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The Role of Modern Information Technology in Supporting Banking Information Systems via Dashboards Using Microsoft Power BI

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Abstract:
This study investigates the pivotal role of modern Information Technology (IT) in enhancing the operational and strategic efficiency of Banking Information Systems (BIS). By leveraging advanced Business Intelligence (BI) tools—specifically Microsoft Power BI—the research examines how interactive dashboards and visual analytics facilitate data-driven decision-making. Utilizing a descriptive-analytical approach combined with a case study methodology on a loan portfolio database, the findings reveal that integrating BI tools fundamentally transforms traditional Transaction Processing Systems (TPS) into dynamic Decision Support Systems (DSS). Ultimately, visual analytics substantially mitigate decision latency, optimize credit performance evaluation, and foster greater organizational agility within the banking sector.

Keywords: Banking Information Systems (BIS), Business Intelligence (BI), Microsoft Power BI, Data Visualization, Decision Support Systems (DSS), Granted Loans, Performance Evaluation.

1. Introduction

The global financial sector is experiencing a profound paradigm shift, catalyzed by rapid digitalization and continuous technological innovation. In a hyper-dynamic environment where risk factors fluctuate in real time, traditional data processing mechanisms fail to deliver timely and effective decision support. Modern banking institutions are currently confronted with an unprecedented "data explosion"—generated by voluminous customer transaction logs, complex behavioral patterns, and multifaceted credit risk profiles. Consequently, transforming raw data into actionable strategic intelligence has evolved from a secondary operational capability into an essential core competency. Within this context, Business Intelligence (BI) serves as a vital strategic bridge, closing the gap between raw data analytics and strategic execution. Specifically, platforms like Microsoft Power BI play a pivotal role in transitioning banking

operations from static, historical reporting to dynamic financial intelligence systems capable of facilitating real-time monitoring and advanced predictive forecasting.

1.1 Research Problem

The Problem Statement: The core research problem revolves around examining how modern Information Technology (IT) solutions optimize the operational efficiency and decision-making capabilities of Banking Information Systems (BIS) through visual data processing and dynamic, interactive dashboards.

1.2 Objectives of the Study

- **Elucidating IT Capabilities:** To highlight the role of modern Business Intelligence (BI) tools in reinforcing the structural efficiency of banking information systems.
- **Evaluating Visual Dashboards:** To empirically investigate the impact of Power BI interactive dashboards on enhancing operational transparency and simplifying complex data analytical processes derived from actual banking databases.
- **Building Strategic Knowledge Assets:** To provide a blueprint for financial institutions to construct intelligent, cost-effective databases that generate real-time visual outputs to accelerate strategic decision-making.

1.3 Significance the Study

- **Theoretical Contribution:** Enriches academic discourse in financial management and accounting information systems by providing contemporary insights into visual analytics, interactive reporting, and real-time data architecture.
- **Practical/Applied Value:** Provides banking executives with a practical framework to reduce "decision latency"—minimizing the lead time between financial transactions and strategic analysis—while elevating credit and operational risk governance.

2. Literature Review

This section critically synthesizes relevant empirical and theoretical literature exploring the integration of Business Intelligence (BI) technologies—specifically Microsoft Power BI—within banking and financial environments to optimize decision-making efficiency.

2.1 Review of Empirical Studies

- **Hjelle et al. (2024):** In an experimental investigation ($n = 524$), the authors examined the influence of dashboard-based Information Quality (IQ) on organizational decision-making. The study revealed that core IQ dimensions—namely formatting, currency, and completeness—significantly improve user satisfaction and alleviate cognitive task complexity. Crucially, information satisfaction directly correlated with heightened decision quality, whereas excessive complexity impeded analytical effectiveness.
- **Alnajjar (2023):** Utilizing a qualitative case study design, this research analyzed the deployment of Power BI dashboards for credit risk mitigation within a UAE-based auto finance firm. Findings demonstrated that transitioning from legacy tools (e.g., Excel and Tableau) to Power BI markedly improved analyst productivity and streamlined the Turnaround Time (TAT) for loan processing. Additionally, the platform delivered real-time visibility over credit default Key Performance Indicators (KPIs), fostering superior credit risk assessment.

- **Zamil et al. (2024):** A systematic review of 86 empirical publications highlighted the strategic utility of BI systems within financial and accounting contexts. The synthesis identified Microsoft Power BI as a robust framework for real-time performance tracking and financial modeling, particularly within Microsoft-integrated enterprise environments. Furthermore, integrating Power BI dashboards with Enterprise Resource Planning (ERP) systems reduced financial reporting cycles by 25% to 60%, thereby enhancing organizational agility in dynamic markets.
- **Coelho (2024):** Employing a Design Science Research approach, this study developed a specialized BI data infrastructure (utilizing Data Mart architecture and ETL workflows) for a bank's compliance department. A subsequent field survey indicated that over 90% of end-users confirmed the platform's efficacy in enhancing decision-making precision, specifically regarding Anti-Money Laundering (AML) monitoring and suspicious transaction detection.

2.2 Synthesis, Comparative Analysis, and Research Gap

- **Points of Convergence (Similarities):** A synthesis of the literature (Hjelle et al., 2024; Alnajjar, 2023; Zamil et al., 2024; Coelho, 2024) reveals consensus that the value of financial data is realized through intelligent visual processing rather than volume alone. These studies collectively reinforce that interactive dashboards reduce executive cognitive load and serve as the foundational pillar for evolving routine Transaction Processing Systems (TPS) into advanced Strategic Decision Support Systems (DSS).
- **Divergence and Research Gap:** Existing studies primarily address isolated domains: experimental cognitive dynamics (Hjelle et al., 2024), regulatory compliance (Coelho, 2024), or niche auto-finance operations (Alnajjar, 2023). A noticeable empirical gap remains regarding holistic banking system efficiency—specifically analyzing multi-factor models affecting **granted loans** within broader credit portfolios.
- **Contextual Positioning of the Study:** This study bridges the identified gap by providing a comprehensive operational framework for integrating Power BI within legacy banking structures. Applied to an authentic banking loan dataset, the research demonstrates how visual analytics shorten the latency gap between financial event occurrence and executive decision execution.

3- Theoretical Framework

In today's rapidly evolving and highly competitive environment, banking institutions rely heavily on information systems to streamline operations and enhance service delivery. Faced with escalating challenges—such as aggressive market competition, security threats, and rising customer expectations—establishing an effective and reliable Banking Information System (BIS) has become imperative for sustaining long-term institutional success and operational excellence.

3.1 Distinctive Characteristics of Banking Information Systems:

A robust BIS is distinguished from traditional processing systems by specific operational characteristics (Boutoura & Samaili, 2020, p. 141):

- Information Accessibility: Provides authorized personnel with frictionless, timely access to decision-critical data.
- Data Integrity and Objectivity: Delivers accurate, unfragmented, and unbiased information—particularly concerning interest rates, commission disclosures, and client-confidentiality protocols.
- Reporting Diversity: Generates custom multi-tiered reports tailored to specific stakeholder levels.
- Multi-Stakeholder Utility: Produces versatile outputs serving internal executives, regulatory bodies, and external clients.
- Punctuality and Compliance: Adheres strictly to reporting schedules, thereby elevating user trust and operational satisfaction.
- Information Governance & Confidentiality Balance: Maintains stringent protocols to safeguard sensitive client data while balancing necessary public disclosures without excessive, counterproductive opaqueness (Boutoura & Samaili, 2020, p. 141).

3-2- Contemporary IT Challenges Facing the Banking Sector

Information systems form an indispensable backbone for modern financial institutions. However, they operate within a highly volatile technological landscape marked by complex challenges, such as cybersecurity threats (e.g., cyberattacks, data breaches) and technological disruption. Contemporary banks operate under several transformative structural shifts:

a- The Technological Revolution: The transition toward digital networks for executing banking operations has increased capital expenditure (CapEx). This shift toward capital-intensive automated systems has altered human resource deployment, reducing traditional banking job roles.

b- Product and Service Diversification: Intensified market competition has forced banks to expand their portfolio of financial products. Although this increases operational overhead, it expands non-interest revenue streams.

c- Globalisation: Financial globalisation connects cross-border capital markets, intensifies competition, lowers traditional transaction costs, and accélérâtes information dissemination.

d- Financial Deregulation (*Dérèglementation*): Global deregulation has relaxed government restrictions governing financial institutions (e.g., removing interest rate caps on savings deposits). This has enabled non-bank financial intermediaries (e.g., savings and loan associations, credit unions) to offer services previously monopolized by commercial banks (Bokhari & Alaib, 2013, pp. 10–12).

e- Intensified Industry Competition: Deregulation coupled with rapid technological innovation has narrowed operating margins across similar financial products, pushing banks to compete aggressively for deposit acquisition and customer retention (Bokhari & Alaib, 2013).

Technological advancement is not an end in itself, but rather a strategic mechanism leverageable to achieve organizational goals, optimize administrative methods, and elevate service quality (Toubin, 2012, p. 251).

To continuously evaluate performance when adopting modern IT infrastructures, banks must align their selections with specific analytical criteria, as outlined in Table 1:

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Table 1: Selection Criteria for Banking Information Technologies

Criterion	Operational Definition
Applicability	The technology must be feasible and adaptable to the bank's specific operational scale and resource constraints.
Quantifiability	Outputs and performance gains resulting from IT deployment must be measurable via concrete quantitative metrics.
Integrability	Seamless alignment and compatibility between the technological tool and the underlying banking workflows.
Interactivity	Interactivity should be developed iteratively through tested operational trials rather than single-instance assessments.
Usability / Ease of Use	Minimizing system complexity so staff can collect, process, and analyze data efficiently without technical friction.

Source: Prepared by the authors based on Moussawi & Tagraourt (2022, pp. 61–62).

Selecting the appropriate IT infrastructure depends on an institution's size, service mix, and budgetary constraints. Banks must balance the capital expenditure required for IT implementation against the anticipated operational ROI and efficiency gains.

Strategic Advantages of Advanced IT Integration in Banking

The integration of advanced IT solutions delivers distinct competitive advantages:

- Organizational Growth: Facilitates regional and international expansion while diversifying product-service portfolios.
- Cost Reduction: Minimizes end-to-end transaction processing costs across supply and service chains.
- Service Differentiation: Enables the design of unique, high-value service features to gain market share.
- Network Infrastructure Expansion: Strengthens real-time communication networks to bolster strategic relationships with clients and partner banks (Moussawi & Tagraourt, 2022, p. 62).
- Continuous Improvement (Kaizen): Accelerates the innovation cycle for financial products, enhancing customer satisfaction (Moussawi & Tagraourt, 2022, p. 62).
- Customer Need Identification: Uses exploratory data analytics and field surveys to rapidly process client preferences and build brand loyalty.

- Promotional Enhancement: Utilizes multi-channel digital platforms to deliver targeted marketing campaigns across diverse geographies and timeframes.
- Regulatory Adaptability: Drives necessary updates to internal governance frameworks to keep pace with evolving macroeconomic and digital finance regulations (Mezaache, 2021, pp. 166–167).

3-3- Impact on Banking Service Quality:

Modern IT directly elevates service quality across four main dimensions (Kerrouche & Oulad Brahim, 2014, p. 171):

- Decentralization of Services: Eliminates physical site constraints, enabling customers to execute transactions remotely without operational friction.
- Self-Service Banking: Empowers clients to perform transactions and inquiries independently via online platforms and digital portals.
- Remote Inquiry and Feedback Systems: Enables real-time tracking of customer feedback and sentiment analysis to optimize service delivery.
- Elimination of Wait Times: Reduces queueing and processing delays by processing concurrent transactions simultaneously.

Based on the theoretical concepts governing Banking Information Systems and Information Technology, these models must be validated through practical application. To translate raw technological infrastructure into actionable business intelligence, this study employs visual matrix models, KPI scorecards, and dynamic visual indicators.

By constructing an interactive Power BI dashboard, this research demonstrates how a modern BIS converts raw financial databases into real-time visual analytics, directly reducing decision latency and enhancing executive oversight.

4- Applied Case Study:

To extract actionable intelligence and embedded insights from the target database—sourced from Kaggle (Kaggle.com) containing historical bank loan portfolio records—the theoretical concepts were operationally applied. This empirical phase evaluates the target bank's loan granting performance using dynamic, interactive dashboards developed via Business Intelligence (BI) technology, specifically Microsoft Power BI, following the rigorous evaluation of IT adoption criteria. A critical precursor to dashboard architecture in Power BI is Data Preparation and Cleansing. Methodological literature emphasizes that the reliability of analytical outputs depends directly on data hygiene. In this project, data cleansing involved identifying and treating outliers, handling missing values through systematic imputation or deletion, and eliminating duplicate records. Here, duplicate removal specifically targeted anomalous row replication (e.g., identical client transaction entries repeated across fields) using Power BI's Remove Duplicates transformation workflow. Below is the dynamic visual report illustrating the evaluated loan dataset:

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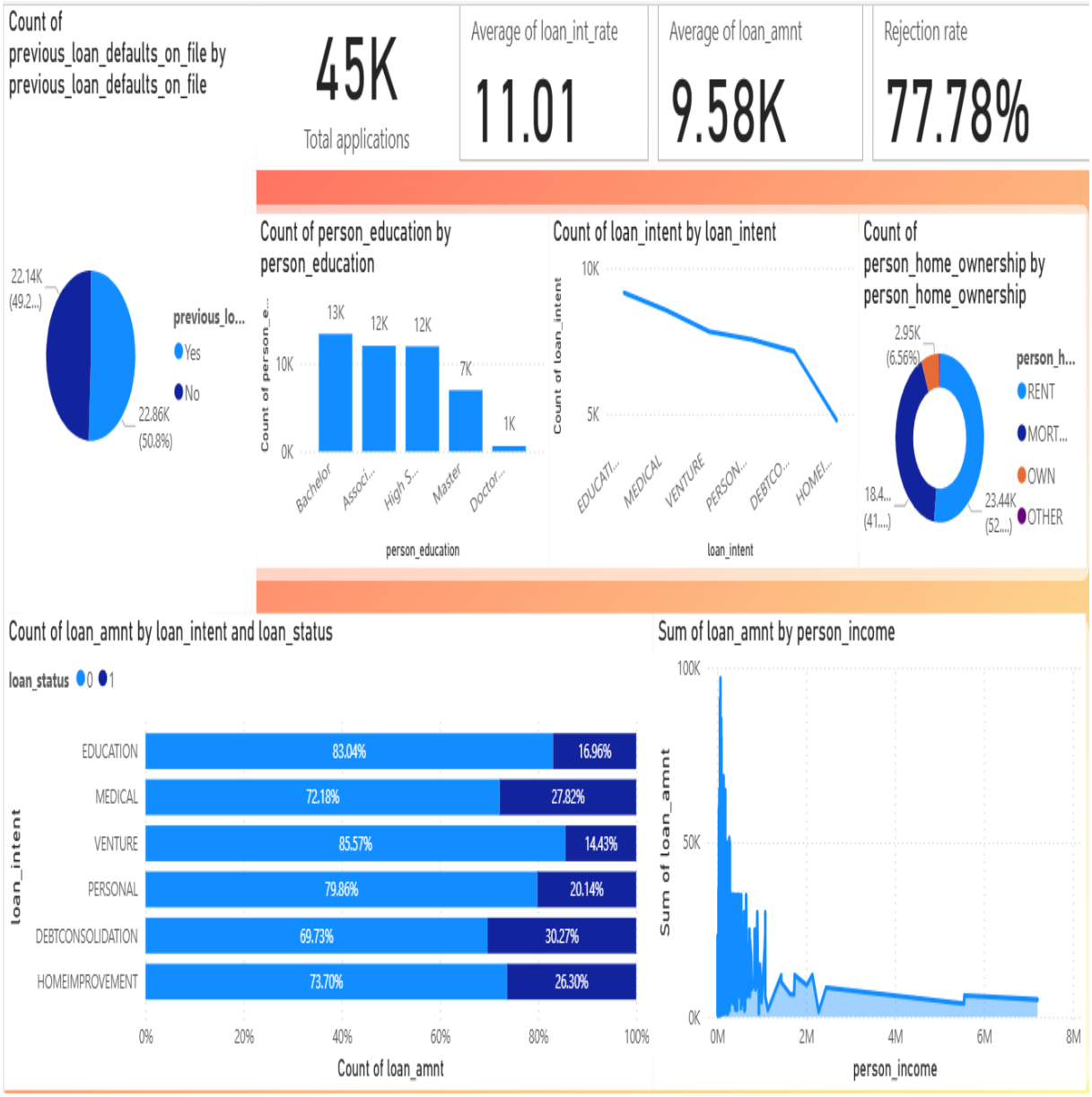
Figure 1: Interactive Business Intelligence Dashboard for Granted Loans Analysis



Source: Authors' elaboration using Microsoft Power BI outputs

rom the indicator card analysis, the total loan demand stands at **45,000 applications**. Notably, the precise processing timeframe for accepting or rejecting these applications is unspecified; the absence of a temporal metric is highlighted due to its crucial importance in gauging fluctuations in demand velocity over time.

The overall **average interest rate** is estimated at **11%**, a benchmark figure common across international banking institutions. Average interest margins vary across jurisdictions depending on central bank monetary policy stances and loan product categories.

The **average loan amount** reached **958,000 monetary units**, governed primarily by underwriting parameters and specific financing structures across loan types.

Conversely, the overall **rejection rate** reached a remarkably high **77.7%**. This elevated rejection level is largely attributable to historical default patterns—the baseline default rate accounts for **50.8%**, as illustrated in the historical default pie chart. The remaining **26.9%** of rejected applications are driven by secondary credit factors, including insufficient debt-to-income (DTI) ratios and strict risk-underwriting criteria.

a- Applicant Demographics and Intent Analysis

Regarding applicant educational profiles, the stacked bar chart reveals a clear variance in credit demand across education levels:

- **Bachelor's Degree holders** submitted the highest number of loan requests (**13,000 applications**).
- **Associate Degree holders** (representing two-year post-secondary qualifications) and **High School graduates** followed with **12,000 applications** each.
- **Master's Degree holders** submitted **7,000 applications**.
- **Doctorate (Ph.D.) holders** represented the lowest demand with **1,000 applications**.

This distribution aligns with the adjacent **Line Chart** illustrating loan purpose. The primary driver for credit demand among a substantial segment of applicants is financing **educational tuition fees**. This reflects socio-economic realities where rising tuition costs necessitate borrowing to complete higher education—specifically for Bachelor's degree holders seeking to pursue post-graduate qualifications (Master's and Ph.D.). Given that younger demographics typically lack accumulated collateral assets, education is treated as a strategic investment in human capital. Secondary loan purposes include healthcare expenses, venture/startup financing, and personal consumption.

b- Housing Status and Collateral Risk Evaluation

The **Donut Chart** detailing applicant housing status indicates that the majority of applicants are **renters (52.1%)**, followed by those with active **mortgages (41.09%)**, while **property owners** account for only **6.56%**.

This distribution aligns with the dominant academic loan intent: younger applicants pursuing education generally possess minimal asset holdings. From a risk-management perspective, the lack of unencumbered asset ownership limits the bank's ability to secure tangible collateral, exposing the institution to heightened default probabilities and interest-rate volatility.

c- Loan Approval and Rejection Rates by Category

An analysis of approval and rejection dynamics across distinct loan categories reveals the following performance metrics:

- **Education Loans:** Registered an approval rate of **83.04%** (versus a **16.96%** rejection rate). This high acceptance rate is facilitated by potential state guarantee schemes, parental co-signatures, and a lower systemic risk profile compared to large-scale commercial investments.

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- **Healthcare Loans:** Recorded a **72.18%** approval rate. The relatively small loan sizes associated with medical treatments mitigate overall loss-given-default (LGD) exposure for the institution.
- **Venture / Startup Loans:** Achieved an **85.57%** approval rate. This high acceptance is driven by equity-sharing structures, profit-participation models, and positive credit histories among corporate sponsors, despite the inherent high-risk nature of entrepreneurial ventures.
- **Personal Loans:** Recorded a **79.86%** approval rate. Approvals are backed by formal credit scoring and direct payroll-deduction agreements, reducing credit risk for the bank while exposing borrowers to higher interest rates relative to standard consumer credit.
- **Debt Consolidation Loans:** Registered the lowest approval rate at **69.73%**. Debt consolidation carries elevated counterparty risk, requiring rigorous underwriting procedures relative to educational or medical credit.
- **Home Improvement Loans:** Recorded a **73.70%** approval rate for property maintenance and renovation financing. Approvals are anchored by real estate collateral, as property renovations enhance asset valuation and marketability, improving capital protection and risk mitigation.

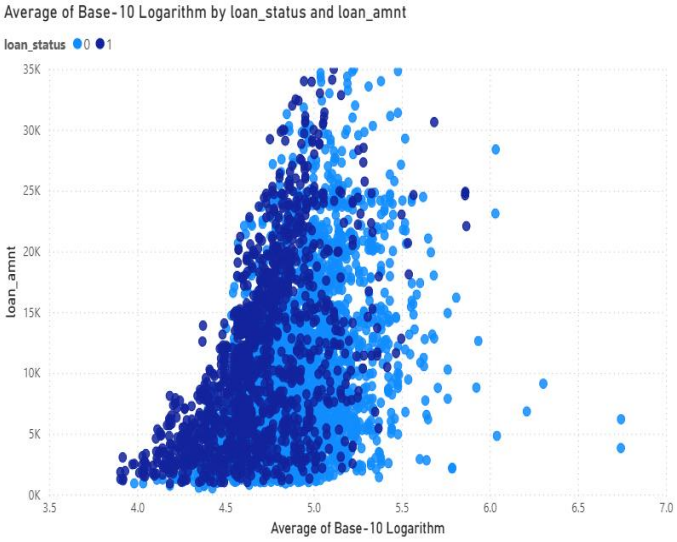
d- Income-Loan Correlation Analysis via Scatter Plot

To examine whether higher income levels correlate positively with larger loan amounts, and to detect potential anomalies or structural clusters, a **Scatter Plot** analysis was conducted.

Before plotting, income distributions were transformed using **Power Query** by applying a e-**logarithmic transformation (log)** to normalize right-skewed income data and handle extreme outliers. Furthermore, a binary status variable was introduced: **0** denoting non-defaulting borrowers and **1** denoting defaulting borrowers.

The resulting distribution and cluster analysis are illustrated below:

Figure 2: *Scatter Plot of the Income–Loan Amount Relationship*



Source: Authors' elaboration using Microsoft Power BI outputs.

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As illustrated in the scatter plot above, a positive correlation exists between income levels and loan amounts; specifically, higher income values generally correspond to larger loan allocations.

Applicants in low-income brackets—corresponding to log-transformed income values between 4.0 and 4.5 (or lower)—are predominantly associated with smaller loan amounts equal to or less than 10,000. Conversely, middle-income applicants—with log-transformed income values ranging from 5.0 to under 5.5—account for peak loan amounts reaching approximately 35,000, representing the maximum loan ceiling in the dataset.

This concentration of maximum loan values among middle-income borrowers is driven by income stability and adherence to credit underwriting criteria. For financial institutions, this segment balances credit risk effectively, as middle-income applicants exhibit lower default probabilities than low-income applicants while demonstrating higher loan demand than high-income earners.

Notably, substantial dispersion is observed among very high-income applicants (log-transformed values ranging from 5.3 to 6.8). Within this range, demand for maximum loan amounts declines, with credit requests fluctuating primarily around small-to-medium loan figures. This pattern suggests that high-income borrowers tend to rely on self-financing or alternative investment vehicles rather than debt financing.

Furthermore, the plot demonstrates that borrowers with historical default records are primarily concentrated within low-to-middle income categories who secured disproportionately large loan amounts. This indicates that low income alone is not the sole determinant of default risk; rather, credit risk is jointly driven by the interplay between income level and total loan size.

Age Group and Loan Category Analysis via Heatmap Matrix

To investigate potential relationships between the aforementioned loan categories and borrower age demographics, a **Matrix Heatmap** was constructed to enhance visual interpretation. Age values were discretized into defined age brackets using **Data Analysis Expressions (DAX)** in Power BI, followed by matrix formulation with data cell values emphasized.

The resulting heatmap distribution is illustrated in the following figure:

Table 3: Matrix Heatmap of Customer Age Brackets Across Loan Categories

loan_intent	20-29	30-39	40-49	50-59	60+	Total
DEBTCONSOLIDATION	47839070	17189368	2633742	437514	123150	**68222844**
EDUCATION	67026030	16522939	3134797	169269	168252	**87021287**
HOMEIMPROVEMENT	31641715	15026913	2770420	314425	81500	**49834973**
MEDICAL	54151214	19536845	3807073	361892	254251	**78111275**
PERSONAL	51108020	16826714	3035477	1137731	420850	**72528792**
VENTURE	54172953	18065043	2878600	338505	67818	**75522919**
Total	**305939002**	**103167822**	**18260109**	**2759336**	**1115821**	**431242090**

Source: Authors' elaboration using Microsoft Power BI outputs.

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As observed from the heatmap matrix, the vast majority of borrowers belong to the youth demographic, specifically within the **20–29 age bracket**. This empirical finding strongly corroborates the preceding analysis regarding educational loans. Total granted credit allocated to this age cohort exceeded **300 million monetary units**, out of a cumulative total loan portfolio of **431 million**.

The **30–39 age group** followed in demand volume, with loan applications continuously declining as applicant age increases. This inverse relationship aligns with standard economic theory, which posits that younger demographics face higher liquidity requirements to fund human capital investments (such as education) and to establish foundational financial stability.

Regarding the distribution of loan categories across age cohorts, the heatmap reveals the highest color intensity within the **20–29 age bracket**:

- **First Rank:** Educational Loans dominate credit allocation within this group.
- **Second Rank:** Healthcare financing and Startup/Venture capital loans.
- **Third Rank:** Personal loans and remaining credit categories.

In contrast, middle-aged and older age brackets exhibit a more dispersed loan distribution, marked by a progressive decline in educational credit demand as age advances.

Ultimately, the matrix demonstrates that variations in credit demand are primarily driven by two key interacting variables: **borrower age demographics** and the underlying purpose of the granted loan.

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5. Discussion of Results

The theoretical and empirical findings underscore the imperative of establishing a integrated understanding of Banking Information Systems (BIS) and Information Technology (IT) fundamentals. This study highlights that IT functions as a foundational enabler within the information system architecture, facilitating efficient data processing and actionable knowledge generation. Consequently, the structural relationship between IS and IT is conceptualized as a whole-to-part continuum, wherein the system represents the macro-framework and technology serves as its operational apparatus.

In this context, **Microsoft Power BI** was leveraged as an analytical platform providing an extensive suite of data visualization techniques, including advanced scatter plots, bar charts, binary data visualizations, and dynamic visual dashboards. Applied to a global bank's loan database, these visualization tools enabled the systematic extraction and transformation of raw financial data into strategic business intelligence. This pipeline directly enhances the BIS capacity to make expedited, cost-effective, and data-driven credit decisions.

The analysis evaluated key determinants influencing credit distribution, notably income levels, loan purpose categories, and applicant age demographics. A **Scatter Plot** was employed to empirically test whether higher income levels positively correlate with larger loan amounts. Concurrently, a **Matrix Heatmap** was constructed to investigate variations across borrower age cohorts and loan types.

The empirical results demonstrate that low income alone does not serve as the primary proxy for credit risk or default probability; rather, default risk is jointly determined by the interplay between income levels and total loan obligations. Furthermore, the heatmap analysis revealed distinct variations in credit demand driven by two principal interacting variables: **borrower age** demographics and the underlying purpose of the granted loan.

6- Conclusion

This study investigated a historical loan portfolio dataset to evaluate credit allocation patterns and risk parameters. The empirical findings demonstrate that integrating advanced data visualization techniques into credit analytics substantially improves the assessment of actual banking performance.

Integrating modern business intelligence tools—such as **Microsoft Power BI**—into a Banking Information System elevates the system's operational capability from traditional Transaction Processing Systems (TPS) to advanced Decision Support Systems (DSS). By leveraging real-time visual dashboards and business intelligence outputs, banks can significantly reduce decision latency—minimizing the time gap between financial event occurrence and analytical execution. Ultimately, this integration enables Banking Information Systems to deliver timely, cost-effective strategic decision-making and sustainable operational excellence.

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