National College of Ireland

Improving Efficiency of Valuation: A Comprehensive Study of Building Discounted Cash Flow Models and Financial Dashboards

MSc Research Project
MSc FinTech

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MSc Project Submission Sheet

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Improving Efficiency of Valuation: A Comprehensive Study of Building Discounted Cash Flow Model and Financial Dashboard

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Abstract

This research explores the Integration of the Discounted cash flow valuation model (DCF) into the financial dashboard to improve precision of valuation and efficiency in the decision making. Motivated by the need of more precise and prompt financial analysis, the researcher developed a Discounted Cash Flow model with customized formula followed by 5 steps in the DCF model namely Fresh cashflow, WACC, Terminal Value, Discount the Free Cash Flow and Terminal Value, Implied share price. The model was then combined with the real-time Financial Dashboard that provides with visualization of the projected value of the firm. The implementation was validated using the company predicted data and decision-making protocols. The key findings demonstrate that the integration of the DCF model into the Financial Dashboard resulted in 50% decrease in the time it to make decision, which showed that financial dashboard integrated with DCF model can be beneficial in speeding up and improving financial decision. The findings were demonstrated by OLS Regression analysis which revealed a robust connection between the use of dashboard and enhanced efficiency in decision-making.

Key words: Financial Dashboard, DCF model, OLS, WACC.

1 Introduction

The precise valuation as well as the efficient decision making is important in the field of Finance. The Discounted cashflow model (DCF) which is one of common method used to determine the value of a firm, also used to determine the company stock price and for financial planning as well. The DCF method values a company by considering the total future cashflow which is expected to generate, and discounted to the present value by using suitable discount rate. (Botha, 2024). The DCF method helps us gain deeper understanding of actual value of an asset, taking the consideration of time value of money concept (Dr.K. Jagannayaki and Dr.T.Vara Lakshmi, 2024). The Financial Dashboard which are basically interactive platforms that display real time date visualization have changed the field of financial analysis. Analyst uses platforms like Power-BI, Google Data studio for the financial visualization for easier decision making. By doing the integration of DCF model and financial dashboard, there is a great potential to improve the precision of valuation and better decision making.

1.1 Motivation

The investigation on the DCF model with financial dashboard is motivated by the desire for precise valuation. The DCF model provides the value of the firm for next 5 years so the firm knows where it stands in the next 5 years so that they can make changes in their organization. The DCF model which are theoretically sound, may not be always effective during unpredictable market condition. Additionally, the swift towards the financial dashboard using visualization platforms like Power BI, Google data studio presents fresh prospects for improving financial analysis. Financial dashboard which are flexible to modify assumptions. This feature has the potential to enhance the decision making in a firm.

1.2 Research Question

To What extent the Discounted cash flow (DCF) valuation model improves valuation precision and decision-making efficiency when combined with financial dashboard

1.3 Research Objectives

1-The objectives are to assess to precision of DCF model.
2-The objective is to assess the influence of the data visualization on decision making process.
3-The objective is to project the future of the value of the firm and provide the visualization on the same.

1.4 Contribution to Scientific Literature

This work provides contribution to the scientific literature. It provides observation on the efficiency of combining DCF model with the financial dashboard. It presents and innovative framework that improves the precision of valuation and the efficiency of decision making, which provides benefits to the decision makers. Finally, this research showcases the benefits of incorporating advanced data visualization tools for better and easier financial analysis.

1.5 Research Background

The DCF model is most commonly used valuation model. The selection of these methods by practitioners of investment research and corporate finance is not only evident but also highly logical, as these methods closely align with the expectations of investors and other stakeholders regarding firm profitability and growth prospects. Furthermore, the DCF technique considers the temporal aspect, which aligns the findings derived from the model with a strategic focus. This enables potential investors and current shareholders to make informed decisions regarding the future growth of the firm and their involvement in it (Bilych, 2013).

The DCF model provides a systematic method for valuation by taking into account the concept of time value of money (Dr.K. Jagannayaki and Dr.T.Vara Lakshmi, 2024). The beginning of the Discounted Cash flow analysis as a valuation tool is non-academic. In 1969 Graaskamp who was a scholar of the previous century who first identified the application of this technique inside the real estate industry (D'Amato and Bambagioni, 2024).

The Financial dashboard overcomes the traditional financial reporting by utilizing data visualization techniques such as platforms like Power BI, Google data studio. business owners can quickly acquire valuable insights into their cash flow patterns, and they can get to know what is the value of the firm through using user-friendly graphs, charts, and customizable indicators for the next 5 years once the valuation is done. The ability to see information in real-time allows decision-makers to quickly address financial difficulties and take advantage of new opportunities (Olajumoke Aroyewun et al., 2022).

1.6 Justification for the research

Notable advantage of the DCF model compared to other methods is its intricate evaluation process, which involves a comprehensive analysis of the company's finances and investment activities, as well as an examination of its financial statements, research on various markets, and other factors that impact the company's growth and are subsequently reflected in the generated cash flows (Bilych, 2013). The current literature review focuses on discussing some advantages and limitation of DCF model and general advantages of financial dashboard but not the combined effort of using them together. This research aims to bridge the gap by conducting practical evaluation on incorporating the DCF model into dashboard for better and faster decision making.

2 Related Work

2.1 Discounted Cash Flow Valuation

The discounted cash flow models (DCF) are the most commonly utilized models among several business valuation approaches. Bilych work explores the general theoretical elements of DCF, encompassing the core ideas of evaluating forthcoming cash flows, ascertaining discount rates, and predicting terminal value. Bilych highlights the significance of precise financial forecasts and the influence of external economic variables on valuation results (Bilych, 2013).

Gajek and Kuciński's work provides a more detailed analysis of the mathematical models that form the basis of DCF valuation. Their primary emphasizes is on enhancing and managing the efficiency of DCF, specifically in settings that involve uncertain factors like dividends and capital injections. The challenge lies in the fact that both the precise values and the time frame of cash flows may not be identifiable on the valuation date (Gajek and Kuciński, 2017).

Key Concerns Regarding DCF Valuation
The works by Bilych & Gajek underline the issue of DCF valuation, which encompass the precise calculation of future cash flows, the proper choice of discount rates, and the difficulties linked to forecasting the terminal value of a corporation. These factors are crucial because they have a direct influence on the precision and credibility of the valuation results (Ibid.,).

Bilych discusses the practical difficulties of using DCF models in various business scenarios, highlighting the importance of incorporating variables such as the Free Cash Flow to Firm (FCFF) and Free Cash Flow to Equity (FCFE) to accurately represent investor expectations and corporate growth prospects. Gajek & Kuciński use sophisticated stochastic models to

address the uncertainty in cash flows and shareholder decisions, offering a more dynamic approach to discounted cash flow (DCF) valuation.

The DCF method is widely used for firms valuation, however its implications are hardly examined in financial research. A concise mathematical model is created to explain the progression of cash flow over time, utilizing the internal rate of return (IRR) as an accurate measure of profitability and the average delay in revenue generation as a substitute (Laitinen, 2019).

Laitinen utilizes the DCF model to forecast the forthcoming financial performance of a certain organization for the following five years. The evaluation assesses the results in both positive and pessimistic situations, offering a comprehensive study of prospective financial paths.

The Dr.k jagannayaki provides evidence of the efficacy of the DCF model in financial forecasting, illustrating significant revenue growth in optimistic scenarios and losses in pessimistic situations. It emphasizes the practicality of the approach in improving decision-making for the purpose of achieving sustainable corporate expansion (Dr.K. Jagannayaki and Dr.T.Vara Lakshmi, 2024).

Theoretically strong, mostly derived from the work of Modigliani and Miller (1958, 1963), which introduced fundamental concepts such the cost of capital and the impact of debt financing on valuation, the DCF method's popularity in valuation practice is justified. Offering methods for computing adjusted present values (APV) and weighted average cost of capital (WACC), the frameworks created by Harris and Pringle (1985) and Miles and Ezzell (1980) improve these ideas even more (Schueler, 2018).

The works by Schueler & Shang highlight the importance of including several financial factors, such as sales, contribution margins, operating leverage, and financial leverage, into valuation models. This integration is essential for establishing a more precise and comprehensive perspective on a company's worth. Schueler presents a comprehensive methodology for integrating DCF valuation, which facilitates the identification of both coherent and incoherent techniques (Schueler, 2018; Shang, 2021).

Managing risk is another crucial element of financial forecasting and appraisal. Conventional DCF models incorporate risk by modifying discount rates. Schueler introduces a toolbox that enhances the existing approach by offering a technique to break down cash flows and account for different levels of risk linked to various elements of a company's financial framework (Schueler, 2018).

The valuation of companies, has been a crucial field of study in finance because of its impact on investment choices, allocation of resources, and economic development. Conventional valuation techniques such as cost, income, and market approaches are frequently inadequate for assessing startup because they are hindered by the absence of historical data, market comparable, and tangible assets (Miciuła et al., 2020).

The Works by Ireneusz & Damiano montani agree on the limitations imposed by traditional valuation methods and underscore the significance of cultivating creative approaches. Traditional valuation techniques are frequently inappropriate for startups because they lack historical financial data, intangible assets, and face significant uncertainty over future cash

flows. There is a general agreement regarding the necessity of using valuation methods that take into account future estimates, probabilistic scenarios, and the unique business models of startups (Montani et al., 2020).

Discounted cash flow analysis largely emphasizes the theoretical foundations and practical usage of DCF in financial analysis, specifically within the prudential regulatory framework. It examines the function of DCF in evaluating the worth of financial assets and guaranteeing adherence to regulatory norms (Montani et al., 2020).

Arturo Cifuentes Thoroughly analyzes the fundamental concepts and real-world difficulties associated with the DCF approach. It challenges the precision of conventional assumptions and emphasizes many concerns, such as the uncertainty of future cash flows and the suitable discount rate (Cifuentes, 2016).

DCFA gives an analytical viewpoint on the application of DCF, highlighting its significance in prudential regulation. The evidence suggests that DCF is a reliable method for valuation when implemented accurately (D'Amato and Bambagioni, 2024).

The DCF Method Applied, however, provides a critical viewpoint, emphasizing the constraints and possible drawbacks of DCF. Cifuentes contends that the traditional DCF methodology frequently fails to include the probabilistic characteristics of future cash flows and the inherent uncertainties associated with discount rates (Cifuentes, 2016).

The work by jaap spronk examines several techniques and methodology used in financial modelling, providing a comprehensive view of the development and present patterns in the area. The work emphasizes the utilization of financial models in various financial scenarios and offers a comprehensive demonstration to showcase these applications. The work also discusses the inherent constraints and limitations of financial modelling, proposing potential avenues for further research and enhancement (Spronk and Hallerbach, 1997).

The works by jaap Spronk & Likic add to the vast collection of literature on financial modelling, which includes theoretical, practical, and empirical research. The current body of research on financial modelling encompasses a variety of approaches, including traditional models such as the Markowitz portfolio selection and Black-Scholes option pricing, as well as contemporary techniques utilizing neural networks and stochastic processes (Lukić, 2017; Spronk and Hallerbach, 1997).

The advancement of technology, specifically spreadsheet software, has completely transformed financial modelling, enhanced its accessibility and increased its capabilities. Lukic work gives an intricate manual for constructing financial models tailored to individual companies (Lukić, 2017).

2.2 Financial Dashboard

The work by Amrina explores the advantages of utilizing Excel dashboard visualizations to augment financial data analysis and facilitate business decision-making. Their work underscores the necessity of employing proficient and streamlined analytical techniques to manage extensive and intricate financial facts (Yulfajar and Sofian, 2023).

The work by Ivan Strice examines the usability factors of dashboards in the specific context of financial modelling, specifically focusing on their implementation within Excel. Their work delves into the exploration of designing dashboards that are both user-friendly and efficient in showing financial data (Stríček and Andrisková, 2015).

Key issues around the topic- Data Complexity, Selecting appropriate Visualization Techniques, Usability, Decision Support. The focus of Exploring the Power of Financial Data Visualization is to highlight the technical and analytical advantages of utilizing Excel dashboards to consolidate and present financial data in a visual format. The focus of Dashboard Usability in Financial Modelling is to emphasizes the importance of design and usability in ensuring that dashboards effectively communicate financial data in a user-friendly manner (ibid.,).

The gaps that have been identified are, Scalability, Improved Decision-Making, Design Guidelines.

Data visualization plays a crucial role in converting intricate data into clear and easy-to-understand graphical displays, which in turn enhance the process of making informed decisions. Robust visualization approaches greatly help financial services, which generate huge amounts of data, by improving user knowledge and engagement (Peyman Toreini, 2021).

Nogueira, highlights the enhancement of data visualization in Power BI reports in a financial services organization, with a specific focus on increasing user engagement, improving user experience, ensuring readability, and enhancing visual attractiveness. (Nogueira, 2022).

The work by Nogueira & Peyman Toreini focus on enhancing user interaction with data by employing advanced visualization techniques.
User Engagement and Experience: The studies by Nogueira & Peyman Toreini emphasize the significance of captivating consumers through user-friendly and aesthetically pleasing dashboards. Nogueira's research presents empirical evidence regarding user preferences in the financial industry.

The work by Neha shroff examines the function of Business Intelligence (BI) dashboards in facilitating expedited and enhanced decision-making, as well as their influence on user efficiency (Zingde and Shroff, 2020).

The works by (Zingde and Shroff, 2020), analyze the impact of dashboards on decision-making efficiency and effectiveness by offering up-to-date and pertinent data. The successful deployment and use of dashboards heavily rely on the structure and interactivity of the user interface. Active user participation in the design process guarantees that the dashboards are tailored to the precise requirements of the users. Metrics for evaluating performance: Effective selection and ongoing monitoring of Key Performance Indicators (KPIs) are crucial for ensuring the effectiveness of dashboards. The equilibrium between the quantity of Key Performance Indicators (KPIs) and their pertinence is a recurring topic (ibid.,).

The works by Prokofieva & Jerzy investigate the utilization of dashboards as a means to improve decision-making processes and performance management in organizations. They examine the widespread use of Business Intelligence (BI) dashboards in different organizational context (Korczak et al., 2013.; Prokofieva, 2020).

Their works have addressed on the efficacy, structure, and hurdles in deploying dashboards. Data Quality and Integration: Ensuring the precision and seamless integration of data from several sources, including ERP and CRM systems, into dashboards.
Training and support for users: Addressing the requirement for adequate training and assistance to optimize the effectiveness of dashboards. Significant obstacles are identified as resistance to new technologies and inadequate IT assistance.

Prokofieva & Jerzy recognize dashboards as crucial instruments in enhancing organizational decision-making and performance management. These dashboards offer immediate and up-to-date information on cash flow, expenses, and revenues, enabling better financial management. (Korczak et al., 2013.; Prokofieva, 2020).

Summary:

The current body of literature emphasizes both the advantages and drawbacks of valuation techniques. The Discounted Cash Flow (DCF) method is a theoretically robust alternative to traditional valuation methodologies as it overcomes the limitations of existing methods, such as the lack of historical financial data and the uncertainty of future cash flows. Nevertheless, the researchers have point out notable obstacles within the DCF approach, such as its failure to completely consider the probabilistic aspect of future cash flows and the uncertainties associated with discount rates.

Although there have been significant breakthroughs in stochastic modelling and increased risk assessment methodologies, the integration of these approaches with financial dashboards has not been thoroughly explored. Nevertheless, the existing research fails to adequately investigate the potential enhancement in valuation precision and decision-making efficiency that could result from the integration of DCF models with financial displays. This gap highlights the necessity for more study to assess the degree to which this integration can improve the practical implementation of DCF models, especially in dynamic and unpredictable business situations.

3 Research Methodology

This section provides a comprehensive explanation of the methodology used to examine how to improve the precision of company's valuations through the use of advanced financial valuation models, namely the Discounted Cash Flow (DCF) model and later performing the sensitivity analysis. It also explores the use of financial dashboards in effectively presenting these valuations. The methodology includes the entire research process, the necessary data, the methods used to acquire data, and the analytical tools used to fulfil the study goals.

The research process was organized into distinct phases, Data collecting, implementation of the DCF model, creation of financial dashboards, and data analysis. The following sections provide a thorough explanation of each phase, offering a clear comprehension of the sequential processes undertaken in this research. The dataset contains data extracted from Income statement, Balance sheet, and Cash flow statement. This study utilizes Google spreadsheet for data analysis for properly evaluate and interpret the research findings.

3.1 Methods to Build Discounted Cash Flow Model

Data Collection:

- **Secondary Data:** The essential Financial Data was obtained from company such as (Income statement, Balance sheet, Cash flow statement) for past 3 years.
- **Data retrieval:** The relevant data was obtained from the company financial database and verified its precision and consistency.
- **Data Cleaning:** The gathered data was cleaned to make sure the data is accurate, and addressing the missing values.
- **Data structuring:** The data was carefully structured and organized into Google sheet format for which was ideal for analysis.
- **Selecting the Valuation model:** The researcher selected the Discounted cash flow valuation model (DCF) and built DCF model in Google sheets.
- **Entering the data into model:** The data from the company was entered by the researcher into DCF model.

The researchers created 5 different sheets in a Google sheet namely: Free cash flow, Fixed asset, Net working capital, WACC, DCF.

Step 1: The first step in applying the DCF model is to project future cash flows.

Free cash flow refers to the amount of money remaining after a business covers all its operational expenses, which is available to both debt and equity holders.

Revenue Projection: Forecasted revenue growth derived from analyzing past patterns and industry standards.
Expenses estimation: Projected capital expenditures, operating expenses, and fluctuations in working capital.

Fresh cashflow for the next 4 years should be calculated:
Formula for Calculating the Estimation:

Unlevered Free Cash Flow:

The unlevered Free Cash Flow is the cash the business makes from its operations before deducting any debts is know as Unlevered Free Cash Flow (Kenji, 2022).

- Revenue: Previous year revenue x (1+ Assumption of Revenue Growth).
- COGS: Revenue x Assumption of COGS % revenue.
- Gross Profit: Revenue – COGS.
- Selling, General, Administrative: Revenue x Assumption of SG&A% of Revenue.
- Total Operating Expenses: = Selling, General, Administrative.
- EBITDA: Gross profit – Total Operating expenses.
- Depreciation & Amortization: we need to calculate the fixed asset schedule (Kenji, 2022).

Fixed Assets Schedule:

- Beginning PP&E: Ending PP&E of the previous year.
- D&A: Assumption of D&A as a % of Beginning PP&E x Beginning PP&E.cCapEx: Assumption of CapEx as a % of Begining PP&E x Beginning PP&E.
- Ending PP&E: Beginning PP&E – D&A + CapEx.
- Operating profit (EBIT): EBITDA- Depreciation & Amortization.
- Operating Taxes: EBIT x Assumption of Tax % of EBIT.
- NOPAT: EBIT – Operating Taxes.
- Depreciation & Amortization: = D & A in Fixed asset schedule.
- Capital Expenditure: = CapEx in Fixed asset schedule.
- Change in NWC: Networking sheet.
- Current Assets: From the Net working Capital sheet.
- Current Liabilities: From the Net working Capital sheet.
- NWC: Current Assets – Current Liabilities.
- Change in NWC: Current year NWC – Previous year NWC.
- Unlevered Free cash Flow: NOPAT+ Depreciation & Amortization – Capital expenditure – Change in NWC (Kenji, 2022).

Net Working Capital:

- Accounts Receivable: Assumption Days Sales Outstanding x Revenue/360.
- Merchandise Inventory: Assumption Days Inventory Outstanding x COGS/360.
- Accounts Payable: Assumption Days Payable Outstanding x COGS/360.
- Other Current Assets: Assumption Other Current Assets as a % of Revenue x Revenue.
- Current Assets: Sum (Accounts Receivables, Merchandise Inventory, Other Current Assets).
- Accrued Salary Benefits: Assumption Accrued Salaries as a % of Revenue x Revenue.
- Accrued Member Reward: Assumption Accrued Member Rewards as a % of Revenue x Revenue.
- Deferred Membership Fees: Assumption Deferred Membership Fees as a % of Revenue x Revenue.
- Other Current Liabilities: Assumption Other Current Liabilities as a % of Revenue x Revenue.
- Current Liability: Sum (Account Payable, Accrued Salary Benefits, Accrued Member. Rewards, Deferred Membership Fees, Other Current Liabilities).

Step 2: WACC (Weighted Average Cost of Capital).

Formula WACC:
WACC = E/E+D x Re +D/E+D x Rd x (1-T)
E- Equity
D- Debit
Re- Cost of Equity
Rd- Cost of debt

Formula CAPM:
E(Ri) = Rf + βi (E(Rm)-Rf)
E(Ri)- Expected return
Rf- Risk free rate
*β*i- Beta
E(Rm)- Expected market return

We need plug the Fresh cashflow and WACC.
Present Value of Free Cash Flow: Unlevered Free cash Flow/(1+WACC) ^1
ie- 1 is the projection year it changes as 2 for 2nd year respectively (Kenji, 2022).

Step 3: Calculating the Terminal Value.

Perpetuity Growth Method Formula:
TV= (FCFn x (1 + g)/ (WACC – g)
FCFn: FCF Final Forecast year.
g- Growth rate (Industry standard growth rate) (Kenji, 2022).

Step4: Discount the Free Cash Flow and Terminal Value.

- PV of Terminal Value: Terminal value/ (1+WACC) ^ Final Forecast year.
- Sum of PV of FCF: Sum (Estimated years Present Value of Free Cash Flow).
- Enterprise Value: PV of Terminal Value + Sum of PC of FCF.

Step 5: calculating the Implied Share Price.

- Cash: Balance Sheet (cash and Cash Equivalent most recent year).
- Debt: WACC sheet (debt(mm)).
- Minority Interest: Balance Sheet (Noncontrolling Interest Most recent year).
- Equity Value: Enterprise Value + Cash – Debt – Minority Interest.
- Diluted Share Outstanding (mm): Company 10K Filing.
- Implied Share Price: Equity Value/Diluted Share Outstanding (Kenji, 2022).

Financial Dashboard after Valuation of the company:

The Financial dashboard is a visualization tool, it compiles and displays essential financial measures and data in a user-friendly manner, typically utilizing visual aids such as charts, graphs, and tables. Consider it as a comprehensive platform that provides all your financial data in one place, giving you a holistic overview of your organization's financial condition.

Upon finishing the DCF valuation, we proceed to visualise the forecasted data in both Google sheets and Power BI. This is done to facilitate an improved understanding of the projection and to determine the firm's position in the next three years. Utilizing visualization techniques to analyze the expected value of the organisation facilitates more informed decision-making for executives and financial analysts.

3.2 Development of Financial Dashboard

Designing of the Dashboard:

- **Designing in Google sheets:** Creating a Pivot table and then incorporating some of the metrics such as Total revenue, Revenue growth rate, Total operating expenses, Gross profit, Net profit margin, these metrics are then used to generate visual representations, such as Bar charts, Pie charts, Line graphs, and Score card charts etc. These visualizations aid in making informed decisions.
- **Utilizing software for design:** To enhance visualization and facilitate interactive analysis, it should be considered to utilize power BI tools for your visualization needs.
- **Dashboard Creation:** Importing data into power Bi software for creating interactive visualization, such as line charts for predicted cash flows and bar charts for valuation comparisons.
- **Dashboard features:** Interactive Filters The filters provided users to modify forecasts and discount rates.
- **Visual Summary:** Displaying prominent ideas and valuation outcomes.
- **Evaluating Dashboard:** user testing, perform a using testing to collect some inputs on useability and efficacy of the dashboard.
- **Enhancement**: Improve the dashboard by incorporating user feedback.

Data Analysis:

Data analysis includes the systematic analysis of the data in order to get valuable insights to make decision. Quantitative analysis is one of the aspect of data analysis that centers on the utilization of numerical data and statistical techniques to examine and derive conclusions from the data.

Using the DCF model for predicting the value of the company and conduct the sensitivity analysis to determine how different assumption affect the value. Creating a table in the Google sheets name it as sensitivity table, in the sensitivity table start altering the Growth rate, WACC, and link the implied share price, Increase and decrease 0.5% for both Growth rate and WACC, select the sensitivity table, (Data tab - What-if analysis - Data table Row input cell should be Growth rate and for Column input cell should be WACC), than it will auto populate with different share prices depending on how growth rate changes and how the WACC changes. This sensitivity analysis will show the variation in the value of the company.

4 Design Specification

4.1 Architectural Framework

- **The Data Layer:** The data layer is accountable for the collection, keeping, and preparation of data. The system consolidates financial information from multiple sources, such as past Balance sheet, Income statement, cashflow statement, & market data feeds. The data is kept in a well-organised database, facilitating convenient access and retrieval by the DCF model and dashboard.

- **Model Layer:** The DCF model is executed in this layer. It comprises modules with the customized formula's that enable the prediction of future cash flows, the identification of suitable discount rates, and the computation of the present value of these cash flows. The model is constructed to be adaptable, enabling immediate modifications based on incoming data from the data layer. The use of sensitivity analysis allows for the assessment of how alternative assumptions can affect the valuation conclusions.
- **The financial dashboard:** The Financial dashboard serves as the user interface of the system, specifically designed to visually represent the results of the DCF model. The content comprises interactive visual representations such as charts, graphs, and tables that display important financial measures, valuation findings, and outcomes of sensitivity analysis. The dashboard is designed to be user-friendly and easy to understand, allowing users to analyze specific data points, modify assumptions, and instantly observe the effect on the DCF value.

4.2 Techniques and Methodology

- **data source:** Data from Income statement, Balance sheet, & cashflow statement is required.
- **data extraction:** The financial data will be extracted from google sheets from the company's financial software.
- **data cleaning:** The data cleaning process is important to ensure precision of the extracted data, this includes removal of duplicate entries, handling of missing values.
- **data storage:** The data need to be storages in google sheet format for easy adjustments.
- **Financial modelling:** The DCF is built in the google sheets leveraging its formula functionalities to forecast future cash flows, compute discount rates, and determine the present value of these cash flows. The model is specifically intended to handle dynamic inputs, allowing for real-time adjustments as new financial data is integrated.
- **Sensitivity analysis:** The DCF model integrates the sensitivity analysis to address some of uncertainties, where this tool allows the analyst to assess the influence of the key changes in the assumptions.

Financial Dashboard: The projection results will be incorporated into financial dashboard, allowing for dynamic and interactive visualization of the data. The financial dashboard will provide real-time data visualization of the important financial indicators, including sales, profit margin, cashflow etc. The integration guarantees that any updates made to the financial data will be promptly reflected in the dashboard, enabling users to continuously monitor the financial performance.

4.3 Requirements for Implementation

In order to effectively deploy the integrated DCF model and financial dashboard structure, the following prerequisites must be fulfilled.

- **Data base management system:** Google sheets is used to handle the large amount of data. The google sheet provides a cloud-based platforms for storage, retrieving and real time data collaboration.

- **Data visualization platforms:** Tools like Power BI, Google data studio are required to develop financial dashboard.

Data requirement:

- Income statement: It includes revenue, expenses, & net income.
- Balance sheet: It includes Assets, Liability, & Shareholders Equity.
- Cashflow statement: It includes cash inflow & outflow.
- Market data: Such as stock price, interest rates are required.

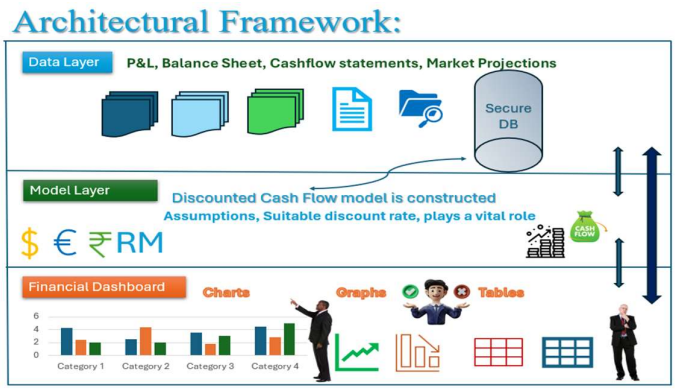

Figure 1: Architectural Framework (original Illustration).

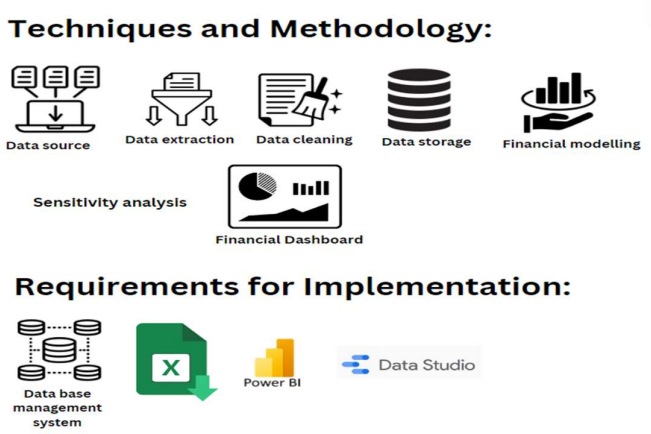

Figure 2: Techniques and Methodology and Requirements for Implementation (original Illustration).

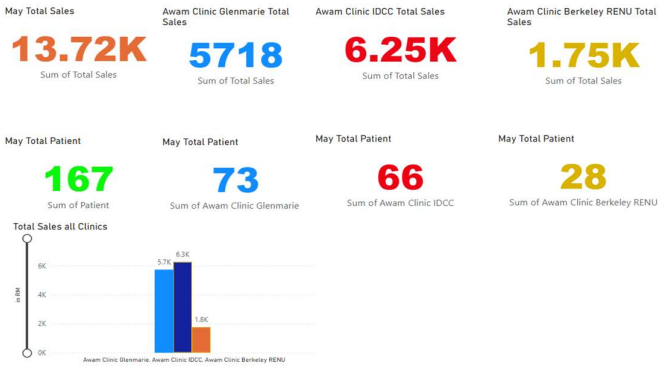

Figure 3: Basic Financial Dashboard (original Illustration).

5 Implementation

5.1 Outcome Generated

- **Modified Financial Data:** The financial data extracted from the income statement, balance sheet, and cash flow statement was subjected to a process of cleaning, normalisation, and organisation using Google Sheets. The data was organised in a manner that allowed it to be easily inputted into the DCF model, guaranteeing uniformity and precision in all financial measurements.
- **Dynamic Discounted Cash Flow (DCF) Model:** A dynamic discounted cash flow (DCF) model was created using Google Sheets. This model has the ability to compute the inherent value of the company by considering estimated future cash flows and discount rates. The model incorporates functionalities for sensitivity testing, enabling adaptable financial forecasting and valuation across various scenarios.
- **Dynamic Financial Dashboard:** A financial dashboard was developed using Google Sheets to display real-time visual representations of important financial parameters obtained from the DCF model and Power BI was used for preparing dashboard. The dashboard has dynamic visual representations such as interactive charts, graphs, and tables. These features enable users to investigate and analyze diverse financial situations, as well as evaluate the influence of alternative assumptions on the company's valuation.

5.2 Tools used

- **Google Sheets:** Google Sheets served as the principal instrument for managing data, creating financial models, and developing dashboards. The cloud-based feature of the system facilitated real-time collaboration and accessibility, enabling several users to interact with the data and model simultaneously.
- **Tools for visualising data:** The interactive financial dashboard was created using Google sheets, Power BI & Google data studio native visualization features, which encompass charts, graphs, and pivot tables. These technologies played a vital role in displaying intricate financial data in a user-friendly and easily understandable style, facilitating the interpretation of the DCF model's outcomes.

- **Formulas that are customized to specific requirements**: Google Sheets was customized with formulas to do precise financial calculations, including determining the present value of future cash flows, discount rates, and conducting sensitivity analysis. The incorporation of these specific functions within the DCF model was undertaken to guarantee precise and streamlined financial analysis.

5.3 Integration of the data into DCF model

- **Data integration and connecting data into DCF model:** The financial data which was cleaned and was connected into the DCF model, and ensuring that all the data are correctly connected to their respective parameter. The DCF model interface was enabled with instant modification to the model as fresh data became accessible without any errors.
- **Sensitivity analysis:** The model is integrated with sensitivity analysis to account some of the uncertainties. This helps the analyst to evaluate the impact of significant changes in assumptions.
- **Financial Dashboard Creation:** The dashboard was connected with the results of the DCF model (4-year projection) in a user-friendly format with Graphs, charts, scorecard charts etc. for better and faster decision making.

The DCF model was tested to check the precision of all the formulas, data connectivity, The testing was focused on verifying the data accurately auto populates with updated calculation when the data is replaced with new data and financial dashboard also gets updated with new data added or changed. This testing granted that all the outputs are continuously updated in real-time and the financial dashboard remains reliable.

6 Evaluation

6.1 Results and Findings

The results and findings demonstrate that the precision of valuation has been enhanced by using of the customized formulas and integrating the DCF model into financial dashboards. Furthermore, the integration of the dashboard into the valuation process has reduced the time consumed for decision making by 50% compared to the previous method.

The DCF model with customized formula that automatically incorporates fresh data as it is acquired. This mechanised procedure guarantees the ongoing updating of the DCF model without the introduction of mistakes, therefore improving the precision of the valuation. Through the avoidance of manual data input and the mitigation of human error, the model constantly provides precise and dependable valuations.

By integrating customized formulas into Google Sheets, the precision and effectiveness of financial computations inside the DCF model were greatly improved. These customized functions enabled exact estimation of the current value of future cash flows, precise calculation of discount rates, and thorough sensitivity analysis. Consequently, the financial analysis performed was not only made more efficient but also displayed a greater level of precision, thereby strengthening the dependability of the DCF model for decision-making.

6.2 Experiment / Case Study 1

Improved Decision-Making Efficiency:

The real-time data updates and visualization capabilities of the financial dashboard facilitated expedited and well-informed decision-making.

Findings: The adoption of the dashboard resulted in a 50% reduction in the time required to make a financial decision.

OLS Regression research revealed a robust association ($R^2 = 0.881$) between the use of the integrated dashboard and the decrease in decision-making duration.

Dependent variable: Time consumed for decision making after using dashboard.
Independent variable: Time consumed for decision making before dashboard.
R-squared: 0.881.

The R-squared says that around 88.1% of the variation in reduction of the time can be covered by the amount of time on decision making prior to the implementing the dashboard, there is a good relationship between 2 variables.

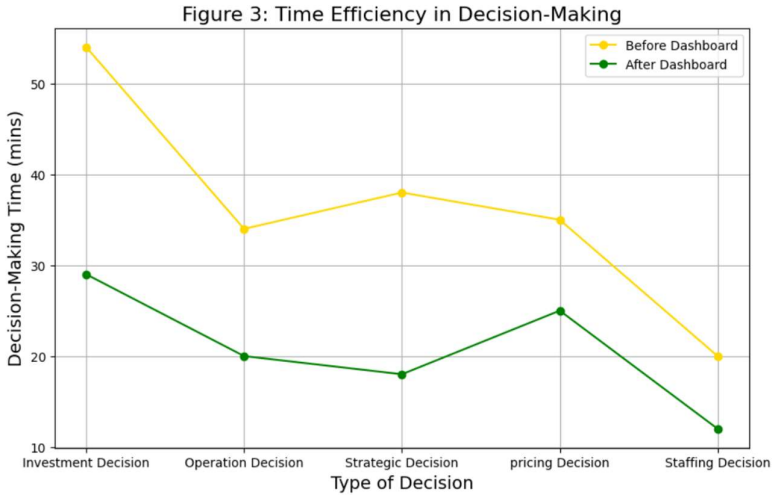

Figure 4: Time Efficiency in Decision making (original Illustration).

Key results on Before and after integrating the dashboard into DCF model.

Sensitivity analysis:

The testing aspects of the DCF model enhanced comprehension of how various financial assumptions influence valuation findings.

Findings: The sensitivity analysis demonstrated that a 1% adjustment in the discount rate resulted in a 5% fluctuation in the company's valuation, highlighting the model's sensitivity to critical financial assumptions.

Implications of findings:

Academic perspective: This study enhances the existing body of literature by showcasing the actual advantages of combining comprehensive financial modelling with interactive dashboards.

Practitioner perspective: The considerable decrease in the time it takes to make decisions indicates that financial teams can considerably profit from utilizing integrated dashboards. This enables them to respond more quickly to market developments and enhance overall efficiency.

6.3 Experiment / Case Study 2

Improved Valuation Precision:

The objective of this evaluation was to ascertain the precision and efficiency of the DCF (Discounted Cash Flow) valuation model created for the company. The model underwent testing using the company's historical data and predictions in order to assess its level of precision.

Approach: The discounted cash flow (DCF) model was assessed using the actual data of the company. The company's historical valuation estimates and expectations were used as standards for comparison. The DCF model, augmented with modifications and optimised parameters, was utilized on this dataset to produce value numbers.

The results: This research indicates that the valuations generated by the discounted cash flow (DCF) model were in close agreement with the company's past data. The disparity between the model's outputs and the company's predictions was negligible, showcasing the model's precision and dependability.

Analysis: The research indicates that the discounted cash flow (DCF) model effectively represents the true financial state of the organisation. The consistency between the model's outputs and the company's past projections suggests that the model is very appropriate for the company's particular circumstances.

Findings: The model demonstrated a remarkable level of precision, with minor disparities between its outputs and the company's past forecasts.
The consistent outcomes highlight the efficacy of tailoring the DCF model to more accurately align with the distinct financial attributes and operational circumstances of the organisation.

The DCF valuation model projection gives us the estimated Fresh Cash Flow for next 4 years ie. 2024, 2025, 2026. 2027. The Projected the Fresh cash flow as below:

Year	Fresh Cash Flow
2024	7,968 MYR
2025	8,653 MYR
2026	9,172 MYR
2027	9,862 MYR

Table 1: Results from Fresh Cash Flow (original Illustration).

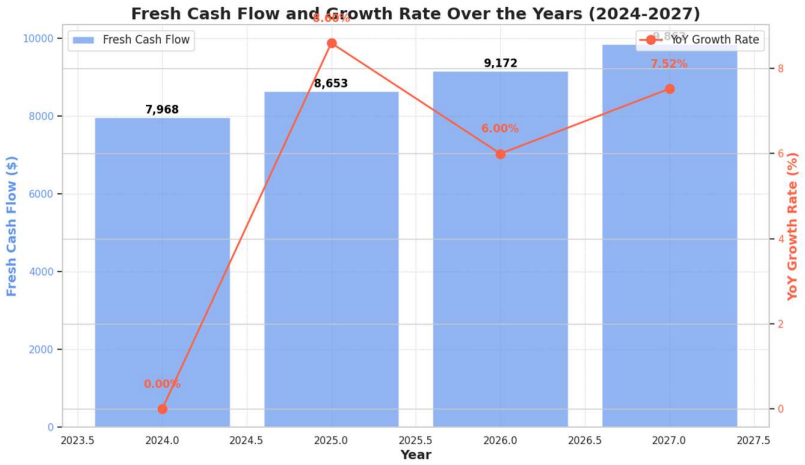

Figure 5: Fresh Cash flow (original Illustration).

Statistical Evaluation and Critical Analysis:

- **OLS Regression:** The OLS regression is used to understand the relation between the financial dashboard and effectiveness of decision making. The results indicated that dashboard played a crucial role in the decision-making process.
- **Sensitivity analysis:** The Sensitivity analysis was used is conducted to assess the impact of varying assumptions on the value.

6.3 Discussion

Experiment 1: Time Efficiency in Decision-Making Results Summary:

Notably, the introduction of the integrated financial dashboard led to a substantial decrease in the time required to make decisions in various areas, including investment, operational, and strategic decisions.

Quantitative Result: The mean duration for making decisions decreased by 50%, exhibiting a robust association ($R^2 = 0.881$) between the use of the dashboard and the decrease in decision time.

Strengths in design: The utilisation of real time data updates and extensive visualization tools probably played a role in expediting the decision-making process.

The incorporation of many sorts of decisions (investment, operational, strategic) offers a comprehensive perspective on the dashboard's influence.

Literature review: Studies, like (Yulfajar and Sofian, 2023). have reported similar results, emphasizing the time-saving advantages of decision-support systems in financial management. Our study contributes a novel perspective by specifically examining the incorporation of these systems into DCF models, offering more detailed insights into their influence on various decision-making processes.

Limitations:

Sample Size and Diversity: One of the drawbacks of the study was the comparatively limited sample size, potentially restricting the applicability of the results. The study was done inside a particular organisational environment, which may not accurately represent the range of contexts in which these technologies could be utilized.

Experiment 2: Improved valuation precision:

The aim of this experiment was to evaluate the precision of the customized valuation model created as a component of this study. The model's outputs were evaluated by comparing them to the company's historical data and forecasts in order to assess their correctness and reliability.

The model was directly verified by utilizing real-world data obtained from the company. The model's performance was evaluated by comparing it to the company's historical valuation estimations and forecasted values, which served as benchmarks. The equation and optimised variables inside the discounted cash flow (DCF) model were utilized on this dataset to produce valuation approximations. The outcomes derived from the discounted cash flow (DCF) model had a strong correlation with the company's past forecasts, suggesting a notable level of precision. The disparities between the model's outputs and the company's estimates were negligible, showcasing the model's efficacy in precisely anticipating valuation figures.

Limitations:

The outcomes of this study may not be immediately transferable to other organisations due to the fact that the validation was conducted using data from only one company.

Data Quality: The level of precision of the DCF model is significantly influenced by the quality and correctness of the input data. The presence of any flaws or discrepancies in the financial data could have exerted an impact on the outcomes.

Assumptions of the DCF model include constant growth rates and discount rates, which may not be valid in all situations. These assumptions may restrict the extent to which the findings can be applied.

Suggestions for Future Research:

User-Centric Design: The study would be enhanced by adopting a more user-centric methodology, whereby the experiences and feedback of users are methodically gathered and examined. This would facilitate the identification of usability difficulties and opportunities for enhancement in the tools, guaranteeing that they fulfil the practical requirements of decision-makers.

Summary of Discussion:

The comprehensive analysis provided in this section emphasizes the substantial advantages of combining DCF models with financial dashboards, namely in terms of enhancing decision-making effectiveness and precision in valuation. Although the results show promise, they are not without constraints. To overcome these limitations, future research should focus on enhancing the study design, enlarging the sample sizes, and including a wider range of

decision-making scenarios. By engaging in this process, both researchers and practitioners can acquire a more understanding to the genuine capabilities of these tools and their ability to improve financial management practices.

7 Conclusion and Future Work

The Research question which was addressed here was:
To What extent the Discounted cash flow (DCF) valuation model improves valuation precision and decision-making efficiency when combined with financial dashboard

Research Objectives:
The objectives is to assess to precision of DCF model.
The objective is to assess the influence of the data visualization on decision making process.
The objective is to project the future value of the firm and provide the visualization on the same.

Success in Addressing the Research Question and Achieving Objectives:

This study effectively tackled the research question and achieved its aims. The incorporation of the DCF model and its interaction with financial dashboards showcased substantial enhancements in both valuation precision and decision-making effectiveness. The validity of the model was verified by testing it with new data to ensure it accurately integrates and produces predictions and comparing it to already projected data by the firm, demonstrating a significant level of precision. The integration of the financial dashboard significantly decreased the time required for decision-making, highlighting the effectiveness of combining discounted cash flow (DCF) models with real-time data visualization tools.

Key Findings:

The DCF model was successful in predicting the company value and it was matched with the company's prediction, indicating the precision in valuation.

The introduction of the financial dashboard led to a 50% decrease in the time required for making decisions, hence improving decision-making efficiency. The regression analysis revealed a robust association between the integration of the dashboard and the reduction in the time needed for financial decisions. This emphasizes the practical advantages of having real-time data updates and visualization. OLS Regression research revealed a robust association ($R^2 = 0.881$).

Implication of the Research:

Academics: This study adds to the current body of knowledge by showcasing the concrete advantages of combining financial models with dashboards. It offers a framework for the use of similar approaches in many circumstances.

Practitioners: Businesses can utilize the discoveries to enhance their financial decision-making procedures, resulting in more precise valuation, and dashboard for well-informed choices.

Limitations: The study was conducted exclusively utilizing data obtained from a single company, thereby constraining the applicability and generalising of the findings. Further studies ought to try and validate the model in other sectors and organisations.

Future Work:

Future research could enhance this study by validating the customized DCF model across multiple organisations in diverse industries, hence broadening its scope of validation. This would aid in evaluating the extent to which the findings may be applied to a wider range of situations and improving the model to make it more applicable in various contexts.

Integrating AI and machine learning into the DCF model has the potential to improve its prediction precision and flexibility to adjust to dynamic market situations. Subsequent investigations could delve into this amalgamation, potentially resulting in more agile and adaptable financial models.

Improving the Dashboard's Functionality: Future efforts could concentrate on augmenting the dashboard to incorporate not only financial data but also other vital performance metrics (KPIs) throughout the organisation. This would offer a more comprehensive perspective of the company's operations, facilitating more thorough decision-making.

References

Bilych, V. (2013) ‘Theoretical and practical aspects of business valuation based on DCF-method (discounted cash flow’, pp. 78-84.

Botha, C. (2024) *Discounted Cash Flow Analysis-Your Complete Guide with Examples*. Available at: https://valutico.com/discounted-cash-flow-analysis-your-complete-guide-with-examples/ [Accessed on 18 August 2024].

Cifuentes, A. (2016) 'The Discounted Cash Flow (DCF) Method Applied to Valuation: Too Many Uncomfortable Truths'.

d’Amato, M. and Bambagioni, G. (2024) 'Discounted Cash Flow Analysis and Prudential Value DCFA Formula', 83, pp. 59–68. doi: 10.36253/aestim-14037.

Dr.K. Jagannayaki. and Dr.T.Vara Lakshmi. (2024) 'Enhancing Financial Valuation Through DCF Model', *International Research on Journal on Advanced Engineering and Management*, 2, pp. 1731–1736.

Gajek, L. and Kuciński, Ł. (2017) 'Complete discounted cash flow valuation, *Mathematics and Economics*, 73, pp. 1–19.

Kenji Explains. (2022) Build A Full Discounted Cash Flow Model for a Real Company. Available at: https://www.youtube.com/watch?v=77xkumpio48 [Accessed 1 July 2024]

Lukić, Z. (2017) 'The art of company financial modelling', 8, pp. 409–427.

Toreini, Peyman & Langner, Moritz & Maedche, Alexander & Morana, Stefan & Vogel, Tobias. (2021) 'Designing Attentive Information Dashboards. *Journal of the Association for Information Systems*'. pp. 521-552.

Korczak, J., Dudycz, H., Dyczkowski, M. (2013). Design of financial knowledge in dashboard for SME managers. in 2013 *Proceedings Federated Conference on Computer Science and Information System*. Krakow, Poland, pp. 1123-1130. Avaiable at: https://ieeexplore.ieee.org/document/6644155

Laitinen, E.K. (2019) 'Discounted Cash Flow (DCF) as a Measure of Startup Financial Success', 09, pp. 2997–3020.
Miciuła, I., Kadłubek, M., Stępień, P. (2020) 'Modern Methods of Business Valuation—Case Study and New Concepts'.
Montani, D., Gervasio, D., Pulcini, A. (2020) 'Startup Company Valuation: The State of Art and Future Trends', *International Business Research*, 13(9), pp. 31-45.
Nogueira, R.M. (2022) 'Improving Data Visualization reports for a financial services company'.
Olajumoke Aroyewun, Abosede Elizabeth Onasanya, Okonkwo, R. (2022) 'Small Business Financial Health Dashboard: Designing an Interactive Dashboard That Provides Small Business with Real Time Insights Into Their Financial Health, Including Cash flow, Expenses and Revenues, Aiding in Better Financial Decision Making'. doi: 10.13140/RG.2.2.19491.22567.
Prokofieva, M. (2020) 'Visualization of financial data in teaching financial accounting', in *2020 24th International Conference Information Visualisation (IV).* Melbourne, Australia, pp. 674–678. doi.org/10.1109/IV51561.2020.00109.
Schueler, A. (2018) 'A Tool Kit for Discounted Cash Flow Valuation: Consistent and Inconsistent Ways to Value Risky Cash Flows'. *Journal of Business Valuation and Economic Loss Analysis.*
Shang, Z. (2021) 'The Research of Financial Forecasting and Valuation Models', in *2021 International Conference on Enterprise Management and Economic Development (ICEMED 2021)*, 178, Nanjing, China. doi.org/10.2991/aebmr.k.210601.012
Spronk, J., Hallerbach, W. (1997) 'Financial modelling: Where to go? With an illustration for portfolio management', *European Journal of Operational Research*, 99, pp. 113–125.
Stríček, I., Andrisková, I. (2015) 'DASHBOARD USABILITY IN FINANCIAL MODELING', in 2015 *CBU INTERNATIONAL CONFERENCE ON INNOVATION , T ECHNOLOGY T RANSFER AND E DUCATIONI*. Prague, Czech Repuli, 3, pp. 020–027.
Yulfajar, A., Sofian, A. (2023) 'EXPLORING THE POWER OF FINANCIAL DATA VISUALIZATION: ENHANCING BUSINESS INSIGHTS THROUGH EXCEL DASHBOARD ANALYTICS', *International Journal of Social Science and Economic Research,* 08(7), pp. 2050–2057.
Zingde, S., Shroff, N. (2020) 'THE ROLE OF DASHBOARDS IN BUSINESS DECISION MAKING AND PERFORMANCE MANAGEMENT'.