**Introduction**

In an environment of fierce competition and rapid market changes, small businesses face the necessity of making prompt and informed decisions. Although such businesses have limited capital turnover, a local area of operations, a limited legislative framework for their activities, and a small number of jobs created, they are flexible. As a result, traditional management methods often fall short when running a business efficiently.

This contrasts approaches that use Big Data tools generated from day-to-day business operations. It is precisely the integration of Big Data into traditional management that unlocks new opportunities for continuous transformation in small businesses, allowing them to understand their customers and swiftly adjust business processes, customer interactions, and overall operational efficiency.

Given the complexity of the outlined process, it is advisable to study it through the lens of a case study, interpreted as a detailed analysis of a specific situation or problem. Essentially, a unique success or failure story involving the use of Big Data in small business should be created, aimed at studying, analyzing, and drawing practical conclusions.

**11.1. Features of applying Big Data in small business management**

Big Data is a powerful tool that transforms vast amounts of information into valuable insights. For small businesses, this means the ability to make more informed decisions. Thanks to big data, small businesses gain the ability to:

1. Create personalized offers for each customer, enhancing loyalty and increasing

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the average transaction value through features like extensive customer segmentation, detailed customer profiling, and customizable, flexible recommendation systems [1; 2; 6]. The outlined specifics shape clear directions and general characteristics of processes according to the specifics presented in Table 1.

Notably, creating personalized offers based on Big Data is a powerful tool for enhancing sales management effectiveness [1].

For example, while viewing a product, a customer may see relevant recommendations, reviews from similar customers, and personalized offers. Additionally, a management system integrated with Big Data can generate and send targeted messages.

However, for the successful implementation of this approach, it is essential to consider a range of factors, including data quality, customer privacy, and the business's technological capabilities [1-2].

**Table 1 -** Directions and general characteristics of the processes for creating personalized offers for customers

| Directions of personalized offers | Characteristics of the processes for creating personalized offers | The result of offer personalization |
|---|---|---|
| Broad customer segmentation | Performed using clustering algorithms and other big data analysis methods that allow companies to divide customers into groups with similar characteristics | Allows creating more relevant marketing offers |
| Detailed customer profiling | Creating detailed customer profiles based on their behavior, preferences, and purchase history | Allows understanding what motivates customers and which offers will interest them |
| Flexible recommendation systems | Using algorithms that analyze the customer's purchase history, interactions with products, and the behavior of other users with similar characteristics | Allows adjusting and refining the offer. |

*Source: formulated by the author based on [1; 2; 6]*

2. Identify the most effective sales channels and audience segmentation for more precise implementation of the business entity's commercial policy through such process features as overall attribution, A/B testing, and customer journey analysis.

In particular, a business entity gains access to a vast amount of information about its customers through Big Data, including their purchase history, website behavior, demographic data, interactions with marketing campaigns, and more.

The outlined specifics shape clear directions and general characteristics of the processes according to the specifics presented in Table 2.

Notably, determining the most effective sales channels and audience segmentation based on Big Data allows managers to make real-time decisions on which channels to use, how to allocate the marketing budget, and how to evaluate the results of marketing campaigns [4-5].

**Table 2 -** Directions and general characteristics of the processes for creating personalized offers for customers

| Directions for implementing commercial policy | Characteristics of the processes for implementing commercial policy | Result of implementing commercial policy |
|---|---|---|
| Overall attribution | Determining which specific marketing channel led to the purchase | Allows management to focus on managing the most effective sales channels |
| A/B testing | Comparing the effectiveness of different marketing campaigns to identify the best options | |
| Customer journey analysis | Tracking the customer's interaction with the brand from the first contact to the purchase | Helps identify potential issues in marketing budget allocations and how to evaluate the results of marketing campaigns |

*Source: formulated by the author based on [1; 4-5]*

For example, analyzing traffic sources might reveal that younger people more frequently visit the website through Instagram and TikTok, while older individuals do so through Facebook. Additionally, Big Data can be used to compare which channels generate the most orders. For example, it may be determined that most purchases occur after clicking on a banner ad on Google. Additionally, big data can identify which specific marketing campaign played the largest role in making the purchase: Instagram ads or Google search ads [1].

3. Quickly identify and resolve customer issues, enhancing their satisfaction

through features such as feedback analysis, chatbots, and proactive service [1]. The outlined specifics shape clear directions and general characteristics of processes according to the specifics presented in Table 3.

When managers can analyze large volumes of data on customer behavior, feedback, and interactions with a product or service, they gain valuable insights that enable them to [2; 7-8] identify the cause of each existing problem and determine ways to address issues more effectively, forecast future problems, and optimize the set of interrelated tasks and measures aimed at achieving specific goals or outcomes within the business.

**Table 3 -** Directions and general characteristics of the processes for identifying and solving customer problems

| Directions for identifying customer problems | Characteristics of the processes for identifying customer problems | Result of identifying customer problems |
|---|---|---|
| Feedback analysis | Monitoring customer feedback on social media, forums, and other platforms | Identifying problems and trends |
| Chatbots | Automating the customer service process using chatbots | Assisting in informing customers about basic issues and resolving simple problems |
| Proactive service | Predicting customer problems based on data analysis and proactively resolving them. | Allows the business entity to identify bottlenecks in customer service processes and automate routine tasks |

*Source: formulated by the author based on [2; 7-8]*

Notably, the adequacy of data on customer behavior, feedback, and interactions with a product or service enables managers to make more informed decisions and adjust business processes.

For example, if a business notices that customers frequently return products because the size is incorrect, and Big Data analysis shows that the issue is related to inaccuracies in the size chart, it creates an opportunity to adjust the size chart based on data about actual customer sizes, provide more detailed size descriptions, including size charts and recommendations for size selection, or develop a tool that helps

customers choose the right size based on their measurements.

4. Identify bottlenecks in production processes through sensor data analysis, logistics data analysis, and quality data analysis. The outlined specifics shape clear directions and characteristics of these processes according to the specifics presented in Table 4.

Notably, when managers have the ability to analyze large volumes of data on bottlenecks in production processes, they gain a powerful tool for enhancing the efficiency of production or other core activities [1; 4].

**Table 4** - Directions and general characteristics of the processes for identifying bottlenecks in production processes

| Directions for identifying bottlenecks | Characteristics of the processes for identifying bottlenecks in production processes | Result of identifying bottlenecks in production processes |
| --- | --- | --- |
| Sensor data analysis | Collecting data from sensors installed on equipment that provides information on the consumption of raw materials, materials, and energy. | Detecting deviations from normal indicators and predicting failures. Identifying inefficient processes and developing measures for energy conservation. |
| Logistics data analysis | Optimizing delivery routes, inventory management, and production planning | Eliminating bottlenecks in production processes. |
| Quality data analysis | Identifying the causes of defects and product flaws, determining the level of product quality | |

*Source: formulated by the author based on [1-2; 4-5]*

Improving production efficiency or other core activities based on Big Data allows a small business to achieve increased productivity and reduced costs. For example, in electronics manufacturing, data analysis can help identify the causes of component failures and improve the productivity of the main product. The Data analysis in the food industry can ensure compliance with sanitary standards and food safety, thereby improving product quality.

5. Optimize inventory, and reduce costs for energy and other resources through demand forecasting and inventory level optimization. Excess inventory in small

businesses leads to additional costs for storage, maintenance, and potential losses from spoilage [1]. On the other hand, insufficient inventory can lead to production downtime, loss of customers, and a negative impact on the company's reputation [6].

Thus, inventory optimization based on big data (with directions and specifics outlined in Table 5) is a key factor in achieving a balance between meeting customer demand and minimizing costs, managing inventory at the point of sale, and optimizing ordering processes.

Notably, inventory optimization based on big data creates opportunities for implementing specialized software for automating inventory management processes and real-time data analysis.

**Table 5 -** Directions and general characteristics of the processes for optimizing processes

| Directions for inventory optimization | Characteristics of the inventory optimization processes | Result of inventory optimization |
|---|---|---|
| Demand forecasting | Using statistical analysis methods to forecast future product demand | Predicting future demand for products or services for more accurate production and procurement planning |
| Inventory level optimization | Determining the optimal inventory level to minimize storage costs and avoid shortages | Determining the optimal inventory level for each type of product |
| Inventory management at the point of sale | Monitoring inventory levels directly on store shelves | Ensuring maximum product availability for customers |
| Order process optimization | Automating ordering and supply processes | Reducing order fulfillment time and lowering costs |

*Source: formulated by the author based on [1; 6-7]*

For example, based on Big Data, small bakeries can analyze bread sales over the past 5 years, data on the use of flour, yeast, and other ingredients, and weather data (since humidity affects dough quality). In particular, it is possible to build a forecasting model that takes into account seasonal demand fluctuations (e.g., higher demand for bread before holidays), the impact of weather, and marketing promotions. The content of this model includes [1; 6-7]:

- Determining the optimal inventory levels of flour, yeast, and other ingredients, considering their shelf life and cost;
- Creating an automatic ordering system for raw materials when a critical stock level is reached.

6. Analyze data on future trends to forecast upcoming trends and develop new products and services through trend analysis on social media, competition data analysis, and seasonal forecasting [1; 6]. By combining these three directions, companies can create more accurate forecasts, adapt their strategy to changing market conditions, and achieve greater success, taking into account the specifics outlined in Table 6.

**Table 6 -** Directions and general characteristics of the processes for analyzing data on future market trends

| Directions for analyzing data on market trends | Characteristics of the processes for analyzing data on future market trends | Results of analyzing data on future market trends |
|---|---|---|
| Analysis of social media trends | Identifying new trends and shifts in consumer sentiments | Assessing consumer perceptions of a brand, product, or industry. This allows for adjustments in marketing messages and customer interaction strategies. |
| Analysis of competition data | Monitoring competitors' actions and adapting one's own strategy | The ability to outpace competitors by developing products or services that address unmet consumer needs. |
| Seasonal forecasting | Detecting seasonal demand fluctuations and planning production and marketing campaigns accordingly | Planning activities with consideration of seasonal peaks and troughs in demand, helping to avoid product shortages or surpluses. |

*Source: formulated by the author based on [1; 7-8]*

It should be noted that generating a significant amount of high-quality data on future trends based on Big Data is a key step for successful forecasting and adapting a business to changing market conditions [7-8].

For example, if the management of a small business that produces sportswear analyzes social media and discovers a trend indicating growing interest in eco-friendly production, they can develop a new line of products made from organic cotton and receive a positive consumer response. If a small business that develops smartphone

software notices, by tracking competitors' activities, that they are actively advancing in the field of artificial intelligence, the business can expedite its research in this area and release new software with innovative AI-based features.

## 11.2. Case study on the application of Big Data in small business management

Currently, there are relatively few public studies that systematically assess the success of applying Big Data in small businesses. Many cases presented as success stories do not reflect the overall picture. So we will turn to a more detailed analysis of current practices in Big Data application in management.

In our examination, we will consider success as a conditional category that can be measured in various ways [6-7] increased sales, enhanced customer loyalty, cost optimization, etc. For one business, success might be a slight increase in sales, while for another, it could be a significant reduction in expenses [1-2].

There are numerous successful cases of using Big Data in small businesses. For instance, the specifics of successful big data applications in small business management can be illustrated by the case study: "How the small coffee shop business Arabika (Mukachevo). Uses Big Data for Growth. It should be noted that a prerequisite for using Big Data in management was that the business located in the city center faced a decline in sales during weekdays. The owner aimed to understand why customers stopped visiting the establishment and how to increase sales through Big Data uses. The solutions derived from applying big data in the café management are outlined in Table 7.

Based on the provided data, it is clear that the use of Big Data in management allowed the café owner to gain a detailed understanding of customer behavior, optimize the operations of the establishment, and increase sales. This case study demonstrates that even small businesses can successfully utilize Big Data to achieve their goals [6].

**Table 7 -** Solutions derived from the application of big data in the management of the café "Arabica"

| Data collection | Data analysis | Strategy development | Results of applying Big Data |
|---|---|---|---|
| Loyalty program [1] Social media [2] Weather data [3] City event data [4] | Determining peak hours [5] Analysis of popular Drinks [6] Customer segmentation [7] Review analysis [8] | Expanding the product range [9] Special offers [10] Operational optimization [11] Marketing campaigns [12] | Sales on weekdays increased by 20%. The average transaction value grew due to the sale of additional products and special offers. The number of visitors using the loyalty program increased. |

Note
1.  Implemented a discount system via a mobile app that allowed collecting data on each customer's purchases.
2.  Analyzed customer reviews, trends, and mentions of the café on social media.
3.  Analyzed the impact of weather conditions on the number of visitors.
4.  Analyzed the impact of concerts, festivals, and other events on customer traffic.
5.  Identified that the highest customer flow occurs in the morning and lunchtime.
6.  Determined the most popular drinks among customers.
7.  Segmented customers into groups based on visit frequency, average check, and drink preferences.
8.  Identified main reasons for customer dissatisfaction (e.g., long queues, limited dessert options).
9.  Added new types of desserts and snacks that are popular with the target audience.
10. Developed special offers for different customer segments (e.g., discounts for students on weekdays).
11. Increased the number of baristas during peak hours, and implemented a pre-order system for drinks via the mobile app.
12. Launched targeted advertising campaigns on social media and local media
*Source: formulated by the author*

A notable example of a successful Big Data application in management is the case study: "How a Small Online Clothing Store Increased Sales Using Big Data. The application of Big Data in management became necessary when the small online clothing store "Lily" faced a decline in conversion rates and average order value. The owner aimed to use Big Data to understand why customers were abandoning their purchases and how to increase the average order value. The solutions derived from the Dig Bata application in the management of the online store are presented in Table 8.

Based on the provided data, it is evident that the use of Big Data in the management of the clothing e-commerce store allowed the owner to gain deep insights into customer behavior, optimize the website, and increase sales.

**Table 8 -** Solutions derived from the application of Big Data in the management of the clothing online store 'Lily

| Data collection | Data analysis | Strategy development | Results of applying Big Data |
|---|---|---|---|
| Analysis of user behavior on the website [1] <br> Analysis of purchase data [2] <br> Customer data [3] | Identification of user hain points [4] <br> Customer segmentation [5] <br> seasonality Analysis [6] | Website optimization [7] <br> Personalization [8] <br> Marketing campaigns [9] <br> Loyalty program [10] | Increased conversion rates <br> Increased average order value (through upselling and cross-selling) <br> Enhanced customer loyalty through personalized approaches and loyalty programs |

Note
1. Tracking user actions on the website (page views, adding products to the cart, abandonment of purchase).
2. Analyzing products that are frequently purchased together, average order value by different product categories.
3. Using analytics tools to gather information about customers' age, gender, and geographic location.
4. Analyzing reasons for cart abandonment (complex checkout process, lack of necessary product information).
5. Segmenting customers by loyalty level, purchase frequency, and other criteria.
6. Identifying seasonal fluctuations in demand for different product categories.
7. Simplifying the checkout process, adding detailed product descriptions, and using high-quality images.
8. Implementing a system for personalized product recommendations based on users' purchase history.
9. Developing targeted advertising campaigns for different customer segments.
10. Creating a loyalty program to encourage repeat purchases.

*Source: formulated by the author*

Despite numerous successful cases of applying Big Data in small businesses, there are also examples where such attempts have failed. Analyzing these cases is equally valuable, as it allows for identifying common mistakes and developing recommendations to avoid similar situations in the future. In this case, the experience of the small online store "Green Basket," which specializes in organic food products, is particularly illustrative. It is worth noting that the application of Big Data in management was prompted by the business identifying a problem related to low customer conversion and the lack of sales growth. As a result, the owner decided to implement a website analytics system to collect data on user behavior.

A large amount of information was gathered on page views, items added to the cart, and abandonment of purchases. Based on this data, a new website design was

developed, the catalog structure was changed, and personalized product recommendations were implemented. However, despite significant investments in technology and development, the situation did not improve. Conversion rates remained at the same level, and sales even slightly declined. This was associated with the following issues in the use of Big Data:

1. While analyzing large volumes of data, the business focused on superficial metrics without addressing the underlying reasons for low conversion rates. It's possible that the issue was not with the website design but with product quality, pricing policy, or lack of customer trust.

2. The implementation of the analytics system was treated as a separate project rather than as part of the overall business development strategy. There was no clear goal defined for data collection and specific actions were not developed to achieve these goals.

3. The business focused on digital data while ignoring important factors such as customer service quality, delivery speed, and marketing communications.

This case demonstrates that the use of Big Data alone does not guarantee success. For effective data analytics, it is essential to have a clearly defined goal (specifically, before starting data collection, it is necessary to determine what problems need to be solved through analytics [4]), use the right tools (the choice of tools for data collection and analysis should match the scale of the business and available resources [3]). It is also important to integrate data analytics into the overall business strategy.

**Summary and conclusions.**

The research findings indicate that while most existing practices demonstrate that small businesses can successfully use Big Data in management to achieve their goals, this is only the case when the process is directed towards a clearly defined goal and relies on the right tools. Additionally, data analysis should be an integral part of the decision-making process at all levels of the business.

Considering the content of Big Data processes and existing case studies, several additional features that ensure success in using the large volumes of information created daily by businesses through computers, smartphones, and other devices can also be identified, including:

1. Real-time data formation and utilization.

2. Formation and utilization of data from various sources integrated into a unified system.

3. Data formation using various tools such as SQL, Python, R, as well as specialized business intelligence platforms.

4. Data formation through machine learning algorithms that identify complex patterns and enable the creation of evolutionary forecasts.

5. Visualization of the generated data helps make the analysis results clearer for managers and more suitable for making more informed decisions.