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The Effect of Business Intelligence on Bank Operational Efficiency and Perceptions of Profitability

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Abstract: The purpose of the study is to examine the effects of business intelligence on the bank's operational efficiency and perceptions of profitability. The study is based on 259 responses from 27 branches of a commercial bank, employing a simple random sampling technique. This research uses the partial least square- structural equation method (PLS-SEM) method to test the hypotheses. The study verifies construct's reliability and construct's validity of the measurement model, and tests the fitness of the structural model. The study finds that business intelligence is positively associated with operational efficiency and profitability. Further, the study reveals that operational efficiency through business intelligence positively affects bank's profitability. Based on competitive theory, this research states that business intelligence allows the productive entity to generate superior margins compared to its market rivals. Thus, banks can offer better options more cheaply than their rivals and thereby ensure competitive advantage. Further, based on resource-based view theory, the study argues that business intelligence as a strategic resource can provide the foundation to develop bank capabilities that can lead to superior performance over time. Therefore, the study implies business intelligence application in the banking companies and helps decision-making effectiveness for the management body of banks, academics, and policymakers.

Keywords: business intelligence; operational efficiency; profitability; resource-based view; bank performance

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1. Introduction

The banking and financial industries are undergoing a transformation as a result of technological advancements [1–3]. Financial institutions now face increased competition, evolving client needs, and the requirement for stringent control and risk management in a very dynamic market. Simultaneously, technology has enabled the development of sophisticated business intelligence tools [4]. There are technologies that the banking and financial industry can employ to exploit consumer data in order to gain insights that can result in more intelligent management practices and business decisions [5–7]. To that end, there are several ways that banking and finance organisations are leveraging Business Intelligence (BI) technologies to increase profitability, mitigate risk, and gain a competitive edge. Business intelligence enables banks to react to changing economic conditions in both normal and tumultuous economic times [8].

Globally, business intelligence (BI) methods and technologies help banks gain a better understanding of their operations, their clients, and their prospects. Additionally, BI can pave the way for efficiency by highlighting areas ripe for cost-cutting initiatives, new business opportunities, and more. Banking business intelligence helps users to integrate numerous and dissimilar system sets in order to present dynamic data visualisation dashboards that would not be capable of communicating across platforms in the absence of banking business intelligence [9,10]. Standardising that banking information is a mammoth undertaking that requires multiple workers to spend several weeks each month to finish. That is the present state of play for the majority of banks attempting to implement business intelligence in banking. Consider installing a software layer on top of all those disparate

banking services data stores that connect them all and enable "live" reporting of all data at the same time. While that may sound like the simplest remedy possible, much work must be done to standardise the underlying data before they can be used effectively [6,11].

Banks cannot afford to simply add workers in order to increase income [1,12–14]. They must always look for ways to improve the efficiency of their present employees. Banks can utilise business intelligence tools to examine operational operations in order to help minimise ongoing expenses and/or maximise available resources and expertise. Banks can identify methods to improve and enhance the customer experience at the point-of-contact by assessing the performance of branch workers who engage with the customer base. Banks employ business intelligence technologies to monitor customer, product, and branch profitability [4,15,16]. Banks are increasing profitability and tracking improvement through effective pricing strategies and efficient business operations. Additionally, business intelligence technologies are utilised for predictive analytics to determine which customers may be interested in acquiring which goods, when, and how (in-person, over the web, or direct mail) [5]. Banks can use this additional data to develop new and enhanced goods and services that better fulfil client wants and increase their market competitiveness. Armed with profitability and demographic data on its customer households, banks will have a better idea of what a good prospect looks like and will be able to promote to them more effectively. Cross-selling and up-selling efforts can be more successful if banks know which customers to target [3,17]. Additionally, business intelligence systems can be used to analyse developments outside a bank in order to develop alternative investment plans. Investors can acquire particular insight into sentiment and build trade signals by analysing data from social media [18]. Through the use of analytics and business intelligence technologies, entirely new categories of investing are developing. Financial institutions must be as lean and efficient as possible in today's ultra-competitive industry. By analysing operational processes with business intelligence tools, banks can decrease ongoing costs and maximise available resources and knowledge [19]. Organisations can identify methods to improve and enhance the customer experience at the point of contact by assessing the performance of customer-facing staff such as sales representatives, tellers, and account managers.

A limited amount of business intelligence (BI) studies has been found in Bangladesh [12,20–24]. Tumpa, Saifuzzaman [20] studied the BI covering the mental healthcare sector of Bangladesh; Arefin, Hoque [21] studied on organisational culture and BI; Al-Hasan, Aktar [22] presented BI model for textile industries; Babu [12] stated the challenges of artificial intelligence in Bangladesh; Nahar, Naheen [23] studied artificial intelligence and fire surveying; and Biswas, Rahman [24] stated the roles of emotional intelligence. However, there is a gap regarding the association of business intelligence with operational efficiency and perceptions of profitability of banks in Bangladesh.

Furthermore, only a few studies on business intelligence were found internationally [17,18,25–30]. Lim, Chen [18] studied on business intelligence analytics and operations but did not link profitability; Ranjan [25] showed the links between BI and strategic decision making; Elbashir, Collier [17] found links between BI and bank performance; Sahay and Ranjan [26] studied on BI and supply chain analytics; Nofal and Yusof [27] researched BI and enterprise resource planning; Işık, Jones [28] found links of BI with environmental decision and operational efficiency; Olszak [29] studied the application of BI by collecting qualitative data; Yiu, Yeung [31] links BI and profitability; and Lawrence [30] found linked of BI with operational efficiency in hospitals. Thus, there is a gap in the association of BI with bank operational efficiency and profitability in the business intelligence literature internationally.

The study found a dearth of business intelligence studies in banking companies in both nationally (Bangladesh) and internationally. Furthermore, Tumpa, Saifuzzaman [20], Al-Hasan, Aktar [22], Biswas, Rahman [24], Lim, Chen [18], Elbashir, Collier [17], Olszak [29], and Lawrence [30] suggested further study as BI has implications on businesses. In Bangladesh, banking companies are going to implement BI to attain a strong business frame. Thus, the study developed a research model (see Figure 1) that links business

intelligence with the operational efficiency and profitability of banks. More specifically, the study seeks answers to the following questions: "What is the impact of business intelligence on the operational efficiency of banks ?" and "What is the impact of business intelligence on the profitability of banks ?" Thus, the study aims to examine the effects of business intelligence on the operational efficiency and profitability of banks. Figure 1 shows the conceptual model of the study.

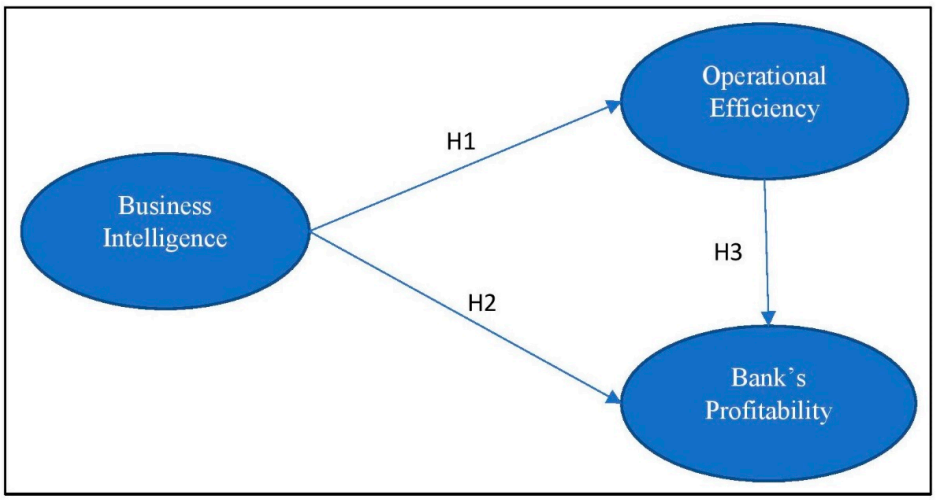

Figure 1. Conceptual model with hypothesis developed by the author.

The study uses 259 responses from general manager, senior officers, general officers, and employees of 27 branches of a commercial bank in Bangladesh, employing simple random sampling technique. This research uses the partial least square- structural equation modeling (PLS-SEM) method to test the hypotheses. The study verifies construct's reliability by factor loadings, Cronbach's alpha, rho-value and composite reliability while verifying construct validity by average variance extracted and the Fornell-Larcker criterion for the measurement model. Then, the study tests the structural model's fitness through the f-square, R-square, standardized root means square residual, and normed fit index methods. The study finds that business intelligence is positively significant in improving operational efficiency and profitability of the branches. Furthermore, the study reveals that operational efficiency through business intelligence positively affects the profitability of the branches. Based on competitive theory, this research states that business intelligence allows a productive entity to generate superior margins compared to its market rivals. Thus, banks can offer better options more cheaply than their rivals and thereby ensure competitive advantage. Furthermore, based on resource-based view theory, the study argues that business intelligence as a strategic resource can provide a foundation to develop bank capabilities that can lead to superior performance over time.

This study contributes in at least four respects. First, the study shows a positive and significant relationship between business intelligence and operational efficiency in banks. This finding is unique in both national and international literature. Thus, management bodies and policymakers can implement this finding in banking companies to enhance operational efficiency. This finding somewhat complementary to Tumpa, Saifuzzaman [20], Işık, Jones [28], Olszak [29], and Lawrence [30] who conceptualises BI in the same direction. Furthermore, the study finds that business intelligence significantly increases the profitability of banks. Thus, this finding will create insights for banks and particularly for banking companies. This finding is also complementary to Arefin, Hoque [21], Biswas, Rahman [24], Ranjan [25], Elbashir, Collier [17], and Olszak [29]. Second, the study employs resource-based view theory of business intelligence to explain the association between BI, operational efficiency, and bank's profitability. Thus, this research has theoretical contribution in this respect. Third, structural equation modelling through the PLS technique, which offers an evaluation of the model fitness as to the reliability and validity of each tested

construct and the overall model, was employed for the methodological contribution. Thus, the findings of this study are derived from the best-fitted model and make a methodological contribution to previous research [8,12,20,28,32–36].

The rest of the paper presents the literature review and hypothesis development in Section 2, research methodology in Section 3, analysis and results in Section 4, Final two sections cover discussion and conclusions, respectively.

2. Literature Review and Hypothesis Development

2.1. Resource Based View of Business Intelligence

The term "business intelligence" (BI) has broadened over time, from its original definition by the Garner Group in the mid-1990s, to include a wide variety of approaches, tools, and technologies in the realm of data collection, analysis, and reporting [30]. The primary responsibility of business intelligence is to enable organisations to analyse data in real-time to assist in pragmatism in strategic decision-making. Consequently, with interactive access to real-time data, strategists arrive at an educated strategic conclusion based on both current and previous data [25]. This information may be used for a range of purposes, including marketing, sales promotions, future building requirements, etc. BI is a process that utilises a broad variety of tools and applications to transform data into useable information, which can then be transformed into actions to enable key managers to make educated choices. BI can provide banks with a competitive advantage. According to Barney [37], the resource-based theory of competitive advantage is predicated on the suppositions that banks are diverse in their possession of critical strategic resources and that resources are not completely movable across banks. Bank resources are defined as strengths that businesses may utilise to formulate and execute their strategy. Physical capital resources, human capital resources, and organisational capital resources are the classifications of resources. Physical capital resources include physical technology, plant and equipment, geographic position, and access to raw materials [37]. Human capital resources consist of the education, experience, judgement, intelligence, relationships, and perception of the company's management and employees. Organisational capital resources consist of the formal reporting structure, informal and formal planning, coordinating, and regulating mechanisms, informal relationships between groups inside a company, and other agents in the company's environment [37].

In order to understand why certain businesses are more successful than others, it helps to look at how each one uses its resources and skills to meet the demands of its customers. According to the RBV, a company's resources are the most important factors in determining its performance, and they may even help it maintain an edge in the market [38]. Banks may perform better if it is difficult for them to imitate those that are already successful. Companies gain competitive advantage via the accumulation of resource and capability combinations that are unique to them. BI systems include a number of features that allow them to collect, link, organise, and analyse data from many sources, including consumers, supply chains, and rivals, and then present this information as knowledge for managerial decisions. BI systems provide companies with the information they need to effectively plan and coordinate their management activities in response to changing operational circumstances, marketing performance, and external variables [17]. Businesses may obtain new perspectives and organisational insights from their management data with the help of BI tools that go beyond the production of standard reports. Organisations that put BI systems to use can gain access to valuable market and internal data in real time, providing a competitive edge that is both temporally compressed and route dependent [27].

A company's ability to gain a competitive edge does not just depend on its ownership of precious, uncommon, unique, and non-substitutable resources [39]. However, in order to be competitive, businesses need the ability to coordinate their resources, package them into capabilities, and then exploit those capabilities to advance their own objectives [40]. Banks that make extensive use of BI systems are in a better position to strategically deploy their resources, so synchronising their management efforts across organisational func-

tions and integrating operational capacity with managerial knowledge eventually leads to greater performance [41]. BI allows companies to proactively investigate data about their operations and management in an effort to boost productivity [42].

Table A1 shows the literature review summary (See Appendix A).

2.2. Business Intelligence and Operational Efficiency

Business intelligence is a highly adaptable set of tools, technologies, applications, and procedures for gathering, integrating, organising, and analysing data in order to provide actionable insights [11,40]. It provides a consolidated picture of company data and can provide historical, present, and predictive insights that transform raw numbers into action plans. With the massive amount of data generated by corporate operations and client interactions, experts may become overwhelmed and perplexed. As business owners or operators, they must now more than ever learn how to decipher and control such data for the advantage of their businesses. End-users of banks and financial services organisations can develop interactive data visualisations using SAAS (software as a service) in the context of business intelligence in banking [2]. Power BI, Tableau, Tibco Spotfire and Domo are some of the most often used banking business intelligence solutions. Banking business intelligence apps can be virtualised or customised to run on devoted personal servers for financial services banks with stringent data security requirements [5,43].

Corporate intelligence is a collection of concepts used to optimise business performance via the intelligent use of accessible data [30]. In business intelligence, technologies are used to transform data acquired from many sources into relevant information for use in the business. This shift facilitates decision-making on a strategic level. In other words, it is conducting business using intelligent tools and technologies. There are numerous definitions of business intelligence, but the simplest is conducting business by incorporating external intelligence [26,44]. Operational efficiency refers to the standard of work performed by an organisation from start to finish. It encompasses all of a system's processes. Business intelligence is an element that contributes to a system's operational efficiency enhancement [14,30,40]. Numerous organisations are increasing their operational efficiency through the use of business intelligence [15]. We are living in a data-driven era where enterprises are implementing cutting-edge solutions to make the most of this data. With the technological spectrum extending so far, enterprises must adapt to the environment and stay ahead of the curve [45]. As a result, they are hard at work building cutting-edge business intelligence solutions. These solutions typically involve software that enables the creation of value from big data [43,46].

Each organisation has a few unique measures that are used by business intelligence systems to analyse past and current data in order to derive insights and forecast the future [22,44]. This forecasting enables businesses to develop a strategy for future use. Every day, technology advances. It is critical for organisations to monitor these changes and upgrade their technological capabilities. As a result, a wise, efficient, and effective business intelligence system is required to deal with the current circumstances. There are numerous ways in which business intelligence can benefit a bank [2,40]. It advocates for the establishment of a robust customer relationship management policy. This method makes it simple to decipher customer behaviour and purchasing habits. It enables CEOs to make sound judgments. Additionally, business intelligence assists in cost reduction identify new business prospects, and identify underperforming areas of business. Efficiency in operations does not come easily [13,15]. It takes a committed workforce and a well-thought-out plan to identify process bottlenecks and influence all levels of a business. Business intelligent solutions have a significant impact on all key aspects of a business, and so have the potential to improve operational efficiency as well [3,4,47].

According to recent bank systems and technology research, numerous banks and other financial institutions in the United States could benefit from installing a business intelligence system [14,40]. "Banks aim to leverage customer-level data on product holdings, channel activity, and profitability to improve the targeting of online advertising and to

streamline and automate the account application and funding procedures", Chandrasekhar and Sonar [45] stated. By analysing organisational data with a business intelligence solution, banks can keep improving and streamline operational efficiencies, allowing them to not only strengthen sales and marketing strategies and develop better customer service programmes, but also mitigate risk through the development of more appropriate risk mitigation mechanisms. A global banking survey conducted by KPMG found a rise in both the volume and the value of financial frauds [17,19]. This has elevated fraud prevention and detection to the top of every bank's priority list. As a result, when a credit union bank situated in Canada approached Rishabh Software to design a comprehensive fraud management system, they supplied an enhanced risk prevention business intelligence platform [15]. It enables the client to process 1 million transactions per second with absolute precision. The solution also made payment processing easier, alerted businesses to take action before something bad happens, monitored in-process transactions in real-time, and blocked deceitful credit cards and payouts in real-time [6,11,43,45]. This study postulates the following alternative hypothesis:

H1: *Business intelligence enhances bank's operational efficiency.*

2.3. Business Intelligence and Perceptions of Bank's Profitability

The profitability of a bank serves as an indicator of the bank's success [10,40]. In order for a bank to make money, it must earn more money than it spends. Most of a bank's earnings come from service charges and interest collected on its assets, both of which are major sources of profit [2]. It is possible to measure the success of a bank by gauging its operational efficiency, as well as its ability to diversify its revenues through non-interest income activities and cost management, by using profitability-based measurement [15]. As the banking system becomes more complex and integrated, so does the range of risk variables. Banks must certainly focus their efforts on reducing fraud as a top concern. It is critical to keep an eye out for unusual activity on your checking or credit card accounts [9]. The danger of lawsuits and embezzlement can be reduced by monitoring employee activity for unusual transactions, withdrawals, expenses, and lending. Keeping track of past dues and repayments may reveal general trends, such as a downturn in the economy. Retaining current consumers is a very profitable and long-lasting business strategy, making business intelligence tools one of the most valuable assets available. A bank will be able to market the most relevant products and services to consumers' requirements and preferences if it has the most up-to-date information about its clients. Information can be gathered by banks to determine which products require improvement and which can be retired [2,10].

The banking and finance industries have jumped on the personalisation bandwagon quickly. A competitive advantage is essential because of this. Personalising consumer interactions is easy with business intelligence tools and the data you currently have [9,48]. Market trends may be monitored to identify new investment opportunities, customer behaviour can be predicted using analytics, and products can be customised to meet the specific demands of each client. Customer relationship management (CRM) data can reveal the profitability of marketing operations [49]. Measuring email performance, advertising expenditure, and overall campaign success may help banks identify areas where their messages are resonating with customers and possibilities to enhance them. In order to estimate the success of prospective cross-selling efforts, BI systems can be used to conduct win-loss data analysis [1]. Cross-selling insurance products was a goal of a financial services company in Asia. For this, they required a smart system that could analyse CRM data, detect customer trends, and identify the customers most likely to convert based on previous purchases of other products [16]. The customer-designed business intelligence and analytics support desk facilitates the generation of Excel-based analytics reports and the identification of potential customers most likely to convert based on their purchasing behaviour and profile [45]. Increased revenue and lower costs for pricey statistical tools were achieved by using this method [4].

Tracking individual income streams using BI solutions helps banks identify profitable products and services and those that are not profitable [24]. However, the advantages do not end there. Financial institutions can also employ business intelligence systems to analyse massive amounts of client data in order to learn more about their customers' banking needs and attitudes, which they can then use to improve their products and services [50]. Using an example, it may be found out that customers are looking for a more efficient method of tracking and analysing their income and expenditures. Customers may wish receive more timely alerts from institutions [6], or they want an application and funding process that is simpler and less time-consuming. Organisations can gain a competitive edge by using these types of information to produce new and enhanced financial goods and services that better satisfy client needs [27,29]. Credit card fraud is one of the most common types of fraud that banks are able to detect and prevent because of the capacity to trace client transactions. Monitoring internal communications and trading behaviour helps companies comply with new regulatory frameworks resulting from the 2008 financial crisis and recent insider trading instances [9,31,51]. Global banks may be able to better estimate credit risk for counterparties in all asset classes if data from previously isolated systems can be accessed. Another risk mitigation benefit of BI is the ability to accurately estimate the risk of client loans based on crucial parameters like the borrower's earning capability and present financial assets, as well as fresh data sets and the current economic climate [52]. Delinquency cases can be detected early with the help of BI technologies, and prompt action can be taken to avoid them.

According to Acharya, Engle Iii [53], stock prices of banks crashed due to higher capital buffers during COVID-19. COVID-19 negatively affects the profitability of banks [54,55]. During the pandemic, bank operations were hampered seriously due to lockdown, and thereby banks were less efficient in operation [56]. The COVID-19 pandemic and its global effects on practically every sector, including the healthcare system, international trade, capital and financial markets, and the banking industry, is an unprecedented phenomenon. Boubaker, Le [57] projected a 3.1% decline in the global economic growth rate and an 8.2% decline in global trade volumes in 2020 due to COVID-19. COVID-19 created extraordinary shocks in several areas, including the labour supply, the equity risk premia of economic sectors, the cost of manufacturing, consumer demand, bank's efficiency, bank's profitability, and government spending [54–56,58].

It is possible to visualise a customer experience strategy through the use of BI and analytics tools in finance [11,59]. Such a strategy would improve targeted products and services, tailor marketing campaigns, remain on top of the competition, and as a consequence, drive profitability with the correct data processing. Tracking various revenue streams can also reveal which items and services do not resonate with customers and which are more profitable for the business [7,10,60]. Traditional financial services remain important, but the sector is facing significant challenges due to the expansion of big data, more competition, and increased client digital expectations in every area of wealth management. From improved internal operations and transparency to increased connection and individualised service offers, BI applications in finance offer a number of feasible motivations for future digital experiences in financial management [8,25,26]. This study postulates the following alternative hypothesis:

H2: *Business intelligence improves the profitability of banks.*

2.4. Operational Efficiency and Perceptions of Bank's Profitability

Every industry may profit from data that are easy to grasp and apply to real-world decision-making [61]. Understanding the vast amounts of data available across the banking and finance industries is no small task. Manually completing this task would be exhausting, daunting, and take a significant amount of time. Obtaining a complete picture of your customers and business can be difficult no matter how big or small your company is, given how much data is scattered across numerous applications and services [62]. A single data aggregate is a must-have in order to benefit from business intelligence methods. As a

result, organisations are turning to software to help them evaluate and extract value from large amounts of data. A bank's internal organisation's effectiveness is just as critical to the company's success as the experience its customers have with it [5,18,21]. To evaluate a bank's resources, procedures, and staff, business intelligence software provides a data-backed method. In order to save money, improve customer service, and increase operational efficiencies, banks can use business data.

Global data production now exceeds 2.5 billion gigabytes each day [12]. Financial institutions can gain a competitive advantage by putting their data to use [7,14,15,20,23]. It is also possible to bring together data from diverse applications using business intelligence tools, creating a single source of information that can be used by everyone in the bank. Competition, risk management, and changing client expectations are some of the issues faced by the BFSI industry [29]. In order to gain valuable insights from customer data, they use BI technologies. Assisting in the analysis of trends, finding patterns, and providing real-time reporting are some of the functions of these tools. They may make use of BI's adaptability and transparency to enhance their financial operations and decisions. In order to remain relevant in the banking industry, it is essential that banks evolve along with their customers' needs [12,19,46]. To provide meaningful insights, BI solutions analyse and correlate market patterns with the data. This comprises data about the habits, wants, and preferences of individual customers. By making it easier to manage data, banks can provide better financial services.

Throughput volume, service delivery cycle time, mistake rates, and customer satisfaction surveys (CSATs) are just a few of the metrics used by business intelligence in the financial services industry to keep tabs on various departments and workers [17]. Organisations can gain a better understanding of their operations by using this data. Let me give you an illustration of what I mean. A bank's business intelligence is used to understand what customers want, and how their personnel can provide those needs [14]. Thus, banks can provide a superior level of service to their clients. Pieket Weeserik and Spruit [11] argued that using visual dashboards, banks can provide data visualisation services that assist in making better decisions based on visual information. They aid in spotting patterns, tracking corporate goals, and comparing the performance of different categories-products and services. Financial institutions now have access to real-time, actionable data in a variety of areas such as sales, cross-selling, and regulatory compliance [9,60]. The use of BI tools allows financial institutions to better understand why their consumers leave them for their competitors. What the clients desire is an easier way to measure income and spending. It is possible to improve client retention and loyalty by improvising and providing better products and services [22]. Customer segmentation, cross-selling and upselling methods, and customer sentiment research all contribute to a seamless customer experience. In this way, the profitability of banks can be affected by the operational efficiency through BI [15].

It is possible to uncover consumer behaviour patterns and potential system obstructions through the use of business intelligence (BI) in the banking sector [45]. These techniques provide proper knowledge on resource utilisation, teller performance, counter use, and wait times to receive a real-time snapshot of appointments with real-time visibility of operations. In order to reach the optimum goals, banks will need to use BI tools' visual signals [46]. Data can be filtered based on a variety of criteria like geographic location, bank branch, product or service offerings, and the type of transaction. Failure to adapt to changes in the market and new regulations can have a negative impact on a company's profitability. Banks can lower the risk of losses and operational risks by establishing a new risk-reporting system that includes data aggregation, workflows/data quality management, and the use of technology [3,5,40]. Organisational change requires new technologies to help financial service providers close efficiency gaps while also assisting with strategic decisions in an ever-more-competitive market [16].

Money has never been easy to deal with, and it is even more difficult now because financial services providers need to coordinate the organisation in order to create resiliency in their business models. One cannot do it on one's own; it requires a well-oiled

machine [4,14]. When used with KPI dashboards and metrics correlations, BI tools make it possible for the system's constant exchange of transactional information between users, as well as for unified data sharing and automatic manual reporting [13]. The ability to manage performance is a well-known benefit of BI tools. Every aspect of your company's success, including operational procedures, team productivity, customer management patterns, technological efficiency, and so on, maybe quantified in a single score by the data you keep in your system. This makes it possible to assess the overall health of the organisation and the efficiency of each operational procedure [5]. The linked and customised world has made money management a commodity. It is critical to swiftly and accurately analyse the vast amounts of data generated by BFSI (banking, financial services, and insurance) services [14]. Real figures can assess where the business is, discover value drivers and development prospects, and then monitor financial/non-financial KPIs against those. The potential of BI technology is data on demand. Real-time data handling is simplified and expedited with a well-implemented BI solution [2,22]. Analysis of investments and profitability across different dimensions of a financial business (products, customers, services, and channels) can be used to further strategize on valuation or growth optimization [11,18]. As a result, financial institutions now have solid evidence to support future go-to-market strategies and enhanced financial services in general [1,3,5,31,61,63]. This study postulates the following alternative hypothesis:

H3: *Operational efficiency improves the profitability of banks.*

This study reviewed the existing studies and developed Table A1 (see Appendix A).

3. Research Methodology

The sample of the study consists of 27 branches out of 38 branches of a commercial bank in Bangladesh. Hair, Hult [64] stated that a simple random sampling method ensures the unbiased selection of samples. Thus, the study applies simple random sampling in selecting all the branches. A random number generator (https://www.random.org/ accessed on 2 January 2022) has been used to ensure the random selection of the branches. The researchers collected contact numbers from the website of the bank (https://www.sonalibank.com.bd/ accessed on 25 November 2021) and communicated over the mobile phone. While 32 branches agreed to participate in the study ultimately only 27 branches provided us a proper timeline to proceed with them. As Alvarez, Núñez-Cortés [65] argued that a 10% sample is appropriate for a PLS-SEM analysis, we reached the range of 71% (27/38). We spread 10 questionnaires aimed at manager (1), senior officers (3), general officers (3), and employees (3). Thus, the total respondents should be 270 (27×10) but we found 7 blank and 4 partly complete questionnaires. The study uses 259 ($270 - 11$) responses in the main analysis where the response rate is 96% (259/270).

The study followed a web-based survey to distribute the questionnaire to the bank branches as Dillman, Smyth [41] stated that this method allows collecting data from a large sample over a dispersed area with a relatively lower cost but higher speed. The study applied the web and mobile survey guidelines of Dillman, Smyth [41] to design and implement the survey. We used a seven-point Likert scale that ranges from seven for "strongly agree" to one for "strongly disagree". For the administering purposes, the study adopted the pretesting method of Mokhtar, Jusoh [66]. We pretested the questionnaires with two accounting lecturers and two cost-and-management accountants. Then, we revised the questionnaires as per the pretesting inputs. We further modified the questionnaires while piloting them with ten known practicing accountants. The study followed the research ethics and guidelines as per the institutional review board. The profiles of the respondents and banks are shown in Table 1.

Table 1. Profiles of bank and respondent.

Categories	Variations		Freq.	%
Participants' Profile (Total 259 Respondents)				
Gender	Male		168	64%
	Female		91	36%
		Total	**259**	**100%**
Age	Less than 30 years		83	32%
	30–45 years		148	57%
	More than 45 years		28	11%
		Total	**259**	**100%**
Designation	General Manager		25	10%
	Senior officers		74	29%
	General officers		81	31%
	Employees		79	30%
		Total	**259**	**100%**
Bank's Profile (Total 27 Branches)				
Operating years (Bank Age)	Less than 10 years		6	22%
	10–20 years		13	48%
	More than 20 years		8	30%
		Total	**27**	**100%**
No. of Employees (Bank Size)	Less than 25		7	26%
	25–40		9	33%
	More than 40		11	41%
		Total	**27**	**100%**

Source: Author's calculation based on collected data.

There are two sections of survey instruments. Profiles of the banks and participants are covered in section one and section two includes statements of business intelligence, operational efficiency, and bank profitability. The study adopted three items from Nithya and Kiruthika [6], two items from Lim, Chen [18], and three items from Ranjan [25] to measure the business intelligence (BI) variable. Then, to measure bank's operational Efficiency (OE) variable, the study adopted three items from Lim, Chen [18], three items from Işık, Jones [28], and one item from Olszak [29]. Finally, adopting two items from Nithya and Kiruthika [6], one item from Richards, Yeoh [63], two items from Yiu, Yeung [31], two items from Owusu [51], and two items from Bordeleau, Mosconi [16], we measured Bank's Profitability (BP). This study considers two control variables branch size (number of employees) and branch age (years of operation) as past studies argued that bank size and bank age may affect the relationships of profitability, operational efficiency, and business intelligence.

The study used the partial least square structural equation model (PLS-SEM) to test the relationships of the study model. According to Hair, Matthews [67], Sarstedt, Hair [68], and Shmueli, Sarstedt [69], using PLS-SEM is recommended due to the fact that it is best suited for testing hypotheses and is advanced enough to test theories as well as the goodness of fit criterion, and because it is also competent in examining the connections between multiple latent variables at the same time. PLS-SEM was an excellent choice for analysing the data from this study because we constructed a conceptual model (see Figure 1) that consisted of several variables for testing multiple associations, making it a good fit for the data. Several aspects of model reliability and validity, including convergent validity and discriminant validity, non-response bias and common method bias, the goodness of fit, model performance and hypothesis testing, as well as a robustness check, have been discussed in greater depth in the analysis section.

4. Analysis and Results

4.1. Measurement Model

Table 1 represents the profile of banks and participants. A bank's profile includes both bank age and bank size while participant's profile shows gender, age, and designation. Of the respondents who filled out the questionnaires and showed interest in the study objectives, 64% were male, and 36% were female. In the case of the age level, 32% of

participants were less than 30 years old, 57% participants were 30–45 years, and 11% of participants were older than 45 years. Thus, it is noticeable that most of the participants were from 30–45 years of age, and the next largest group was below 30 years of age. Furthermore, respondents were asked about their positions in the banks. 10% of respondents were general managers, 29% were senior officers, 31% were general officers, and 30% were employees. In the case of bank profiles, 22% of banks were less than 10 years old, 48% were 10–20 years old, and 30% were more than 20 years old. Furthermore, 26% of banks have less than 25 employees, 33% have 25–40 employees, and 41% have more than 40 employees.

To test the reliability and validity of the constructs, the researchers conducted the measurement model analysis presented in Table 2. Table 2 shows the latent constructs and their measurement items. The measurement model analysis includes the mean, standard deviation (SD), factor loadings (FL), Cronbach's alpha (α), rho-value, composite reliability (CR), and average variance extracted (AVE). According to Table 2, the Cronbach's alpha for each construct is greater than 0.80, as Hair, Hult [64] suggested to ensure the reliability and internal consistency of the constructs. Furthermore, following the suggestions of Hair, Hult [64], Shmueli, Sarstedt [69], and Sarstedt, Ringle [70], the researchers reported rho values that are greater than 0.81 for each construct. The internal consistency of the measurement scales through composite reliability (CR) has also been tested. The CR values of each scale are 0.865 for BI, 0.885 for OE, and 0.913 for BP, as Hair, Hult [64] and Shmueli, Sarstedt [69] suggested.

Table 2. Laten variables and measurement statements.

Code	Constructs and Items	Mean	SD	FL *	α	rho	CR	AVE
BI	***Business Intelligence***	***4.418***	***1.035***		***0.82***	***0.82***	***0.87***	***0.55***
BI1	"Our bank effectively uses spreadsheets as a business intelligence to model and manipulate bank data"	4.220	1.319	0.839				
BI2	"Our bank visually appeals graphical representations to quickly gain insights."	4.831	1.271	0.932				
BI3	"Our bank uses online platform to communicate clients"	4.198	1.014	0.844				
BI4	"Our bank uses a dashboard of quick metrics designed to support better decisions"	3.401	1.782	0.632				
BI5	"Our bank stores data of all departments in a data warehouse"	5.108	1.281	0.732				
BI6	"Our bank uses big data in strategic and tactical decision-making processes"	4.403	1.294	0.742				
BI7	"Our bank uses business intelligence for an analytical querying of the prepared data"	4.173	1.290	0.848				
BI8	"Our bank uses business intelligence to prepare key performance indicators to the clients"	5.319	1.371	0.826				
OE	***Operational Efficiency***	***5.502***	***1.189***		***0.85***	***0.87***	***0.89***	***0.53***
OE1	"Our bank simplifies operations through business intelligence tools"	4.948	1.014	0.758				
OE2	"Our bank enhances process consistency by business intelligence tools"	4.482	1.734	0.812				
OE3	"Our bank assures timely, accurate, and relevant user information by business intelligence tools"	5.264	1.290	0.825				
OE4	"Our bank assures customer satisfaction through efficient operational functions"	4.037	1.017	0.738				
OE5	"Our bank is providing secured services by business intelligence"	5.129	1.873	0.794				
OE6	"Our bank operates functions with lower costs"	4.672	1.701	0.863				
OE7	"Our bank operates functions with reduced risks"	5.112	1.939	0.882				
BP	***Bank's Profitability***	***5.016***	***1.004***		***0.86***	***0.86***	***0.91***	***0.70***
BP1	"Our bank makes more profit after adopting business intelligence"	4.839	1.187	0.803				

Table 2. *Cont.*

Code	Constructs and Items	Mean	SD	FL *	α	rho	CR	AVE
BP2	"Our bank generates more customer margin through cross-selling strategy of business intelligence"	5.851	1.871	0.684				
BP3	"Our bank improves net interest margin through business intelligence adoption"	5.382	1.193	0.739				
BP4	"Our bank improves return on assets through business intelligence adoption"	5.041	1.173	0.918				
BP5	"Our bank improves return on investment through business intelligence adoption"	4.582	1.276	0.832				
BP6	"Our bank assures potential profitability by improving data analytical capabilities"	4.423	1.103	0.851				
BP7	"Our bank improves return on equity through business intelligence adoption"	5.146	1.126	0.943				
BP8	"Our bank improves profitability through reducing fraudulent activities"	4.605	1.869	0.674				
BP9	"Our bank increases sales through business intelligence adoption"	4.582	1.158	0.814				

Note: SD = standard deviation, FL = factor loading, * All indicators are significant at $p < 0.01$. Source: Developed by the author based on Smart PLS output.

According to Saunders, Lewis [71] and Sarstedt, Ringle [72], average variance extracted (AVE) is a measure of the variation collected by a construct in comparison to the variance attributable to measurement error. As a general rule, and in order to ensure appropriate convergence, an AVE of at least 0.50 is strongly suggested [64,71,72]. According to Hair, Hult [64], an AVE of less than 0.50 indicates that the survey items account for more mistakes than the variance in the survey components. For each construct in any measurement model, an AVE must be determined and must be at least 0.50 [64,69]. In the case of this study, the AVE values for all constructs are greater than 0.50 (see Table 2).

The factor loading value of each item is greater than 0.70 except for BI4 (0.63), BP2 (0.68), and BP8 (0.67). Sarstedt, Ringle [72] argued that factor loadings greater than 0.70 are acceptable for SEM estimations while Hair, Hult [64] suggested not to take a value less than 0.60 for factor loading of measurement items for a path analysis. As the study achieved better values in CR, AVE, α, and rho-value, and more than 0.60 for the factor loading, BI4, BP2, and BP8 were not removed from the study statements.

Shmueli, Sarstedt [69] defined discriminant validity as the statistical difference between two latent variables representing distinct theoretical conceptions, and it is needed in PLS-SEM path analysis. According to Tables 3 and 4, discriminant validity has been established as the Fornell-Larcker criterion, heterotrait-monotrait Ratio (HTMT), and cross-loadings met the threshold value. According to Fornell and Larcker [73], the squared correlations of the latent constructs should be between the squared root of AVE, and this study met the criterion as well (see Table 3). Shmueli, Sarstedt [69] and Hair, Hult [64] argued that HTMT is a measure of how similar two latent variables are. To demonstrate discriminant validity, the HTMT must be clearly less than one. In the case of this study, the HTMT value is less than 1; thus, discriminant validity has been established.

Table 3. Discriminant validity with HTMT.

	BI	OE	BP
BI	**0.742**	*0.541*	*0.440*
OE	0.403	**0.728**	*0.563*
BP	0.528	0.462	**0.836**

Diagonal values: "Square root of AVE". Below the diagonal: Correlation matrix. Above the diagonal: HTMT values.

Source: Self-developed based on PLS output.

Table 4. Cross loadings.

	BI	OE	BP
BI1	***0.839***	0.371	0.217
BI2	***0.932***	0.469	0.362
BI3	***0.844***	0.418	0.316
BI4	***0.632***	0.416	0.303
BI5	***0.732***	0.311	0.167
BI6	***0.742***	0.429	0.250
BI7	***0.848***	0.370	0.278
BI8	***0.826***	0.417	0.278
OE1	0.367	***0.758***	0.382
OE2	0.275	***0.812***	0.386
OE3	0.461	***0.825***	0.324
OE4	0.382	***0.738***	0.276
OE5	0.223	***0.794***	0.425
OE6	0.268	***0.863***	0.424
OE7	0.219	***0.882***	0.461
BP1	0.204	0.217	***0.803***
BP2	0.417	0.276	***0.684***
BP3	0.273	0.305	***0.739***
BP4	0.312	0.231	***0.918***
BP5	0.427	0.412	***0.832***
BP6	0.276	0.380	***0.851***
BP7	0.317	0.423	***0.943***
BP8	0.206	0.427	***0.674***
BP9	0.349	0.322	***0.814***

Source: Author constructed based on PLS output.

4.2. Model Fitness Measures

The researchers checked the model fitness through f squared, R squared, adjusted R squared, standardized root mean square residual (SRMR), normed ft index (NFI), and root mean square error of approximation (RMSEA). Sarstedt, Ringle [72] assert that f-squared measured variance adequately explains each independent variable in the equations. The effect size of the f-squared needs to be more than 0.35, indicating larger effects. In the case of this study, the f square values are greater than or equal to 0.40 (see Table 5), indicating that the exogenous variables explain the endogenous variables with a larger effect. Following previous studies [64,69,74], the path model's goodness-of-fit is measured using the R-squared value. R-squared is a statistical measure of how near the data are to the path line that has been fitted to the data set [69]. In a path model, the R-squared statistic reflects how much variance in a dependent variable can be explained by the independent variables [64]. The value of R squared should be closer to 1 [64,69]. According to Hair, Hult [64], a value of at least 0.25 for R-squared should be found for the path model to explain the influence of the exogenous variables. In the case of this study, the values of R square are 0.624 (indicating the relationship between BI and OE) and 0.772 (representing the relationship of BP through BI and OE). Shmueli, Sarstedt [69] state that R-squared must be adjusted when using a regression model with multiple independent variables. Considering the concept of Shmueli, Sarstedt [69], the researchers reported adjusted R-squared as well in Table 5.

Table 5. Model fit measures.

Variables	f Square	R Square	Adj. R Square	SRMR	NFI	RMSEA
BI						
OE	0.531	0.624	0.609	0.045	0.93	0.049
BP	0.428–0.583	0.772	0.764	0.045	0.93	0.049

Source: Self-developed based on PLS output.

Furthermore, the researchers represent the values of SRMR, NFI, and RMSEA as past studies [36,64,69,72,74] suggested reporting. According to Hair, Hult [64], Shmueli, Sarstedt [69], and Sarstedt, Ringle [72], the threshold values of SRMR should be less than 0.08, RMSEA should be less than 0.06, and NFI should be greater than 0.80. According to Table 5, the SRMR values are below 0.05, and the RMSEA values are below 0.06, and the NFI values are above 0.80. Thus, the model is best-fitted.

4.3. Hypothesis Testing

Table 6 and Figure 2 represent the path analysis and structure model output, respectively. The study finds that business intelligence (BI) positively affects the operational efficiency (OE) of banks, which is significant at a level of significance less than 0.001. The beta coefficient of the BI and OE (BI → OE) relationship is 0.374, and the *t*-value is 15.165. Thus, Hypothesis 1 (H1) is supported. This indicates that when practices of business intelligence increase in banks, the operational efficiency of banks is improved. Thus, banks can enhance their operational efficiency by 0.374% through advancing their business intelligence by 1%.

Table 6. Analysis of path.

Relationship	Coeff. (β)	*t*-Value	*p*-Values	VIF	Decision
Direct Effect					
BI → OE	0.374	15.165	0.000 ***	1.114	H1 supported
BI → BP	0.369	12.486	0.000 ***	1.217	H2 supported
OE → BP	0.521	27.328	0.000 ***	1.125	H3 supported
Mediating Effect					
BI → OE→ BP	0.133	3.127	0.023 **	1.211	Partial Mediation

*** significant at <1% and ** significant at <5%. Source: Smart-PLS output.

In the case of the relationship between business intelligence (BI) and bank's profitability (BP) (BI → BP), the beta coefficient is 0.369, including a *t*-value of 12.486, which is also positively significant at a significance level of less than 0.001 (see Table 6). This indicates that the greater the application of business intelligence in banks, the higher the profitability of banks. Thus, Hypothesis 2 (H2) is supported. Therefore, it can be said that bank's profitability can be improved by increasing the application of business intelligence in banks.

Finally, the study tested whether the operational efficiency of banks affects bank's profitability. The beta coefficient of the relationship (OE → BP) between OE and BP is 0.521, with a *t*-value of 27.328 which is also positively significant at a level of significance of less than 0.001 (see Table 6). Thus, Hypothesis 3 (H3) is also supported. The VIF values are below the threshold value of 3.3 indicating that issues of multicollinearity are absent in the path model [64]. This study employs branch size and branch age as control variables that may affect the relationships of profitability, operational efficiency, and business intelligence. Figure 2 shows that the branch size and branch age are not significant throughout the structural relationships.

Furthermore, the findings of the study suggests that operational efficiency (OE) partially mediates the relationship between business intelligence (BI) and bank profitability (BP). This means that the effect of BI on BP is not entirely direct but is also partially explained by the improvement in OE due to the implementation of BI. In other words, when banks improve their BI practices, it not only directly increases their profitability but also indirectly increases it through improved operational efficiency. This finding highlights the importance of operational efficiency as a mediator between BI and BP and suggests that banks should focus on both BI and OE to improve their profitability. Overall, the study's findings suggest that business intelligence can positively affect a bank's operational efficiency and profitability, and these effects can be partially explained by the mediating role of operational efficiency.

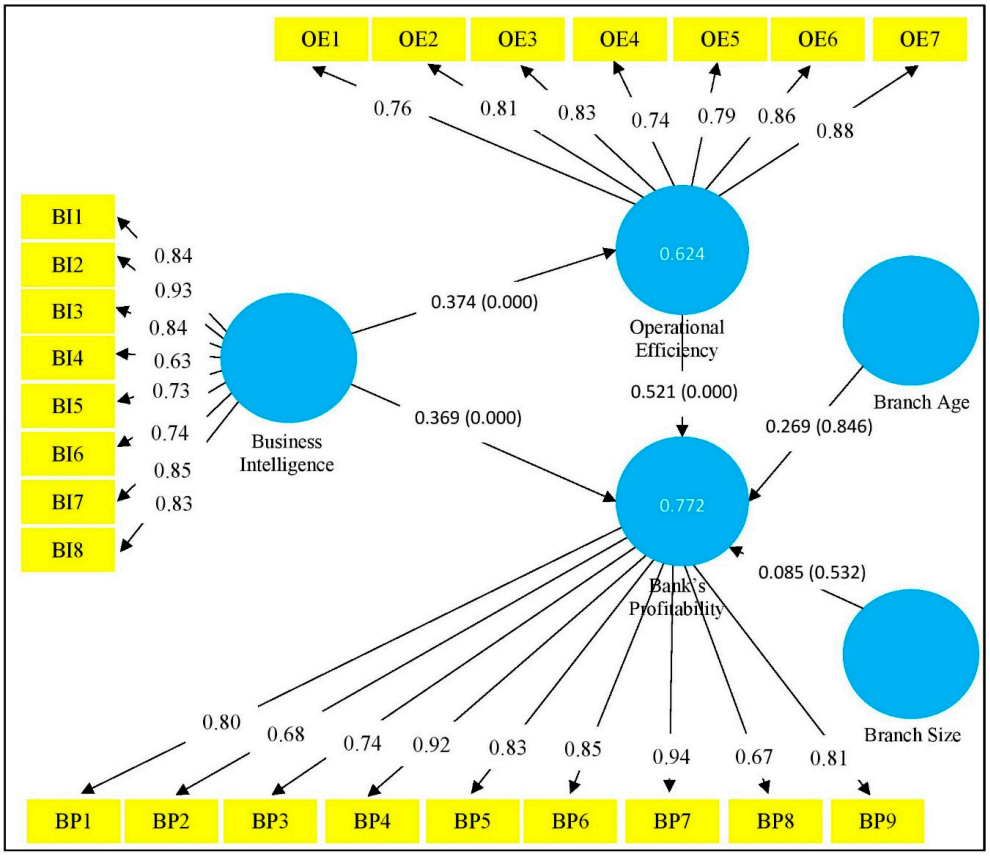

Figure 2. Author's calculation.

5. Discussion

This study found that the application of business intelligence improves the operational efficiency of banks, indicating that a 1% increase in business intelligence implementation improves the operational efficiency of a bank by 0.374%. Data analysis at the local level is substantially facilitated by business intelligence, which assures a high level of accuracy [22]. Each branch's cash flow, personnel composition, and urgent needs can be assessed swiftly and separately. As a result, it is an effective tool for assuring, for example, that every bank branch has a healthy financial situation. Predictive analytics added to BI makes it a powerful tool for increasing branch efficiency by automating formerly manual processes [5]. Improved data management also makes teams more available, allowing them to concentrate on their primary business tasks on a daily basis. The promise of BI is that technology would help organisations become more responsive and flexible, allowing them to take advantage of new opportunities and innovate in a highly competitive market [6]. Among other things, it promises to enable enterprises to analyse and exploit massive volumes of heterogeneous data in a more efficient and precise manner. Connecting separate systems in banking eliminates the need to manually prepare reports for each one. The use of business intelligence in banking enables institutions to collect unprecedented amounts of data on their consumers, allowing them to better serve their clients [23]. With banking BI, banks may gain a better understanding of their consumers, allowing them to handle issues before they arise. Business intelligence in banking eliminates the need to manually wrangle data by connecting directly to core system databases [23,63]. Decision-makers will be able to acquire a competitive advantage by implementing a BI solution that is company-wide. Making decisions based on data increases the likelihood that those decisions will be correct, as the element of guesswork is eliminated [63]. Everyone will be happier, wealthier, and wiser as a result of business intelligence. The findings, thus, create insights into how the banking industry can improve its operational efficiency.

Furthermore, the study found that business intelligence increases the profitability of banks, indicating that a bank's profitability increases by 0.369% if there is a 1% increase in business intelligence implementation. When companies are able to swiftly identify and act on critical operational data, they are more likely to increase their selling efficiency and profit margins. The good news is that most banks can afford the business intelligence (BI) solutions required to facilitate this data analysis [63]. When the underlying analysis is supported by the correct data, the forecasting load can be greatly reduced and the forecast's reliability greatly increased. With the help of business intelligence (BI) software, managers have quick and easy access to historical sales data [68]. The ability to quickly and easily access sales data from the past helps improve forecast accuracy as well as procurement and inventory decision-making.

Finally, the study found that operational efficiency increases the profitability of banks, indicating that a 1% increase in operational efficiency of banks increases the profitability by 0.521%. The key to avoiding unpleasant month-end surprises is to recognize and act on reliable information as soon as possible through BI. To stay on top of the latest company news, sales teams in the modern-day rely on business intelligence (BI) solutions. In these companies, managers and sales representatives are able to quickly comprehend the large picture and then drill down to find specific areas of concern, such as individual goods, accounts, and/or sales regions or representatives [26,61,66]. Organisations that put forth the effort to achieve these sales and marketing objectives stand to gain much from having the appropriate information structured in an efficient manner. The appropriate BI tools may help organisations use their data in new and more efficient ways, regardless of whether or not they already have the data they need. Current BI technologies are easy to adopt and pay for themselves in a matter of months for many banks [7]. The findings, thus, create insights into the banking industries to improve profitability.

This research is interesting and original because it provides empirical evidence on the positive impact of business intelligence on the operational efficiency and profitability of banks. The study uses a comprehensive approach to measure the reliability and validity of the constructs and test the fitness of the structural model, which enhances the credibility of the findings. Additionally, the study takes a unique perspective by applying two theories, competitive theory and resource-based view theory, to support the argument that business intelligence is a strategic resource that can provide a competitive advantage and lead to superior performance over time.

Furthermore, this study is original in the sense that it was conducted on a sample of 27 branches of a commercial bank, which provides insights into the effects of business intelligence at the local level. This approach is different from previous studies that mostly focus on the effects of business intelligence at the organisational level. The study's findings have practical implications for the banking industry, as it recommends the use of business intelligence as a tool to enhance decision-making effectiveness and ensure competitive advantage. Overall, this research contributes to the growing body of literature on the impact of business intelligence on organisational performance, particularly in the banking sector. It provides a unique perspective and empirical evidence on the benefits of using business intelligence and offers practical implications for the banking industry's decision-makers.

6. Conclusions

The purpose of the study is to examine the effects of business intelligence on bank operational efficiency and perceptions of profitability. The study uses 259 responses from general managers, senior officers, general officers, and employees of 27 branches of a commercial bank in Bangladesh, employing a simple random sampling technique. The study finds that business intelligence is positively significant to improve operational efficiency. This finding is somewhat consistent with Tumpa, Saifuzzaman [20], Işık, Jones [28], Olszak [29], and Lawrence [30] who conceptualizes BI in the same direction. The study finds that business intelligence significantly increases the profitability of banks. This finding also adds value to the studies of Arefin, Hoque [21], Biswas, Rahman [24], Ranjan [25],

Elbashir, Collier [17], and Olszak [29]. Furthermore, the study reveals that operational efficiency through business intelligence positively affects the profitability of banks. The findings indicate that business intelligence systems can ensure competitive advantage through improved operational efficiency and increased profitability.

Anecdotal evidence on the benefits of BI systems has been lacking until now, but this study fills that gap with empirical evidence gleaned using a PLS-SEM technique. This empirical evidence, which comes from a developing country, is critical because there is a lack of research on the subject in the business intelligence literature. According to this research, BI systems can improve both operational efficiency and profitability for banks by implementing BI solutions. This has given managers and policymakers an understanding of the importance of using a holistic approach when analysing the impact of IT, such as BI systems, because of the intangibility of some of the benefits. The usage of business intelligence (BI) technologies should also be encouraged by bank managers in order to reap financial rewards in the long run. Vendors and other decision-makers in developing nations could make use of the study's empirical evidence to help raise awareness about BI systems in these countries.

The findings of this study have significant theoretical implications, especially from the perspective of the resource-based view (RBV) theory. According to the RBV, a firm's resources and capabilities play a vital role in achieving and sustaining competitive advantage and superior performance. This theory posits that firms with unique and valuable resources can gain a competitive advantage over their rivals. This study shows that business intelligence can be viewed as a strategic resource for banks. The study indicates that when banks use business intelligence, they can improve their operational efficiency, which positively affects their profitability. Moreover, the study suggests that the application of business intelligence can lead to the development of bank capabilities, which can ultimately lead to superior performance over time. In other words, the findings of this study suggest that business intelligence can be considered as a strategic resource that provides a foundation for the development of bank capabilities, which can lead to a sustainable competitive advantage and superior performance in the long run. This is an important contribution to the literature on RBV theory, as it demonstrates the importance of business intelligence as a strategic resource for banks, which can contribute to their long-term success and competitive advantage.

This study has some limitations. First, the study targets the branches of a bank (single bank but multiple branches); thus, the results may not be applicable to other banks as the branches are regulated under the same regulatory framework. Second, this study is cross-sectional, and thus, a future study may choose a panel data approach such as the study of Salehi and Arianpoor [75]. Third, this research uses banks from Bangladesh, and thus, the findings are not generalizable to other economies. Fourth, the study is based on only quantitative data. Future studies may consider mixed-method approach to make the findings more interesting and practical [76–78]. Fifth, this research could provide more nuanced insights into the mechanisms through which different types of business intelligence affect bank performance. Thus, future research should explore the effects of specific types of business intelligence, such as data mining, predictive analytics, and data visualisation, on operational efficiency and profitability in the banking sector [79]. Finally, this research could shed light on the contextual factors that influence the effectiveness of business intelligence in the banking sector, and could inform the development of more tailored business intelligence strategies for different types of banks. Thus, future research could investigate how organisational factors, such as organisational culture, leadership style, and IT infrastructure, moderate the relationship between business intelligence and bank performance.

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Appendix A

Table A1. Review of existing studies on BI, bank's operational efficiency and profitability.

Authors	Title	Period	Model/Method	Findings
Arefin, Hoque [21]	The impact of business intelligence on organisation's effectiveness: an empirical study	2015	PLS-SEM	BI improves organisational effectiveness. Banks with BI are more efficient than those without it.
Babu [12]	Artificial intelligence in Bangladesh, its applications in different sectors and relevant challenges for the government: an analysis	2021	Qualitative	Application of artificial intelligence maintain banks' policy, information security, regulations, and operational effectiveness.
Bhatiasevi and Naglis [13]	Elucidating the determinants of business intelligence adoption and organisational performance	2018	SEM	BI is positively associated with bank's performance and internal processing.
Elbashir, Collier [17]	Measuring the effects of business intelligence systems: The relationship between business process and organisational performance	2008	Qualitative	BI systems enhance business process and bank performance.
Fethi and Pasiouras [43]	Assessing bank efficiency and performance with operational research and artificial intelligence techniques: A survey	2010	Qualitative	Bank efficiency and performance have positive associations with AI.
Nithya and Kiruthika [6]	Impact of Business Intelligence Adoption on performance of banks: a conceptual framework	2021	Literature	BI adoption has positive impact on bank's performance.
Owusu [51]	Business intelligence systems and bank performance in Ghana: The balanced scorecard approach	2017	PLS-SEM	BI systems are not directly associated with bank performance but they have indirect impacts.
Richards, Yeoh [63]	Business Intelligence Effectiveness and Corporate Performance Management: An Empirical Analysis	2019	Mixed-method	BI has positive associations with corporate performance management. BI is strongly connected to planning but less so to measurement.
Rouhani, Ashrafi [8]	The impact model of business intelligence on decision support and organisational benefits	2016	PLS-SEM	BI has a strong positive impact on bank benefits. Banks with BI can lead effective decision support.
Wamba-Taguimdje, Fosso Wamba [10]	Influence of artificial intelligence on bank performance: the business value of AI-based transformation projects	2020	Qualitative	There is a positive association between artificial intelligence and bank performance.
Yiu, Yeung [31]	The impact of business intelligence systems on profitability and risks of banks	2005–2014	Qualitative	BI increases bank profitability and reduces risks. BI improves operational efficiency.

Table A1. *Cont.*

Authors	Title	Period	Model/Method	Findings
Kimble and Milolidakis [42]	Big Data and Business Intelligence: Debunking the Myths	2015	Qualitative	Big data and BI improve decision making effectiveness.
Varshney and Varshney [38]	Workforce agility and its links to emotional intelligence and workforce performance: A study of small entrepreneurial	2020	Qualitative	Emotional intelligence improves two performances, i.e., adaptive performance and contextual performance but does not impact task performance.

Source: Author's construction.

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