final product is insufficient for determining its quality; therefore, controlled process efficiency is essential.

Bread packaging mainly includes slicing and wrapping. Individual bread packaging is used for hygienic reasons and to extend shelf life. However, packaging does not eliminate microbiological processes. Thermal stabilization is also possible. Bread with an extended shelf life is packaged in a modified atmosphere (Kotsianis et al., 2022). Some bread is sold unpackaged; thus, it is particularly important to maintain hygienic environmental conditions and personal hygiene of employees.

In the bread production chain, one remaining step is delivery of the product to the retail network. According to the identified technological process, deliveries to retail are not formally part of this process but are considered part of the broader production chain.

Bread should be transported to stores by individuals who do not pose a health risk. Specialized transport, i.e., vehicles dedicated exclusively to the transport of bread, must be free of foreign odors. Means of transport should be cleaned daily and periodically disinfected (Galankis, 2020).

3. METHODS – FUNCTIONAL MODEL OF DETERMINANTS OF BREAD QUALITY IN THE TECHNOLOGICAL PROCESS

According to E. Pająk, the description of a process structure is referred to as a model. In the most general sense, the objective for which the model is used may be defined as the description and explanation of reality treated in a comprehensive manner (Pająk, 2006).

For the purpose of a comprehensive assessment of the determinants of bread quality, these factors were identified, systematized, and characterized. Due to the interrelations and connections between individual determinants, a functional model of the determinants of bread quality in the technological process was developed, as illustrated in Figure 1.

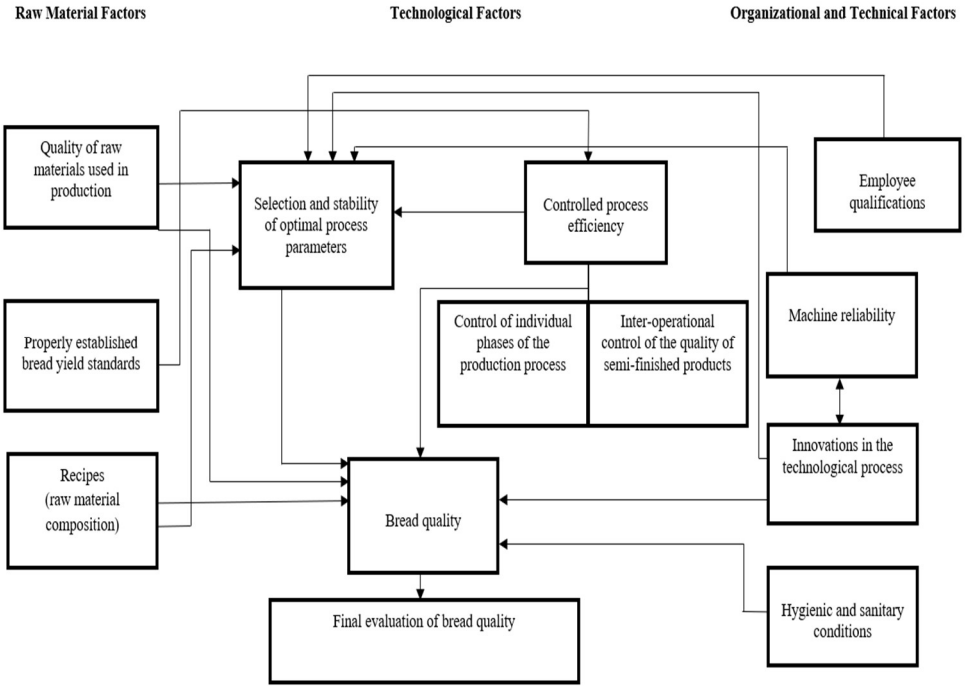

Figure 1. Functional model of determinants of bread quality in the technological process
Source: Author's work.

In the presented functional model of the determinants of bread quality in the technological process, the factors are grouped into three main categories. Each group of factors fulfills a specific function within the technological process:

I. Raw Material Factors, including:

1. Quality of raw materials used in production.
2. Properly established bread yield standards.
3. Recipes (raw material composition).

II. Technological Factors, including:
   1. Selection and stability of optimal process parameters, including: controlled process efficiency (of individual technological phases and inter-operational quality of semi-finished products).

III. Organizational and Technical Factors, which include:
   1. Employee qualifications.
   2. Machine reliability.
   3. Innovations in the technological process.
   4. Hygienic and sanitary conditions of machines, employees, bread storage, packaging, and transportation.

Each of the listed factors influences the shaping of bread quality, but all are also managed under the overarching factor responsible for the selection and stability of optimal technological process parameters.

The mutual interdependencies between the individual factors-and their relative strength-are also indicated by arrows and their directions, which are additionally included in the model. These graphical elements are characteristic of a relationship diagram, also known as a dependency diagram.

4. RESEARCH RESULTS ON THE IMPACT OF INNOVATION ON OTHER DETERMINANTS OF BREAD QUALITY

In response to the ongoing transformations within the bakery industry and considering the growing demand in Poland for bread that meets consumer quality expectations, a study was conducted to identify the impact of innovations in the technological process on improving bread quality.

This research was carried out between 2020 and 2023. A total of 51 bread producers from the Pomeranian Voivodeship participated, during which 56 innovations implemented in the bread production technological process were identified.

The innovations were systematized and divided into two categories: production lines and machines. Among the 22 technological lines implemented were those for the production of bread, bakery products, frozen dough, and robot-assisted production lines. The 34 machines were grouped into the following categories: silos, mixers with bowls, proofing chambers for dough pieces, bakery ovens, and X-ray detectors.

The perceived impact of all implemented technological lines and machines on individual determinants of bread quality, as reported by respondents, was as follows:

- 11.8% – on the establishment of bread yield standards;
- 13.3% – on employee qualifications;
- 13.4% – on recipes;
- 14.6% – on the quality of raw materials used in production;
- 14.8% – on the selection and stability of optimal process parameters;
- 15.8% – on hygienic and sanitary conditions;
- 16.3% – on machine reliability.

This represents a general summary of the influence of all innovations implemented in the technological process on the remaining determinants of bread quality. It is also worth noting that, even during the construction of the functional model of bread quality determinants in the technological process, significant relationships between innovation and machine reliability were observed. These correlations are confirmed by the results of the survey.

Figure 2 presents the model illustrating the impact of implemented innovations in the technological process on the other determinants of bread quality.

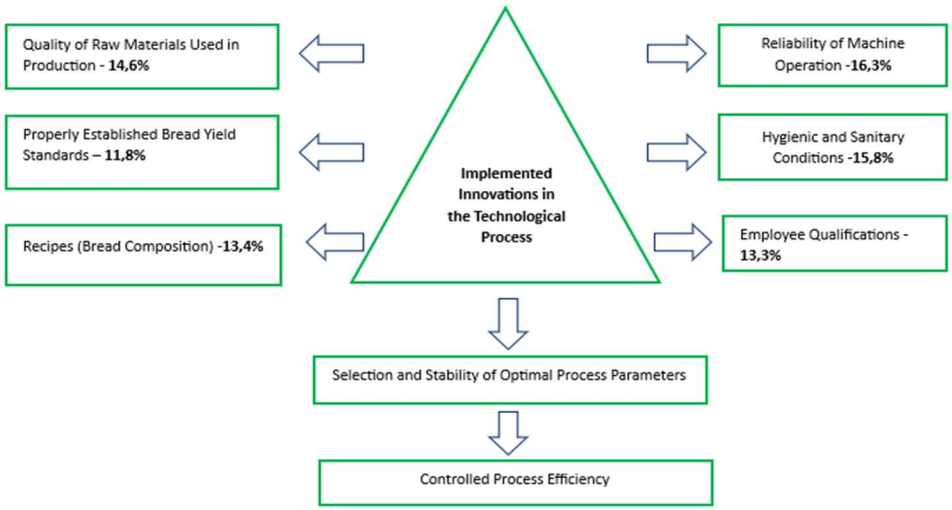

Figure 2. Model of the impact of innovations in the technological process on the determinants of bread quality

Source: Author's work.

5. DISCUSSION

Innovations implemented in the technological process are mainly directed at introducing changes in the methods of manufacturing the product. Although they are the background of product innovations, in the case of bakery products they affect the improvement of the product's quality.

The quality of bread is, next to price, the basic parameter that determines success in the competitive struggle. The dominant problem of modern baking should be the continuous improvement of bread quality to satisfy customers. Although attention to bread quality is essential at every stage of a company's operations, the most crucial element is the technological process.

The literature on the subject lacks a comprehensive study on the determinants of bread quality from the perspective of the technological process. Based on a literature review and participant observations, resulting from the authors' several years of experience in bakeries, the determinants that shape bread quality in the technological process were identified, systematized, and characterized. The identified factors shaping the quality of bread in the technological process include: the quality of raw materials used in production, properly established standards of bread yield, recipes (raw material composition), reliability of machinery, hygienic and sanitary conditions, employee qualifications, selection and stability of optimal process parameters, and innovation.

These determinants constitute a functional whole, and therefore a model of bread quality determinants in the technological process was developed. This model is a conceptual research model. The model of bread quality determinants in the technological process presented by the authors is currently being implemented in practice in bakeries.

6. CONCLUSIONS

Bread quality, alongside price, is a fundamental factor determining success in competitive markets. The dominant challenge facing contemporary bakeries should be the continuous improvement of bread quality to meet customer expectations. While quality must be safeguarded at every stage of a bakery's operations, the technological process remains its most critical element. The literature lacks a comprehensive study of the determinants of bread quality from the perspective of the technological process.

In summarizing the undertaken efforts regarding the determinants of bread quality in the technological process, it should be noted that the factors influencing quality were first identified and systematized through classification into three groups: raw material, technological, and organizational-technical factors. Within the raw material group, the following were recognized: the quality of raw materials used in production, properly established bread yield standards, and raw material composition (recipes). Organizational and technical factors include: machine reliability, innovations in the technological process, employee qualifications, and hygienic and sanitary conditions of machines, equipment, personnel, storage, packaging, and transportation.

The main technological factor shaping bread quality within the production process is the selection and stability of optimal process parameters. This is supported by controlled process efficiency (monitoring of individual production phases and inter-operational quality of semi-finished products). The factor of selecting and stabilizing optimal process parameters also acts as a coordinator of the entire technological process.

The identification and characterization of bread quality determinants based on professional literature and participant observation made it possible to develop a functional model of bread quality determinants in the technological process.

Research conducted in 51 bakeries in the Pomeranian Voivodeship between 2020 and 2023 led to the identification of 56 innovations implemented in the technological process, including 22 related to automated and robotized technological lines and 34 to automated standalone machines. The implemented innovations influenced all determinants of bread quality to varying degrees, from 11.8% (in the area of establishing bread yield standards) to 16.3% (in machine reliability). Based on this, a model was developed showing the impact of implemented technological innovations on the remaining determinants of bread quality.

Technical advancement in the technological process may serve as a prelude to the Fourth Industrial Revolution, the essence of which lies in transferring the majority of decision-making from human operators to the competence of machines.

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REFERENCES

Ambroziak, Z. (2002). Bread quality. In *Baking – recipes, standards, advice and legislation*. (pp. 109-113). Research Institute of the Bakery Industry.

Cappelli, A., Cini, E. (2021). Challenges and opportunities in wheat flour, pasta, bread, and bakery product production chains: A systematic review of innovations and improvement strategies to increase sustainability, productivity, and product quality. *MDPI – Publisher of Open Access Journals*, *Vol. 13*, Iss. 5, 26-38. https://doi.org/10.3390/su13052608

Cauvain, S.P. (2003). Bread making. Ist Edition. *Journal of Woodhead Publishing Series in Food Science, Technology and Nutrition*, 22-30.

Dan, Pop A., Rus, G., Drenta, R. F. (2018). Modeling and simulation of technological factors in bakery industry. *Springer. Advances in Manufacturing Engineering and Materials*, 531-538. https://doi.org/10.1007/978-3-319-99353-9_56

Djonovic, N., Kocic, S., Radevic, S. (2024). Health safety of bakery products. 2nd international symposium on biotechnology. *Proceedings*, 309-316. https://doi.org/10.46793/SBT29.40NDJ

Drozd, R. (2019a). Reliability of production machines in the bakery industry – theoretical and practical issues. *Publishing ABID, Vol. 3*, 208-214. https://doi.org/10.29119/1641-3466.2025.222.36

Drozd, R. (2019b). The influence of robotization on the reliability of the production process in the bakery industry. *Publishing ABID, Vol. 3*, 223-230. https://doi.org/10.1007/s11135-022-01408-7

Drozd, R. (2021). Health safety of bread in small bakeries. Scientific papers of Silesian University of Technology. *Organization and Management Series, No. 157*, 83-96. https://doi.org/10.29119/1641-3466.2022.157.5

Drozd, R., Wolniak, R. (2021). Metrisable assessment of the course of stream-systemic processes in vector form in industry 4.0. *Publishing* House *Springer*, 1-16. https://doi.org/10.1007/s11135-021-01106-w

Galanakis, C. M. (2020). Trends in wheat and bread making. *Elsevier Journal – Academic Press*, 78-82.

Gupta, S., Chaudhary, A., Kanwar, S. (2021). Reliability modelling and analysis of an industrial bakery plant using boolean function technique. *Publishing House Springer, Advances in Information Communication Technology and Computing, Proceedings of AICTC,* 427-436. https://doi.org/10.1007/978-981-19-0619-0_38

Kotsianis, I. S., Giannou, V., Tzia, C. (2022). Production and packaging of bakery proucts using MAP technology. *Elsevier Journal, Trends in Food Science & Technology, Vol. 13,* Iss. 9-10, 319-324. https://doi.org/10.1016/S0924-2244(02)00162-0

Kot, M. (2010). Production process control and quality assessment of baked goods. *Bakery and Confectionery Review, No. 2*, 6-11.

Linzalone, R., Lerro, A. (2022). Managing positional innovation in small food enterprises. The bakery industry. *Journal of Measuring Business Excellence, Vol. 25, Iss. 4*, 509-526. https://doi.org/10.1108/MBE-10-2020-0141

Lubczyńska, H. (2002). Dietary baked goods. In *Baking – recipes, standards, advice and legislation* (pp. 19-23). Research Institute of the Bakery Industry.

Luning, P. A., Marcelis, W. J., Jongen, W. M. F. (2020). *Food quality management, a technological and managerial approach.* WNT Publishing House. https://doi.org/10.3920/978-90-8686-899-5

Martinez-Monzo, J., Garcia-Segovi, P., Albors-Garrigos, J. (2022). Trends and innovations in bread, bakery, and pastry. *Journal of Culinary Science & Technology, Vol. 11,* Iss. 1, 56-65. https://doi.org/10.3390/app12020662

Mitelut, A. C., Popa, E. E., Popescu, P. A., Popa, M. E. (2021). 920210 Chapter 7 – Trends of innovation in bread and bakery production. Academic Press. *Trends in Wheat and Bread Making*, 199-226. https://doi.org/10.1016/B978-0-12-821048-2.00007-6

Obłój, K. (2001). *Strategies of organizations*. PWE Publishing House.

Pająk, E. (2006). *Production Management. Product, technology, organization*. PWN Publishing House.

Patel, B., Waniska, R. D, Seetharaman, K. (2022). Impact of different baking processes on bread firmness and starch properties in breadcrumb. *Journal of Cereal Science, Vol. 4*, 99-184. https://doi.org/10.1016/j.jcs.2005.04.007

Rosell, M. (2021). Chapter 1 – The science of doughs and bread quality. *Journal of Elsevier, Academic Press, Flour and Breads and their fortification in Health and Disease Prevention*, 3-9. https://doi.org/10.1016/B978-0-12-380886-8.10001-7

Rosell, C. M., Santos, E. (2010). Impact of fibers on physical characteristics of fresh and staled bake of bread. *Journal of Food Engineering, No. 98*, 272-279. https://doi.org/10.1016/j.jfoodeng.2010.01.008

Rustamovich, A. O. (2022). *Stages of production of bread and bakery products in Uzbekistan*. International Conference on Humanities, Educationand Sciences, USA 355-364. https://www.conferencezone.org/index.php/cz/article/view/310

Soares, Gerlaldes, C. A., Setti, F., Almeida, J. P. (2023). Improving the Production Process of a Baker. *Elsevier Journal – Flexible Automation and Intelligent Manufacturing: Establishing Bridges for More Sustainable Manufacturing Systems, Vol. 2*, 128-135. https://doi.org/10.1007/978-3-031-38165-2_16

Van der Spiegel, M., Luning, P. A., De Boer, W. J., Ziggers, G. W., Jongen, W. M. (2005). How to improve food quality management in the bakery sector. *Journal of Life Sciences, Vol. 2,* No. 53, 131-150. https://doi.org/10.1016/S1573-5214(05)80002-8

Zgodavova, K., Bober, P., Majstorovic, V., Monkova, K., Santos, G., Juhaszova, D. (2020). Innovative methods for small mixed batches production system improvement: The Case of a Bakery Machine Manufacturer. *MDPI – Publisher of Open Access, Actual Trends of Logistics and Industrial Engineering, Vol. 12*(15), 62-66. https://doi.org/10.3390/su12156266

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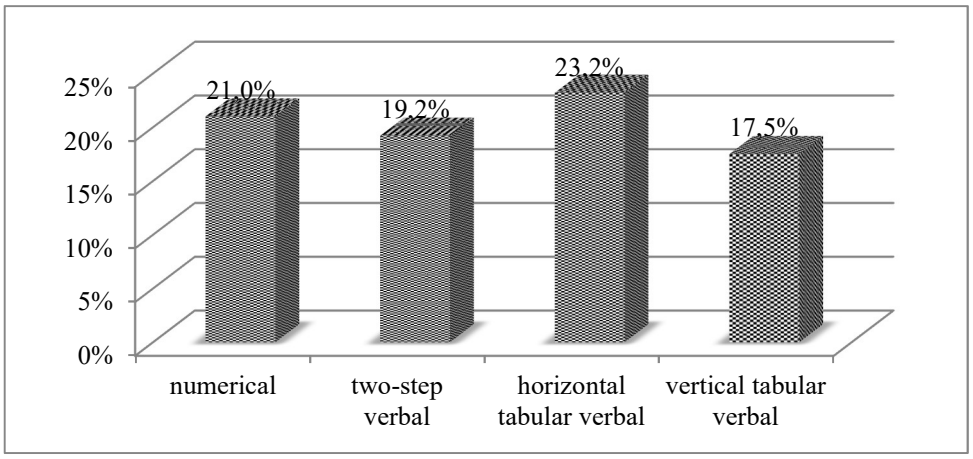

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Surname, A. (Year). Chapter title. In A. Surname (Ed.), *Book title* (pp. X-XX). https://www.xxxxxxx

Ilhan, O.A. (2021). The rise of digitalization in the tourism industry during COVID-19: cyber space, destinations, and tourist experiences. In M. Demir, A. Dalgic, F.D. Ergen (Eds.), *Handbook of Research on the Impacts and Implications of COVID-19 on the Tourism Industry* (pp. 843-862). IGI Global, Hershey, PA.

Online magazine article example
Surname, A. (Year, Month day). Article title. *Magazine title*. https://www.xxxxx

Thomson, J. (2022, September 8). Massive, strange white structures appear on Utah's Great Salt Lake. *Newsweek.* https://www.newsweek.com/mysterious-mounds-great-salt-lake-utah-explainedmirabilite-1741151

Report by a group author example
Name of the Organization. (Year). *Title of the Report by a Group Author.* https://www.xxxxx

World Health Organization. (2014). *Comprehensive implementation plan on maternal, infant and young child nutrition.* https://apps.who.int/iris/bitstream/handle/10665/113048/WHO_NMH_NHD_14.1_eng.pdf?ua=1

Report by individual authors example
Surname, A., Surname, B. (Year). *Title of the Report.* Publisher. https://www.xxxxxxx

Winthrop, R., Ziegler, L., Handa, R., Fakoya, F. (2019). *How playful learning can help leapfrog progress in education.* Center for Universal Education at Brookings. https://www.brookings.edu/wp-content/uploads/2019/04/how_playful_learning_can_help_leapfrog_progress_in_education.pdf

Online newspaper article example
Surname, A. (Year, Month day). Article title. *Newspaper title*. https://www.xxxxx

Bernstein, J. (2024, June 3). The man who couldn't stop going to college. *The New York Times*. https://www.nytimes.com/2024/06/03/magazine/benjamin-bolger-college-harvard-yale.html

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