

## **Dashboard For Business Intelligence, Data Visualisation and Decision Making**

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# **Contextual Report**

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### **Abstract**

The aim of this report is to develop a web application for performance dashboard, which helps clarify several aspects of using dashboard in business intelligence (BI), data visualisation and decision making. From Literature Review section, it points out that there is rising proclivity to use dashboards for business/project management. A performance dashboard may be considered as a great solution to address recent demands. Based on the research findings and academic analysis, the dashboard seems to be vital and beneficial for data visualisation, decision making, impacting the growth of a business or organisation as it can turn data into meaningful information and create meaning from it in order to make better decisions. Literature Review also identifies the causes of failure to use dashboard and identifies relevant information in data types and data visualisation. The product of this project is developed with a focus on front-end (UI/UX) design, offers visualization of data alongside with various functional and interactive features. This report, in addition, will investigate, discuss and scrutinise the process of the dashboard development and the decisions made throughout. More study of similar products existing on the market is also available in this paper, which will provide an overview and support the design process that implements the product.

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# 1 Introduction

## 1.1 Background

The rapid development in society as well as the continued advance of technology over the past decade have transformed the way we communicate and collaborate throughout the Internet. They also have profoundly affected business modelling, which requires the use of proper metrics to monitor business performance, often known as KPI – Key Performance Indicators (Chowdhary, et al., 2006). KPIs are shown to the analyst via a dashboard, which is a user interface (UI) that offers a view of all critical business indicators, a key factor in day-to-day operation to reflect the success of a modern organisation or enterprise. Furthermore, our previous manual and outdated methods were limited to providing information and assessing business behaviours, resulting in complete uncertainty in business owner's decision-making (SM & Belwal, 2017). Take that as motivation as well as by concentrating on the development of a Performance Dashboard, this project is to produce an efficient solution to these challenges and enable decision-makers to visualize the right metrics for successful market edge.

## 1.2 Aims and objectives

### 1.2.1 Aims

This project is aimed to develop a UI web application with a real-time dashboard solution. This dashboard plays a role in utilizing data visualization techniques to simplify complicated data sets to provide users with a quick overview of current performance and to maintain track of the department's capacity to meet service level objectives. Furthermore, our web responsive application supports various devices from a computer to a phone screen. With front-end (UI) developed using HTML, CSS and the main application using JavaScript, the development will demonstrate how all these models may be merged to create the final answer automatically for business management.

### 1.2.2 Objectives

#### i. Researching for report

- Research about the background and the tendency of using dashboard in business;
- Research about the effect of applying dashboard into business management;
- Research about previous works as the same field to write a investigation report: literature review, existing product review, technical review, etc.;
- Research about requirements needed to develop a dashboard.

#### ii. Dashboard development

##### 1. Initial layout

- Study the feasibility, collect functional and non-functional requirements;
- Study figures and charts used in business analysis and management that should be shown in a dashboard, collect data source from public APIs;
- Produce sketches and wireframe – a visual representation of an actual dashboard, design prototype if needed;
- Discuss about product appearance: layout, colour palette, typography, etc.

##### 2. Implementation (UI content)

- Implement initial layout with CSS Grids/Flexbox and Bootstrap;
- Implement UI components;
- Customize UI components to work with data: displaying, paging, sorting, filtering, editing, grouping, exporting Excel, etc.;
- Add features and functionalities;
- Make it responsive and make themes.

#### iii. Testing and evaluation

- Plan for testing: UI testing, feature and function testing, etc.;
- Present testing results and analyse them: comparing expected and actual outcomes,

- establishing if it meets the requirement, identifying limitations, etc.;
- Identify bugs and implementation changes, fix bugs;
- Write instructions for use and description of the application;
- Write reflection report: what was achieved in the application development, what could be improved in the future;
- Write a self-evaluation report: what has been learnt and what could be done better next time.

### 1.3 Approach

The waterfall method is the preferred way for maximising this project development strategy because specifications and deliverables are already well-defined in pre-production stage. Moreover, it is an individual project so there will be no demand for iteratively testing, discussing and fine-tuning. Sequential procedure will keep it easy for understand, simple for development, listed as below:

1. Requirements gathering: Answer questions about objectives, requirements, feasibility, quality about the project.
2. Design: Get an in-depth look at the design and functionality required of a BI dashboard. Draft wireframes, design each page and layout for each of them. Diagrams (e.g. DFD, ERD, use case diagram, class diagram) will be needed to link pages as well as functionality.
3. Coding and unit testing: Make and follow a coding plan of each part of the dashboard properly and efficiently as well as a detailed testing plan to ensure that no errors are missed.
4. Integration and system testing
5. Development and report documenting
6. Maintenance

### 2.4 Justification of the suitability of a Methodology or a Framework followed.

There has always been a debate on which methodology a project should follow. According to Sherman, (2014), traditional waterfall model, wherein corporate people convey their objectives and then IT department conducts a project to meet those objectives, would not be the best suited to a BI project. This section will prove that neither waterfall nor any other methods are the most appropriate fit for a BI project, however, regarding my BI performance dashboard, waterfall is an optimal choice.

On one hand, mentioned by TryQA.com (2020), waterfall method was broadly applied in software development in the 2000s. Even when agile method was announced in 2001, several organisations and companies still opted to apply the Waterfall method. The waterfall method is applied for corporate system development such as Customer Relationship Management (CRM), Human Resource Management Systems (HRMS), Supply Chain Management Systems, Inventory Management Systems, Retail Point of Sales (POS) systems, and so on. It is also applied in banking, healthcare, nuclear facility control systems, space shuttles, and other fields (TryQA.com, 2022). My BI dashboard project also shares some similarities with those systems, so I chose the waterfall method.

On other hand, although iterative or agile method seems to be more preferable nowadays, the writer of the book “Business intelligence guidebook: From data integration to analytics” (Sherman, 2014) has pointed out that it is misleading between choices of project methodology. He believed that the most important takeaway as from comparison is that no solution represents a full life-cycle BI project, which involves data collecting, data integration, database structure, and potentially numerous BI dashboards, insights, or visualisations. Given on such criteria, it indicates that neither waterfall nor agile methods are more suitable for a BI project. Precisely for that reason, my choice of method is not based on building a BI dashboard but on the project size, team size, time budget and other practical requirements.

Waterfall method is a sequence or linear method to manage the project that is focused on specified dates, objectives, and deliverables. Therefore, this method is quite simple to grasp and implement. Also, each

stage in this method must be completely finished before the next stage begins, which helps prevent stages from overlapping. Team members do not need constant contact and, until special integrations are necessary, can function independently. Members of the team can also operate individually and are obliged to make status updates, albeit on a less regular basis. As my project is small, simple, individual, short-term and has clear-cut, well-understood requirements as well as does not require maintenance after submitting, with all mentioned above, waterfall method is my best option.

## 2 Literature Review

### 2.1 Approach to literature searching

The first approach to literature review started from the second week of October after the my chosen topic being approved and continued until late November. The main focus in searching was about the tendency and impact of using performance dashboard in different fields from previous academic sources on similar topic. During winter break period, further approach was and are being made with a goal to bring me up to the speed with present state of literature in the field I am investigating – business intelligence (BI) and data visualisation. By that I hope to accomplish each objective I've set for myself, such as justifying future study in the field.

Most of the finding was based on Internet sources such as journals, articles and conference proceedings published and found from Google Scholar to support my academic research and analysis. In the term of dashboard application development, I have read a few books as well as taken some online courses to consolidate my UI/UX knowledge and enhance my programming skills.

### 2.2 Identifying the problem

#### ***2.2.1 A tendency in using dashboard for business/project management***

For small companies, a system capable of project processing is necessary as data processing and project control are done with manual paperwork, which results in a lack of time, which has a consequence on the preparation of project reports. Or even when it is done with Microsoft Word and Excel, employees are demanded to ensure the accuracy although data collection can take a long time. On the other hand, the use of a computerised system (or a dashboard in my project), can make sure that each action is not only carried out more effectively and efficiently, but also can provide exact and accurate reports. The availability of a project management information system can aid in the processing, control, and monitoring of ongoing project operations by allowing for the recording and reporting of project management results (Soleh, et al., 2020). Scheduling and human resource management, optimization of time and cost of functional quality on project quality have a major influence on boosting corporate performance (Rahayu, et al., 2017). Therefore, the application of information systems in business/project management is crucial that today's enterprises and organizations are utilizing information technology solutions to enhance their efficiency and market value by upgrading their systems and processes. To demonstrate this trend, studies by McGowan & Bohmer (1993), Jeng & Schiefer (2002) and Jeng, et al. (2003) have shown that there were many vendors offering sophisticated tools for representing business activity monitoring and data. Hence, Business Performance Management (BPM) delivers substantial benefits to business runners by allowing them to respond quickly to changes in their environment (Bhattacharya, et al., 2005).

#### ***2.2.2 Dashboard cutting-edge business intelligence (BI) and data visualisation, enhancing decision making***

According to SM & Belwal (2017), competitive nature in the IT industry, investments, business directives, and business data are growing at an exponential rate. As a result, the business owner must take caution and consider all aspects while making decisions, which stimulates business intelligence (BI) to deliver actionable insight to make better choices. Consequently, there is a need for a tool to evaluate the growth and leads the business to a lucrative route. A tool that is capable of seamlessly integrating technologies into a BI environment, provides methods like reporting, ad-hoc querying, and online analytical processing (Wu, et al., 2007). In short, a performance dashboard application can be seen as a brilliant solution to meet the demand mentioned above.

### 2.3 Literature review

Through literature study, other works that have been done previously in developing a variety of

dashboards is reviewed.

### ***2.3.1 Why performance dashboard? Motivation of using dashboard for visualisation and examples of dashboards. Related work.***

**What is performance dashboard?:** According to Few (2012), dashboard is a reincarnation of the Executive Information Systems (EIS) of the 1980s, which never really took off. The Collapse of Enron in 2001, moreover, bumped up the popular appeal of dashboards in the early twenty-first century, rose an urgent need of an innovative solution to keep track on their business. Since then, dashboard has become popular. Performance management is the process of evaluating progress to achieve key goals and maximize performance. Business Intelligence (BI), alongside, includes the tools, techniques, and procedures employed in converting data into useful information and make sense of the information in order to optimise decision making. These two methods, when combined, offer an effective better interaction strategy. The book's author also pointed out 3 main advantages of a performance dashboard, which respectively are communication, monitor & adjustment of the execution of strategy and insight and information delivery (Few, 2012).

**Motivation:** The volume of data generated has increased dramatically. More data has been produced in the last two years than in the entirety of civilization (Cambay Consulting Project Solutions, 2022). According to IDC, the volume of data produced in the world will increase from 29 Zettabytes in 2018 to 175 Zettabytes by 2022. Enterprises and organisations rely primarily on big data and the information encoded in it to understand market developments and business scenarios and make the right decisions in the future. As a result, creating a strong BI tool to analyse and visualise big data is critical. Cambay Consulting Project Solutions (2022) also shares the similar view that businesses that use data to their advantage stand out from the competition by better decision making, improving product and service quality, and improving customer experience. BI analytics tools assist enterprises in giving an overview and extracting valuable insight from data in order to make strategic and operational decisions. These tools take large volumes of complex data from various sources, reshape it, recognize patterns, and assist in gaining actionable insights.

**Related work in another fields:** Authors Sloane, et al. (2006) offer novel advancements to a military medical informatics and business process reengineering research project. The JMAR Executive Dashboard Initiative (JEDI) was a Business Intelligence system. It facilitates making an informed medical decision. In the field of Smart Tourism, Albusaidi, et al. (2016) have also done an effort to achieve Smart Tourism by studying tourist behaviour and data. This data is used to create a knowledge-based dashboard in order to assess tourist satisfaction. As the majority of travellers/visitors leave electronic traces and reviews when searching for locations and booking, as well as feedback on tourism places' services. In business area, a study of Ashraf & Khan (2015) has pointed out the important metrics to include in BI Dashboards to enable decision makers correctly display the relevant indicators for an effective market edge. Based on call detail data, their study provides three business measures and a grading system for valued subscribers and displays the findings in an effective visualisation. Besides, in a paper from 2006, Chowdhary, et al. presented a model-driven method to build a dashboard to connect with business activities and expand it to generate reports of the company. The adaption of new technology to business in Marketing, Sales, and Customer Relationship Management (CRM), Fraud Detection, and Network Management, 61% of inbound calls has been addressed quicker with improved access information (Clarkson, et al., 2012). Comparable researches can be mentioned respectively as BI Service Architecture (Wu, et al., 2007), BI Dashboard For Business Reporting (Chowdhary, et al., 2006), Financial Market Analysis (Kumar, et al., 2010) and Facebook Data Warehousing and Analytics Infrastructure (Thusoo, et al., 2010) have all proved that application of BI dashboard could provide data warehouse and visualization and improve productivity.

### ***2.3.2 What keep people away from using dashboard?***

As result found from a study of Few (2012), we are inundated with data. Metrics, key performance indicators (KPIs), scorecards, and digital dashboards are in demand. We depend heavily on



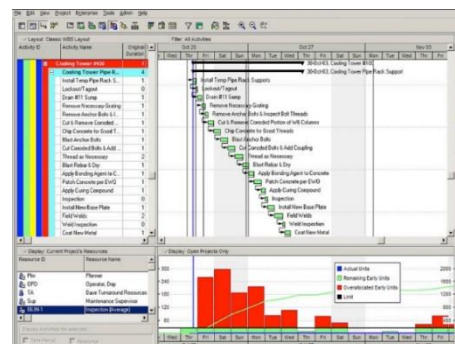
quantitative data to assess the wellbeing of our organisations, create improvements, and forecast the future. Notwithstanding the advancements in data storage and processing, we will continue to fall short if we do not communicate properly the numbers. Data, despite what people think, does not always speak for itself. Millions of dollars can be spent on constructing the world's most dependable and spotless database system, operating on the most advanced hardware and accessible via cutting-edge BI software. However, if the people who work with the data do not understand how to make sense of it or present it clearly to decision makers, your investment will be squandered.

From my research, there are 2 biggest reasons resulting in failure to use dashboard mentioned as belows:

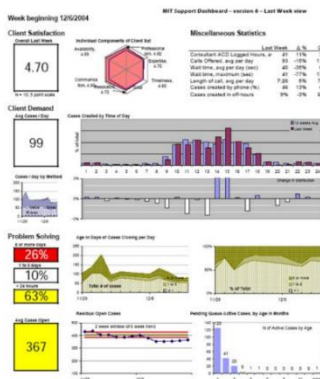
The first reason is that a dashboard may appear to be overly complicated and costly for some organisations or enterprises when they are not ready. They don't want to include the IT team or start a multimillion-dollar system project that will take months or even years to accomplish. Most people simply want to have something instant, simple, and inexpensive to substitute their Excel spreadsheet or the plethora of reports they must sift through in order to decide (Eckerson, 2006).



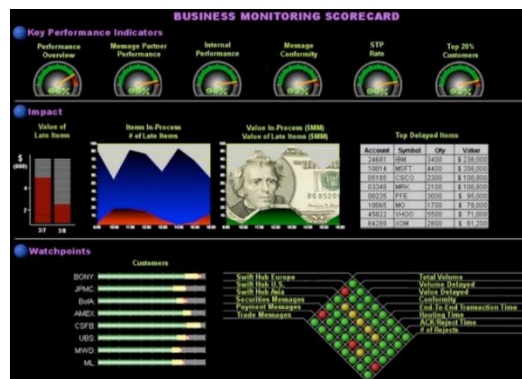
Source: Website of Axiom Systems



Source: Website of Primavera Systems



Source: Website of MIT



Source: Website of Bristol Technology



Source: Website of Aerity

Figure 3.3.2. Visually failed dashboard design examples (Few, 2012)

The second reason is because of the poor visual display in some dashboards. Few (2012) thought that This failure is mostly due to a lack of communication, which is exacerbated by bad design. The major issue with today's dashboards is that they convey too little. To put it another way, they aren't really insightful. According to him, a properly-built dashboard should give a clear and concise picture of what's going on. Also, dashboards aren't meant to show but to communicate. There is no substitute for straightforward communication, no matter how charming it is or how technologically advanced it is. Five failed dashboards are provided to illustrate.

### 2.3.3 Data visualisation

The idea behind adopting visualization tool is to help people read data quickly by from charts, diagrams, etc. as well as comprehend and derive insights from them. It could be used to identify patterns, trends and correlations in textual data and make them visible using visualisation tools (Brush & Burns, 2016).

Images, charts, graphs, scatter plots, data tables and even more complex visual displays such as infographics, sparklines, heat maps, geographic maps, dials and gauges are examples of diverse styles of visualisation. Data visualisation, in addition, can be regarded in study to be classified into 3 parts: qualitative or quantitative data, findings in a picture, and understandable by viewers (Azzam, et al., 2013).

From the article by Azzam, et al. (2013), qualitative and quantitative data are two distinct ways of visualising information. Quantitative data, such as geographic coordinates or quantified code, are used to express info in graphs. Besides, images, video and audio recordings are commonly used to display qualitative data. The rationale for the two sorts of visualisation approaches and picking which to employ is that it can provide a clearer understanding into the data that they carry. However, about the outcomes in an image, this is to guarantee that the potential of visual display does not fail to contain information, as this might damage the findings in what being sought to get from the data. Therefore, it is critical to examine for duplicated input that might lead to erroneous information and always make sure that the visual display is readable. The article's authors also mentioned that the last standard – readable displays – is the most important because after all, the core goal of visualizing is to make it simpler for people to grasp information rather than reading large amounts of data.

Moreover, according to the conclusions from a book of Colin Ware (2019), visualisation frequently permits flaws with the data itself to become readily evident. This statement reinforces Azzam (2016)'s claim that visualisation can aid in the discovery of flaws in data. As can be noticed, Ware (2019) as well mentions the resemblance of how digital visual approaches might be utilised to create a clearer picture of the information. The relation between the two writers yielded results that were comparable to what visualisation can offer. To summarise, visualisation may be used to make data simpler to comprehend and identify patterns and trends.

Additionally, elements need to build an ideal dashboard will be studied and discussed in Requirements' subsection 6.5, mainly based on the findings from 2 articles: Dashboard Design: Why Design is Important (Brath & Peters, 2004) and Perceptual Edge: Dashboard Confusion Revisited (Few, 2007) as well as my observation and experience.

#### ***2.3.4 How can various charts and graphs be used to effectively display various type of data***

When presenting various types of data for visualisation, the option of picking alternative charts, graphs, diagrams, etc. can be more effective. Line graph, pie graph, bar graph, histogram or scatter plot are examples. For illustration, an area chart, as presented in Figure 3.3.4a, can be used to display changes in statistics over time from many data sources. The red line depicts the present state of the business's sales numbers, whilst the grey graph depicts when they first began. Figure 3.3.4b depicts a bar chart. When attempting to compare given information, this graphic is usually applied. It depicts the tendency among the same types of information, allowing for a review of the activities performed on a daily basis (chartblocks.com, 2022).

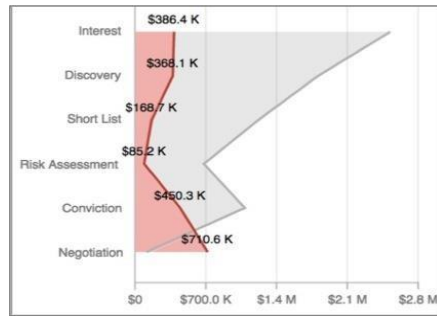


Figure 3.3.4a (chartblocks.com, 2022)

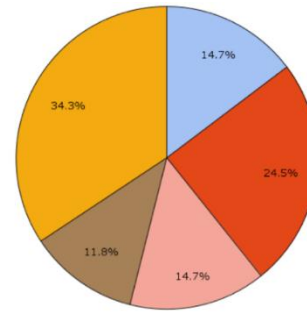


Figure 3.3.4c (howtogeek.com,

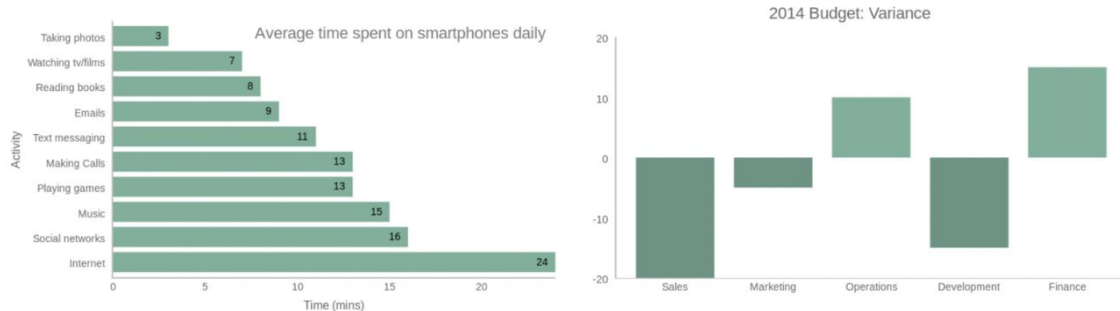


Figure 3.3.4b (chartblocks.com, 2022)

Furthermore, when showing figures for group comparison, bar charts are by far the most commonly used charts. The Y and X axes in this graph represent distinct measures. There are two types of bar charts: horizontal and vertical, depending on the size of your data. If a bar chart is drawn horizontally, as seen in Figure 3.3.4b, it indicates that it is using a bigger set of data. Vertical bar charts, on the other hand, would convey less data due to restricted space and may appear overcrowded (Okan, et al., 2012).

In contrast, pie charts differs from area and bar charts because they do not need an X and Y axis and are better suited for presenting fewer categories. It is frequently used to present data in percentages in circular slices. When the slices are comparable in size, as in figure 3.3.4c, this style of graph is more difficult to utilise for comparisons. The slices in sections 4 and 5 appear to be the same size. Although it is not extremely comprehensive, a pie chart can offer a rapid glimpse of data since it presents less data (Sabherwal & Becerra-Fernandez, 2013).

While some people may choose to visualise a graph over many rows, the decision of tables and charts is equally critical. However, a decent graph must have the X and Y axes, which generally indicate the category being displayed, such as time or sales, and make it simpler to understand what each figure represents. Also, all graphs should have a label that summarises the information they show.

In short, the goal of visually displaying your information is to get your message out and be comprehended as effectively as possible since any visualization of data that you create is only effective to the extent that it expresses to your target viewers what is intended (Sabherwal & Becerra-Fernandez, 2013).

## 2.4 Conclusions

The use of Information System (IS) in project management is a key to the development of a business. It can be seen from the Literature Review that there has been a growing number of businesses and organisations modernising their systems and processes to improve their performances and market value by adapting technology solutions. Bhattacharya, et al. (2005) believed that those Business Performance Management (BPM) solutions offered several advantages to company owners and organisation runners. There are several tools available to assess growth and guide the company down a profitable path, a performance dashboard application might be viewed as an excellent way to satisfy those needs as it can transform data into valuable information and constructing meaning of it in order to make better decisions. Communication, monitor & adjustment of the execution of strategy and insight and information delivery are the three primary benefits from dashboard (Few, 2012).

The Literature Review also discovered two major explanations for dashboard failure, which are the unnecessarily complex design of dashboard and overpriced/unaffordable cost for businesses that are not ready or need it yet. These findings are incredibly valuable and serve as a baseline for this project to specify criteria and requirements, resulting in a more successful completion.

Furthermore, the data types and visualisations contained in the dashboard's design interface are given special consideration in this project. As a result, the following research were studied. Data visualisation is divided into three categories in research: qualitative or quantitative data, results in an image, and understood by viewers. According to Azzam et al. (2013), qualitative and quantitative data are two separate methods of displaying information, which help better understanding and detecting about patterns and trends.

Overall, this Literature Review not only enables to consolidate knowledge from dashboard-related research, but it also has a significant impact on the project's later phases. I understand the market's demands, from which I may derive specific requirements that my project must meet, and I apply that understanding in project design.

### 3 Product Research

#### 3.1 Introduction

“Analytics is the primary enabler to derive truth and meaning from data that drives the business growth” says Hugo Moreno, as quoted by Forbes (SelectHub, 2019). A BI dashboard is a data management tool that employs data visualisation to present KPIs (key performance indicators) recorded by a company or organisation to examine various factors while producing actionable insights (datapine.com, 2022). There are a wide range of standards for a dashboard development, which means a great range of comparison and discussion helpful for my project. However, I will focus only on web-based applications. Despite having difficulty in finding equivalent existing products as there is mostly demos or products with a price to be paid, 3 dashboard software, which are available and selected as Leaders in the market, will be studied respectively: Power BI, Tableau and QlikView.

#### 3.2 Review of similar products or platforms against a set criteria for Usability purpose.

##### 3.2.1 Microsoft Power BI

###### Overview

Power BI was developed by one of the Big 5 giants in technology fields – Microsoft – in July 2011 and known as a business intelligence-focused interactive data visualisation programme (Microsoft.com, 2016). Power BI is a platform for online and cloud-based analytics and data visualisation that work together to transform disparate data sources into coherent, visually engaging, and interactive insights. Power BI also includes integrated visualisations, trend detection, bespoke reports, and SQL Server Analysis Services. According to Stevens (2022), Power BI's Q&A interface is one of its distinguishing characteristics, with which user can query to scour particular data and the Power BI engine will give the answer using recommendations, rephrasings and autofill. In short, makes it simple to connect to data sources, visualise and find what's essential, and share it with anyone or whomever as desire.

###### Features

- Extensive graphical representations created from complicated business intelligence data.
- Ad-hoc Reporting
- Outstanding Navigation Pane
- Comes with a selection of customisable dashboards.

###### Usability

- Reports can be imported quickly to any dashboard
- Easy collaboration among coworkers
- Users may examine data by asking questions using the Q&A inquiry button
- Deep connectivity with other Microsoft services, eg: Azure SQL database or Azure Tables
- Cloud-based file storage that allows a user to view files in Excel, Office,

PowerPoint, and other software

- A REST API for creating dashboards, reporting, and integrating third-party apps with Power BI
- Excellent notification and commenting system

###### Limitation

- No direct interface for services such as Vend POS or Shopify
- Graphical visualisation is quite restricted in comparison to other BI tools
- SQL queries are not supported
- Working with large data sets is rather tough
- Users are not permitted to create scheduled reports, personalised user views, personalised notifications, personalised security views, or customisable reports.

### 3.2.2 Tableau

#### Overview

This tool was released in 2003, ten years before Power BI, and it now offers the finest visualisation capabilities with a superb front-end graphical user interface (Bansal, 2019). Tableau assists us in converting raw data into relevant insights and creating visually appealing dashboards for our data. It also contains certain built-in analytics modules that can be used directly on data, as it allows its users to construct app objects, configure dynamic graphics, and transmit reports and documents to other users over the web.

#### Features

- Convenient drag-and-drop function
- Share data via Tableau Public
- Incorporate collaborative data visualisations through the web
- Could and consistent output
- Work with enormous volumn of data
- Integrate dashboards into current systems like Salesforce, SharePoint, and Jive
- Great drag-and-drop functionality makes it simple to use data and generate graphics to identify trends with just few clicks
- Capability to utilise numerous filters and compute their results on the fly

#### Usability

- Support large numbers of data source, both on-premises and in the cloud, eg: Redshift, Cloudera Hadoop, SQL Server, Salesforce, Google Analytics & Google Sheets, MongoDB, PDF files, spatial files, Dropbox, Amazon Athena, and many more are all supported (Sphere Partners, 2022)
- Simple shifting among extracted data and live connections
- Tableau Server and Tableau Online work together securely to exchange and iterate on crucial findings

#### Limitation

- Data encryption and multiple locations are not supported
- Users are not permitted to share datasets, and a separate subscription package is required
- Integrations and other Could-level activities necessitate IT assistance. Users cannot accomplish this on their own utilising tutorials or self-help videos

### 3.2.3 Qlikview

#### Overview

QlikView, a data exploration and analytics tool, extracts data insights from enormous amounts of data. It debuted in 1993, long before the world was introduced to data-driven decision making (Y & Vaidya, 2022). It is also promoted as a possible rival as an efficient big data solution since it can integrate with various data sources at the same time (Bansal, 2019).

#### Features

- Ability to link data from huge sources to the Qlik view in-memory dataset
- Ability to do business discovery and visual analysis via direct discovery
- Ability to engage with real-time apps and dashboards
- Has a Google-like search engine
- Handle all data linkages and provides data in a green/white/grey colour scheme
- Support for KML in map visualisations

#### Usability

- Its unique learning algorithm, which automatically maintains data relationships, distinguishes it from other BI applications. In contrast to query-based tools, Qlik's inference engine (known as the Qlik Associative Engine) automatically



manages data relationships (Sphere Partners, 2022)

others (Sphere Partners, 2022)

#### Limitation

- Reveal data associations using QlikView's graphics; for example, important data will be detected and displayed in a bright hue, while irrelevant data will be coloured in grey
- Enable users to communicate with and study complex computations generated by third-party engines like as R, Python, Matlab, Spark, and
- OLAP is not supported
- Unable to anticipate the profitability of projects
- Unable to arrange the receipt of BI reports at specified times and in a specific format
- Difficulty in identifying patterns in data
- No ad hoc reporting functionality

### 3.3 Comparing of similar products or platforms against a set criteria for Usability purpose.

#### 3.3.1 Table of comparison

	Power BI	Tableau	QlikView
<b>Datan visualisation</b>	Good	Outstanding	Good
<b>Data analysis</b>	Outstanding	Good	Outstanding
<b>Embedded analysis</b>	Outstanding	Good	Good
<b>Document management</b>	Outstanding	Outstanding	Outstanding
<b>Insight &amp; reporting</b>	Good	Outstanding	Good
<b>Data integartion</b>	Outstanding	Good	Good
<b>Data literacy support</b>	Good	Good	Outstanding

#### 4.3.2. Explanation

##### Data visulisation

Power BI provides a comprehensive variety of visuals. However, described by 2018 Gartner's Magic Quadrant for Business Intelligence and Analytics Platform as "the simplest to use tool among the leading BI vendors" (Bansal, 2019), it means Power BI has a limited visualisation in filtering and exploration. Besides, Qlik is a self-service analytics platform with in-memory data storage engine. Thanks to that, it delivers dynamic visuals. Also, Qlik displays KPIs through various visuals and charts. Its video player visualisation allows you to seamlessly insert YouTube videos into Qlik Sense applications. However, in the Qlik vs Tableau competition, Qlik Sense falls behind since it lacks dashboard and report layouts, despite providing animations out of the box (OOTB). Compared to Power BI, Dashboard Starters in Tableau is more convenient for users by automatically constructing dashboards after connecting to common sources. In short, Tableau offers a complete and user-friendly visual experience and is the market leader in data visualisation.

##### Data analysis to support decision making

Tableau has MATLAB, R and Python for analysis that is completely integrated. It also involves techniques for clustering and forecasting. On other hand, Power BI employs expectation-maximization (EM) methods and K-means. Forecasting is performed using predictive modelling, despite the fact that the solution only supports simple linear regression. However, Power BI does not support PMML (Predictive Modeling Markup Language) for predictive model import/export but Qlik does as it connects to the KNIME Analytics Platform. Through its R plugin, QlikView provides bi-variate linear analysis and forecasting. Plus, a third-party addon, the Vizlib Line Chart, enable to forecast trends and opportunities based on historical and near-real-time data (Kaur,

2020). Compared to Tableau, PowerBI and Qlik are stronger in analysis.

#### Embedded data and analysis

Embedded analytics, also known as white label analytics or OEM, provides users with access to portals and processes, allowing them to make faster choices. With a flexible platform and accessible APIs, users are able to integrate analytics throughout the organisation. Power BI provides immediate access to insights by embedding dashboards, interactive reports, and tiles into an application. With site admin controls and REST APIs, Tableau's users can configure the view, user login, content, and displays. Meanwhile, by incorporating a single client sheet as-is onto a website, QlikView provides report viewers with access to it. Custom analytics systems can well be built with nebula.js for better backend control. From the above, Power BI takes the winner's spot.

#### Document management

In terms of document management, these BI platforms are equal. All the solutions can easily convert reports into numerous formats.

#### Insight and report

According to Kaur (2020), although all three products let you deep-dive into business assets with canned and ad hoc reporting, Tableau is outstanding thanks to its Ask Data feature, which uses natural language querying, enables quicker analysis and reporting.

#### Data integration

Despite the lack of SAS connectivity, Power BI outperforms Tableau and Qlik Sense due to a greater number of source and third-party connectors: It seamlessly integrates with a wide range of existing analytics resources, both on-premises and cloud-based, particularly Microsoft products. It supports Apache Hive, Databricks Cloud, Hortonworks, Pivotal HAWQ, Google BigQuery, etc. and also gathers data from Google Analytics, MySQL, Oracle, Salesforce, MailChimp, Facebook, Zendesk, and other sources (Kaur, 2020).

#### Data literacy support

Understanding how to investigate and share visual data tales is what data literacy entails. Qlik takes the lead as its self-service tool helps users readily uncover insights, including the ability to generate their own reports using drag-and-drop functionality.

#### **4.3.3. Conclusion**

In terms of the features described above, Microsoft's Power BI outperforms the other 2 competitors: Tableau and QlikView. Resulted from the research in this section, I will be able to specify the functional and non-functional requirements, build up a comprehensive picture of design and implementation and finally to know should be approached, what should be avoided in my project.



## 4 Legal, Social, Ethical and Professional Issues and Considerations

Following the legal consideration stated by Soghoian (2008), the target's reputation is harmed as a result of the confused trademark. Therefore, any organization or enterprise uses a similar dashboard without being able to prove it belongs to their intellectual property will face legal issue regarding trademark and copyright. Furthermore, confidential data, information related to employees and customers, transaction information and management plans, etc. being disclosed, attacked or stolen will also lead legal problems related to information security.

As dashboard is accessible only to those who are relevant and have the authority to manage organization/enterprise information, therefore, it is not as vulnerable as other types of information found on public sources (i.e. websites, social media, etc.) Once data breach happens, both customers and company will be affected no matter who causes the leakage. Confidentiality agreements are required for everyone who can access and work with the data. Data leaked or published without consent is not only related to legal but also ethical issue.

Automated workloads will reduce the number of workers, require Coulder knowlege employees to work with new technology or the company has to train their staffs, which is also a concern in today's society. Dashboard provides new possibilities on business performance but also raise the risk of uncontrolled data leakage. Therefore, besides delivering smooth functions, it is also necessary to have clear information security and data privacy policies for the company's professional issues.

About my project, it is a simple webpage operated internally and not uploaded to any web server. Along with that, this is a personal project that is guaranteed not to infringe any intellectual property rights. Moreover. The data appearing in the project is completely created manually and randomly. Therefore, legal matters regarding confidential or sensitive information will not be a concern. In term of social and ethical issues, each and every component in this project is created for academic purpose only and is not stemming from malicious purpose. This project will also be guaranteed that there will be no components against social, cultural, or political standards.

## 5 Requirements

### 5.1 Analysis of requirements

In order to complete the design phase and progress to product development as wanted and planned, requirements must be analysed to capture as many functionalities as possible while also removing any redundant or clashing functions that may have been documented because the majority of failed projects have indeed been attributed to insufficient system requirements analysis. This section is mainly based on Section 4: Product Review to document and comment about products in relation to my project to gain a better perspective of the current standard so as to draw a comprehensive picture of design/prototype and implementation. In addition, observing from the way they present their contents, features, structures and layout of a dashboard, I will have an idea of what to be addressed and what to be avoided, of functionalities and non-functionalities needed.

The requirements is divided into 2 parts: functional requirements (FR), which explain what my final product is expected to achieve, and non-functional requirements (NFR), which show how it will perform and any limitations that may emerge. Following the formation of these requirements, they will be categorized using the MoSCoW method to find the most critical features that should or would be implemented. In addition, MoSCoW method is briefly explained in the next section 6.2.

### 5.2 MoSCoW Prioritisation of requirements

The MoSCoW method prioritise the requirements to be classified into "Must have", "Should have", "Could have" or "Would have" in terms of providing top priority to the most critical requirements, assuring that they are done on time and therefore guaranteeing the project's completion. Prioritizing features helps to control the project and pinpoint low priority features such that they may be removed or deferred if they are intractable due to time limits, minimising the possibility of missing important features necessary for the project's success. "Must have" requirements are prioritised and therefore must be supplied as quickly as feasible, while "Should have" are second priority and therefore should be implemented if time and financial resources are enough, after the "Must have". "Could have" requirements are regarded desirable features that could be added to improve the project but have no bearing on the final completion of the project. This method gives the project with a backup plan in case time becomes an issue.

### 5.3 Functional requirements

Functional requirement	Priority
Dashboard will be presented with essential high-level data.	Must
Dashboard will show goals and report statistics of changes, sales or deals over time.	Must
Dashboard will be adaptive to multiple size of screens. For example: Computer screen, laptop screen, tablet screen, phone screen, etc.	Must
User will be able to analyze the information via diverse charts provided by the dashboard, such as bar chart, line chart, pie chart, carpet chart, donut chart, etc.	Must
User will be able to produce chart with given data (with Plotly)	Must
User will be able to download chart, zoom in and out, view detailed data when hovering at chart, etc.	Must
Dashboard will display the latest data (nearest 6 months)	Should

### 5.4 Non-functional requirements.

Type	Non-functional requirement	Priority
Operation	Dashboard should support multiple users at the same time.	Could
Performance	Dashboard should perform each function or user's action (loading, request, response) within seconds.	Could

Usability	Dashboard should be user-friendly and user-centric with simple and consistent interface.	Could
Usability	Dashboard should have a well-designed and easy-to-understand navigation through pages.	Could
Usability	Dashboard should provide: <ul style="list-style-type: none"> <li>- Access to manage information, privacy, security;</li> <li>- Instruction for advanced actions with “help”, “FAQ” pages;</li> <li>- Updates about new version.</li> </ul>	Could
Design	Dashboard should have a consistent colour scheme, typography to not cause visual discomfort for user.	Could
Accessibility	Dashboard should be run from any browser or platform.	Could
Reliability	Dashboard’s functionality should be carried out as precisely as possible.	Could
Fault tolerance	Dashboard should be continue to run normally, although at a lower level, when any component fails.	Could
Extensibility	Dashboard be able to extend and improve over time, enable for the addition of new features as well as the updating of current ones.	Would
Security & Privacy	Dashboard should provide some level of protection in relation to personal data.	Would
Culture and politics	Dashboard should not have any element that conflicts with culture or politics	Would

## 5.5 Additional design requirements based on literature review

Along with the main ideas mentioned in Literature Review (section 3.3.2 and 3.3.3), a dashboard is a visual representation of the most critical information required to achieve one or more objectives, aggregated and displayed on a single screen for easy monitoring (Few, 2007). Hence, there is some specific requirements for effective dashboard design:

- Make sure dashboard’s content does not extend beyond the confines of a single screen;
- Make sure dashboard provides proper context for the data and display media;
- Make sure dashboard highlights what is important;
- Make sure dashboard does not clutter with extraneous decorative elements;
- Make sure to understand the uses and limitations of color, to not overuse or misuse.

## 6 Design

Design is the first phase in of this project's dashboard development, following the analysis of research findings and the identification of requirements. The design phase is essential as it is the phase that focuses with the website's appearance rather than its functionality or performance. Even more, this phrase makes sure that the product is outward attractive and provides a good initial impression for users.

**Approach:** I began the design phase by collecting examples from current leading dashboards and analyzing them. However, since my main focus is to create just a minimalist, straightforward product in which statistics can be visually presentable via different type of charts, plots, tables, etc., the designs from those top dashboards are just too much for my ability. Realizing that, I turned to search for simpler templates from available sources online as well as incorporate my own ideas and try to comply with the requirements from the previous section. It took me approximate a week to complete my first satisfied sketch on paper. I find this to be the most time consuming step. Once I had the mockup, the remaining steps are relatively quick.

**Resources:** Designs are made up of useful tools:

- Sneakpeekit.com: Template for initial sketch
- Uizard.io: Tool to create low fidelity prototype
- Axure: Tool to create high fidelity prototype

In addition, the design knowledge I have gained from the module COMP1649 – Human Computer Interaction and Design as well as self-study from open sources online, especially from the Bootstrap library.

### 6.1 Visual design

#### 6.1.1 Paper-based design

The user interface (UI) is one of the most crucial attributes if the design and should be made in such a way that appeals to the vast majority of the targeted users. A well-designed app with the sensible colour theme, appropriate site map, proper layout will provide a comfortable and consistent user experience (UX). An optimum design is the initial stages in attracting consumers to look at a product. Therefore, in order to get an idea of UI/UX for this project, an app's freehand mock up was sketched.



Figure 6.1.1.a. Skete design

*Templates provided by [sneakpeekit.com](https://sneakpeekit.com). Mock-ups for other screen sizes can be found at appendix 11.2.1.*

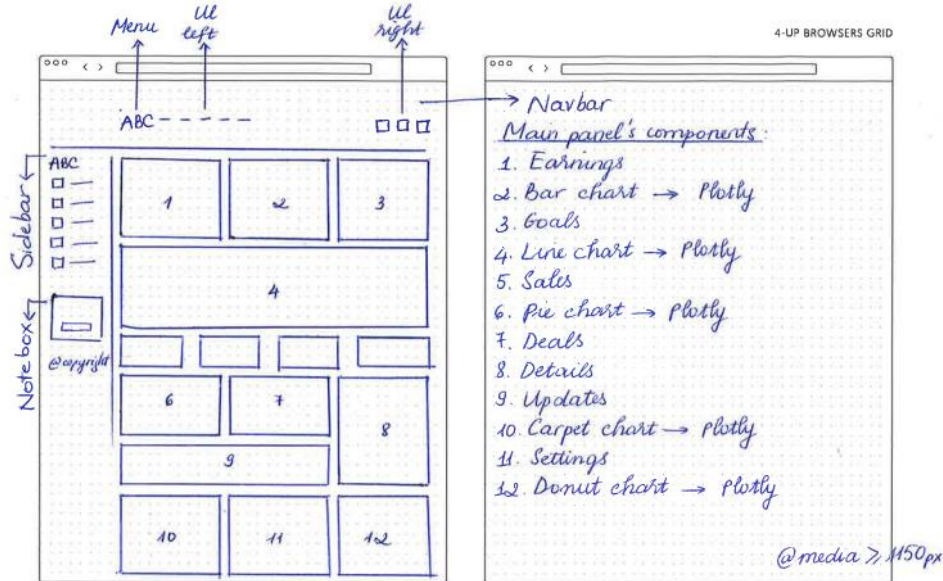


Figure 6.1.1.b. Sketch 1 – Large screen size

### 6.1.2 Low fidelity prototype: Wireframe design

After having a satisfied draft design and in order to emphasise the structure of the product rather than the appearance of the graphic, the following step is to create a more elaborate conceptual design, which offers a more throughout view and supports the final design. These wireframes depict page layouts, transitions, and fundamental functionality.

*Digital prototype created using [uizard.io](https://uizard.io).*

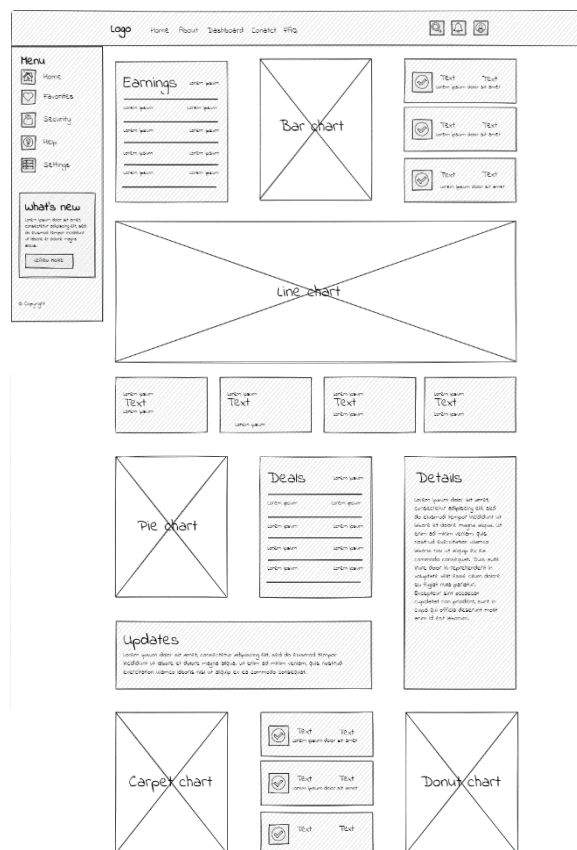


Figure 6.1.2. Wireframe

### 6.1.3 High fidelity prototype: Final design

A high fidelity prototy is used to determined if the UI is intuitive and interactive, to test hypotheses, to ensure that the design complies with different accessibility standards, to understand the design's flaws and hence to solve these flaws.

*Prototype created using Axure software. Prototype for other screen sizes can be found at appendix 11.2.2.*



Figure 6.1.3. Prototype

## 6.2 Navigation, layout, colour scheme, typography design

### 6.2.1 Navigation

An effective navigation assists user in browsing the site. A clear and easy-to-understand navigation



will not only improve the UX, gain their interest but also attract more other users. This site map was designed as simple as possible.

The final prototype is shown to have 2 navigation bar: the primary one and the secondary.

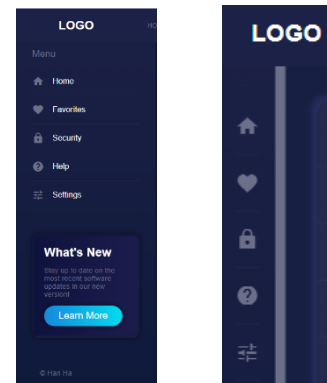
- Main information is displayed in the first navigation bar: Home, About, Dashboard (active site), Contact, FAQ. It can turn to a dropdown menu to adapt to small screen sizes.
- Extended information is displayed in the second navigation bar: Home, Favorites, Security, Help, Settings. It can turn to a collapsible sidebar for smaller screen sizes.



*Primary navigation bar*



*Primary navigation bar – Dropdown menu*



*Secondary navigation bar and its collapsible version*

*Figure 6.2.1. Navigation*

### 6.2.2 Layout

Rather than adaptive design, I chose responsive design for my proposed project product. This decision was made because the layout will interactively varied by adjusting to the dimension specifications of the various devices, divided into 3 main groups:

- Large: Screen that is equal or greater than 1150px (desktop, big laptop)
- Medium: Screen that is equal or greater than 800px (small laptop, tablet)
- Small: Screen that is less than 800px (small laptop, tablet)

*Prototype for other screen sizes can be found at appendix 11.2.*

Grid and spacing are also put on my concern as it is the base of every application design. A good grid will greatly improve the use of margins, padding and spacing.

*This will be covered in greater detail in section 7.2.2.*

### 6.2.3 Colour scheme

Selecting colour scheme is important for UI design. The impact of colours on the website's tone is significant. A colour may give users a feeling, which might have a psychological effect. Inappropriate colours may make a website look unattractive, monotonous, dull, or depressing. There are numerous colour theories, one of which is the complementary colour scheme. I have selected an analogous colour scheme for my design, which includes three colors on the wheel that are close to others: blue, yellow and white. Before coming to this decision, I experimented with another more neutral color palette. The reason for that choice is because I think it will provide a visual comfort to the user. However, as can be seen from the comparison below, the high contrast colors seem to be more eye-catching, more professional looking and obviously deliver a better UX.

*Appendix for the full list of colours used can be found at section 11.2.3.*



*Neutral color palette*



*High contrast colour palette*

*Figure 6.2.3. Colour palette comparison*

## 6.2.4 Typography and Icons

In graphic design, typography plays two major roles. The first is to improve readability aiding in communicating with users. The second is to create a overall tone and keep the website graphically balanced. A clean, easy-on-the-eyes design is aesthetically appealing and delivers an excellent UX. On the other hand, a design is cluttered, complicated, and leads us to strain our eyes, we should avoid it. Learning from these findings, this dashboard design will maintain a consistent font family of Helvetica, sans-serif.

Many UIs include icons that graphically represent things, actions, and concepts. They express the essential idea and intention of a product or function when done properly, and they provide a number of useful features to UIs, including as minimizing screen space and improving visual appeal. Icons used for this dashboard development are provided by Google Fonts web font source.

## 6.3 Conclusion

The knowledge gained during the study done on navigation, layout, colour scheme, and typography and icons was incorporated across the design process, from the mockup design to the final design with all requirements were met. Consistency and simplicity were kept across the site, which enables new users to familiarize themselves with the site. Additionally, in case users get lost on the site, a “Home” button in navigation bar and the link in “Logo” were created to help them navigate their way back to the main page. The navigation is pretty obvious, so the user won't have to read multiple paragraphs to figure it out. Icons are meant to be distinct so that the user can quickly recognise them.



## 7 Implementation

This section will go over the entire development of the proposed application – Performance Dashboard. Although this is not a fully functional product, the process involved a significant amount of reading, research, and implementation of new learning to create a real-life product. The application was developed using HTML5, CSS3 and JavaScript on Visual Studio Code source-code editor.

### 7.1 Review of technology

As the product of this project is mainly about front-end development (FEdev), therefore, it is essential to understand what FE dev is. GeeksforGeeks (2021) defined FEdev as a part of a website which the user has direct interaction with and includes text, pictures, graphs and charts, buttons, navigation bar and so on. By developing a FE product, it means to working on the structure, appearance, behaviour, and contents of everything that appears on any kind of screen displays, from a websites to a mobile application. It is a key point to ensure that the product is responsive, meaning that it can adapt properly on different screen sizes.

There are numerous languages for FEdev available today, each with its own set of benefits and drawbacks. The selection of languages to use leads directly to the quality of development process as well as the quality of UX. Mentioned above, my peoject will be using HTML, CSS and JavaScript to build a dashboard. Therefore, this section is to review and discuss the reasons why they were chosen instead of other languages.

#### ***7.1.1 HTML: Hypertext Markup Language***

HTML is used to create computer docs known as pages that can be found on the internet. Each page has several links to hyperlinks to other pages (Clark, 2022). HTML is free and simple to apply.

#### ***7.1.2 CSS: Cascading Style Sheets***

Just as its name, CSS is used to specifies the way a document is present to users in term of styling and layout. CSS is easy to understand and maintain, developer only needs to write once and CSS can be reused over multiple HTML pages.

#### ***7.1.3 JavaScript (JS)***

JS is a popular programming language that allows developers to add advanced functionality to web pages. It can be activated whenever a page performs a dynamic operation, such as displaying content updates, animated 2D & 3D graphics, interactive maps, video boxes, and other features (Clark, 2022). JS not only can dynamically reduce server load but also has rich UI features and functionality. For example, JS's sliders with drag-and-drop functionality.

#### ***7.1.4 Why HTML, CSS and JS?***

There are a variety of alternative languages that can be used to build FE projects, based on the platform. For instance, Flutter wirh Dart, React with JavaScript. Django with Python and several others. Firstly, They are the most widely used web development languages. Many frameworks, libraries, and other applications rely on them or their derivative components (Atakan Atamert, 2019). “They’re mandatory for front-end web development. They have no alternative in this area and have become standard”, stated by Maric (2019). Sharing a similar point of view, Simushi Jr. (2019) believe that there is no other way to structure a web page not using HTML whereas CSS can help enhance the aesthetic of that web page. Furthermore, a finding of Johansson (2022) that JS is best for web development. Let's do a comparison with Python, one of the most popular programming languages and another language that I was taught in university, it can be seen that JS is clearly better because Python is a backend server-side language, whilst JS can be operated on browser. Although Python is also used to build a website, it cannot be utilised entirely. Nevertheless, creating a website with Python is a difficult task. Even though frameworks such as Django and Flask available to do the job, Python is still not the optimal choice but JS.

## 7.2 Coding

### 7.2.1 HTML (*index.html*)

This is the step to create textual content that specify the layout of web pages, starting by declaring document type `<!DOCTYPE html>` and following a `<html>` tag, which will contain all the text content of the page divided by each layout element, such as `<head>`, `<body>`, `<footer>`, `<nav>`, `<section>`, `<aside>` and so on. *The structure of this entire html file is shown in the hierarchy chart, appendix section 11.3.1.*

```
<? index.html > ...
1  <!DOCTYPE html>
2  <html lang="en">
3  | <!-- All the page's content will be here! -->
4  </html>
```

In `<html>` tag, there will be 2 big tags, `<head>` and `body>`, which will serve the following functions:

- `<head>`: This tag is necessary but should only be used once. I called it right after `<html>` and closed before `<body>`. A `<head>` tag stores particular information about my dashboard page, also known as metadata. It also contains elements like the title (which is required), scripts or links to scripts as well as CSS files.

```
3  <head>
4  | <meta charset="UTF-8" />
5  | <meta name="viewport" content="width=device-width, initial-scale=1.0" />
6  | <meta http-equiv="X-UA-Compatible" content="ie=edge" />
7  | <link
8  | | href="https://fonts.googleapis.com/icon?family=Material+Icons"
9  | | rel="stylesheet"
10 | />
11 | <link rel="stylesheet" href="style.css" />
12 | <title>FYP Dashboard</title>
13 </head>
```

- `<body>`: This is the key tag of a whole html file that holds all of the information that appears on a page. For the page to display and be appropriately listed in search engines, it must be completely filled out. My body tag is made up of four smaller tags: navigation bar, side bar, main panel, and `<script>` tags.

```
14 <body>
15 | <!-- NAVIGATION BAR -->
16 > <nav class="navbar">...
69 </nav>
70
71 | <!-- SIDEBAR -->
72 > <nav class="sidebar">...
125 </nav>
126
127 | <!-- MAIN PANEL -->
128 > <main class="dashboard">...
350 </main>
351
352 <script src="https://cdn.plot.ly/plotly-2.4.2.min.js"></script>
353 <script src="https://cdnjs.cloudflare.com/ajax/libs/d3/3.5.17/d3.min.js"></script>
354 <script src="./main.js"></script>
355 </body>
```

Let's discuss about script tags before we get into main body design. `<script>` tag is used to incorporate a client-side script (JavaScript) and includes scripting statements via `<src>` attribute, connects toward other external script files. *As written in line 352-354.* Scripts can be examined as a page loads to control of making its contents. My script tags are also for dynamic changes of dashboard page's content.

To be able to grasp exactly what to do and to easily implement, I divided the main layout into 3 components respectively: Navigation bar (highlighted in blue), Side bar (in green) and last same main panel.

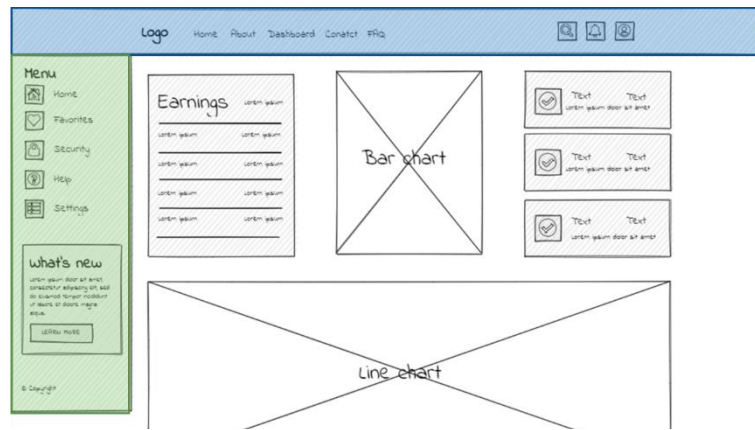
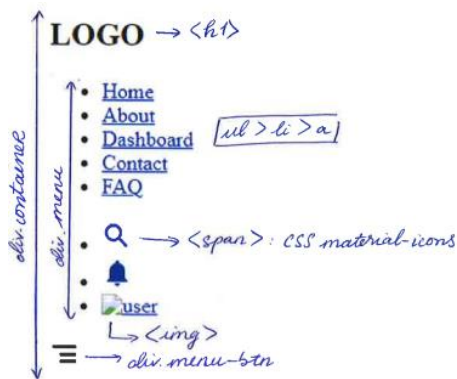


Figure 8.2.1. Dashboard's main layout

**Navigation bar (navbar):** This appears at the top of the page and may be expanded or collapsed based on different screen sizes (*section 7.2.4 will discuss this in details*). Navbar enables user/viewer to gain access to different pages by giving navigation links.



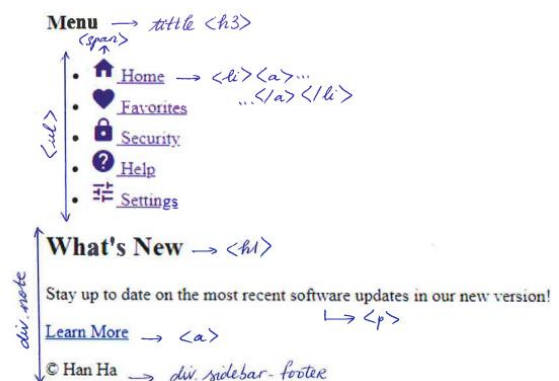
As seen above, here is the complete structure of the navbar section created in the html file with some handwritten notes. The entire content is placed inside the div.container tag, which ensures a logical structure for page's document, helps separate HTML pages into parts to make them easier to read for both developer and user/viewer.

To optimize document design as well as make styling with CSS faster, I divided it into 3 main parts: Logo, menu tabs and options. There is also an extra section menu button (div.menu-btn) that will be hidden and only shown to

accommodate smaller screen resolutions, this is called responsive, which will be adjusted in the CSS file.

- Logo: I tried designing the logo and adding the html as an image, but because I couldn't choose a good logo, I decided to replace it with the text in `<h1>` tag.
- Menu tabs (left side): Tab menus that navigate the user to each of the different pages are created within a single `<ul>` tag, including `<li>` subtags. To link to each page, the `<a>` tag is used.
- Options (right side): This section is quite similar to the tabs menu, but there are two more tags: `<span>` for icons, which will be extended in the CSS file and `<img>` for images (dashboard's user avatar).

**Side bar (sidebar):** Following the navbar is the sidebar, which has similar content and structure. I will focus only on the note box (div.note). Based on the sketch design, a note box appears to notify the user when the dashboard has a new update. If the user needs to update, they will choose to click the "learn more" button. Nothing changes, the button will be created with the help of CSS via the `<a>Learn more</a>` tag.



**Main panel (main.dashboard):** Although the main panel is the main and most important part of this dashboard product, its html part is not so special to come. The content is based on the outline design and placed in different tags with each suitable purpose.

### 7.2.2 CSS (style.css)

The dashboard product development of this project focuses more on the front-end than on functions and databases. Therefore, CSS styling and layout for this project took longer than in HTML and JS. However, to use my time more efficiently and efficiently, I have reused patterns.



Figure 7.2.2. style.css

Highlighted in yellow colour, the *div.panel.list* and *div.goal* are each used twice in this dashboard.

- *div.panel.list*: Used for Earnings and Deals
- *div.goal*: Used for Goals and Settings

They are exactly the same in terms of layout and styling, only the content is generated in index.html.

Highlighted in blue colour, the *div.text.text-vertical* (Details) and *div.text.text-horizontal* (Updates) also share many similarities in design. However, I do not reuse them completely, but adjust them to the best fit to create the product closest to the design. The difference lies in their grid system, or I call it span, which is defined by two CSS properties, *grid-row-start* and *grid-column-start*.

```

312 .text-vertical {
313   grid-row-start: span 2;
314 }
315
316 .text-horizontal {
317   grid-column-start: span 2;
318 }

```

The grid system section of Details and Updates also has other changes to accommodate a variety of screen sizes. This will be discussed in more detail in the section Responsive Design (7.2.4).

```

37 /* width */
38 ::-webkit-scrollbar {
39   width: 10px;
40 }
41
42 /* Track */
43 ::-webkit-scrollbar-track {
44   background: #0c1839;
45 }
46
47 /* Handle */
48 ::-webkit-scrollbar-thumb {
49   background: #6b6f8a;
50 }

```

Scroll bar design: A vertical bar on the right side of a window that enables users to scroll the content of in the main panel up and down.

Line 38-40: Set width for entire scrollbar with *::webkit-scrollbar*

Line 43-45: Set colour for the track (progress) bar with *::webkit-scrollbar-track*. Also known as the background of the scrollbar.

Line 48-50: Set colour for the draggable scrolling handle.

### 7.2.3 JavaScript (main.js)

JavaScript is a versatile programming language that may be used to do a variety of tasks on a website. For instance, it is responsible for the site's overall interaction, user engagement and functionality. Image slideshows, pop-ups, site navigation mega menus, form validations, tabs, accordions, and other complex UI components are all feasible with JavaScript (Schroeder & Sugiura, 2018). In my project, JS is mainly used to create charts, charts' effect and functions for adjusting charts. This section, therefore, will explain that implementation.

Section 7.2.1. briefly mentioned about linking libraries and JS files:

- **Plotly:** creates different scientific charts from graphic visualization online libraries.
- **CDNjs:** for the fast transmission of resources required for displaying content, such as HTML pages, JS files, CSS stylesheets, and other media: photos, clips, etc.

```
352 <script src="https://cdn.plot.ly/plotly-2.4.2.min.js"></script>
353 <script src="https://cdnjs.cloudflare.com/ajax/libs/d3/3.5.17/d3.min.js"></script>
354 <script src="./main.js"></script>
```

index.html

JS files begin by declaring variables and constants with the element and its methods. Because there is no need to alter the value of the variable throughout the programme, I used the *const* keyword to assign value to variable. This keyword is available in JS ES6 and higher. For example with line 2, element is *menu*, variable is *document*, data type is *Document*, method is *.querySelector* where string is *.menu*.

```
JS main.js > ...
1 //Get The Elements
2 const menu = document.querySelector(".menu");
3 const menuBtn = document.querySelector(".menu-btn");
```

After getting the necessary elements and before getting into the implementation of the charts, here are a few short lines to activate the navbar menu by clicking the Open/Close button. This goes hand in hand with the responsive design of the dashboard. When opened to a small screen, such as a tablet or phone, the interface to respond to that screen is designed to be more minimalist, the text can be replaced with icons or hidden by CSS styling. Open/Close buttons are used to reveal hidden information. The *.addEventListner* method will wait when the user clicks on the *menuBtn* to deactivate the *.toggle* method. Toggle method works based on boolean value (true or false): Remove *menu* if it is true and add it if it is false, or vice versa.

```
5 //Toggle the navbar menu on click Open/Close
6 menuBtn.addEventListener("click", () => {
7   menu.classList.toggle('nav-toggle');
8 });
```

```
.navbar .container .nav-toggle {
  height: 16em;
}
```

style.css

Step into the main job of this JS file is to create charts and functions for them:

```
107 // Pie Chart
108 const pieChartData = [{
109   values: [19, 26, 55],
110   labels: ['March', 'April', 'June'],
111   type: 'pie'
112 }];
113
114 const pieChartLayout = {
115   paper_bgcolor: '#172042',
116   plot_bgcolor: '#172042',
117   piecolorway: ['#f0a500', '#03dcee', '#178add'],
118   showlegend: false,
119   margin: {
120     l: 10,
121     r: 10,
122     b: 10,
123     t: 10,
124     pad: 1
125   },
126   height: 300,
127   width: 300
128 };
129
130 Plotly.newPlot('pieChart', pieChartData, pieChartLayout);
```

```
132 // Donut Chart
133 const donutChartData = [{
134   values: [10, 40, 50],
135   labels: ['Sep', 'Oct', 'Nov'],
136   hole: .4,
137   type: 'pie',
138 }];
139
140 Plotly.newPlot('donutChart', donutChartData, pieChartLayout);
```

**Creating pie chart:** Declare constants with properties and data types.

*const* name = {property1: datatype, property2: datatype, and so on};

where, data type can be string, number, boolean, array, etc.

**Plotting pie chart:** After creating, I will plot the table with function:

```
Plotly.newPlot(graphDiv, data, layout);
```

**Creating donut chart:** The reason in different chart types (bar chart, line chart, pie chart, etc) I choose to interpret pie chart and donut chart because they share many similarities, donut chart inherits many properties from pie chart in term of layout as can be seen in the code above.

### 7.2.4 Responsive design

Responsive design, which is as essential as the user interface (IU) in [section 7.2.2](#). CSS, contributes greatly to user experience (UX) and allows devices to have easy access to it. According to DevriX (2021), a good responsive design will guarantee that the design will run smoothly throughout all screen resolutions and sizes, resulting in a stunning appearance on all devices. It also prevents the need to manage separate mobile and web versions, saving time, money and labour.

I divided it into 6 different screen sizes as followings:

**Table of different screen sizes**

		span					
		navbar	sidebar	panel	sales	details	updates
@media ≥ 1150px	Large	full	full	3	4	x=2, y=1	x=1, y=2
@media ≤ 1150px	Medium large	full	full	2	2	x=1, y=2	x=1, y=1
@media ≤ 1050px	Medium	full	collapsed	2	2	x=1, y=2	x=1, y=1
@media ≤ 800px	Medium small	collapsed	collapsed	2	2	x=1, y=2	x=1, y=1
@media ≤ 750px	Small	collapsed	collapsed	1	1	x=1, y=1	x=1, y=1
@media ≤ 700px	Small	collapsed	collapsed	1	1	x=1, y=1	x=1, y=1
@media ≤ 400px	Small	collapsed	collapsed	1	1	x=1, y=1	x=1, y=1

With x: vertical span, y: horizontal span

Navigation bar and side bar: [See figure in section 6.2.1](#).

Main panel (main.dashboard):

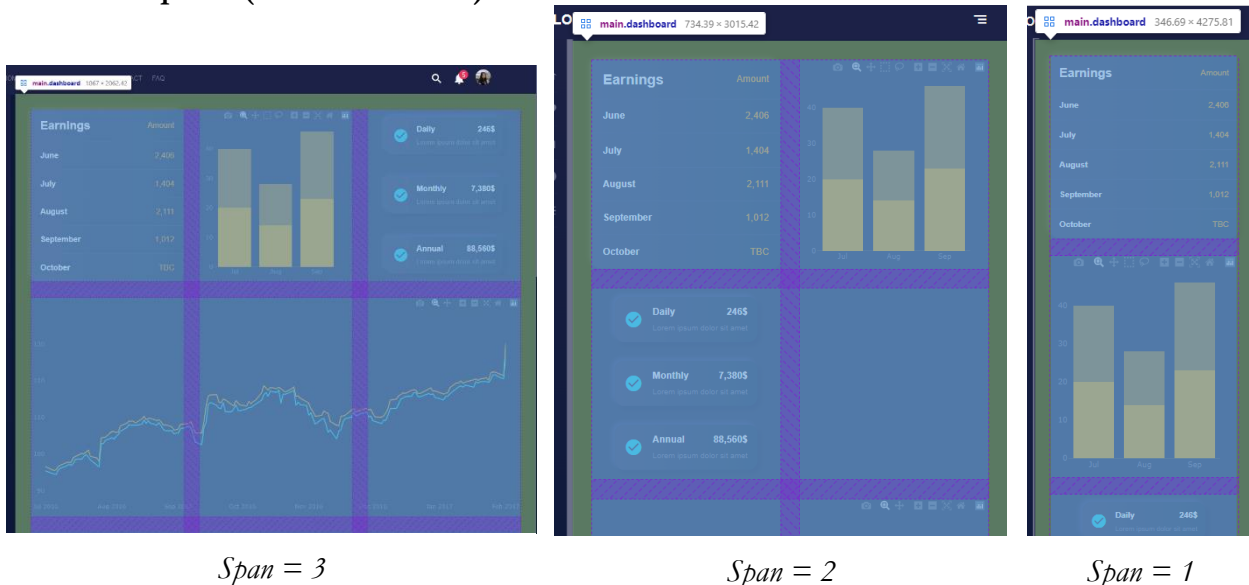


Figure 7.2.4. Responsive design of main panel with large, medium and small screensizes.



Sales (div.sales), Details (div.panel.text.text-vertical) & Updates (div.panel.text.text-horizontal): *See figures in Appendix, section 11.3.2.*

### Codes:

```

357 @media screen and (max-width: 800px) {
358   .navbar .container {
359     display: flex;
360     justify-content: space-between;
361     align-items: flex-start;
362   }
363   .navbar .container > div {
364     grid-template-columns: 1fr;
365   }
366   .navbar .menu {
367     flex-direction: column;
368     align-items: flex-start;
369     height: 0;
370     overflow: hidden;
371     transition: 0.7s;
372   }
373   .navbar ul:nth-child(1) li {
374     display: block;
375     margin: 1em 0;
376   }
377   .navbar ul:nth-child(1) li:nth-child(1) {
378     margin-top: 1.5em;
379   }
380   .navbar ul:nth-child(2) li:nth-child(1) {
381     margin-left: 0;
382   }
383   .navbar .container .menu-btn {
384     display: inline-block;
385     cursor: pointer;
386   }
387   .navbar .container .menu-btn span {
388     font-size: 1.7em;
389   }
390   .navbar .container .nav-toggle {
391     height: 16em;
392   }
393 }

```

Let's take screen size less than or equal to 800px, let's call it medium small, as an example.

@media is used to define a media query that will be applied to the page if and only if the media query fits the devices where the contents is displayed. After calling the elements (.navbar, .container, etc.), we modify their properties (display, justify-content, align-item, etc.) to adjust to a specific screen size. Inheritance and *n-th child* selector are also applied a lot and are very effective in this.

Besides changing the grid structure, the design of the navbar is also modified. First hide the full tabs menu (lines 366-372: *overflow: hidden;*), then activate the menu button *menu-btn* so that when the user clicks on it (JS function: *.addEventListener()*), a colapsible menu toggle will appear. This function is linked and programmed in JS file *main.js* (see the code in section 7.2.3., line 2-8)

The figure on the left is an excerpt of the responsive design code for medium small screen size.

## 8 Testing

*See belows as well as Table of Test Cases in Appendix section 11.4.*

Functional requirement	Result
Dashboard will be presented with essential high-level data.	✓
Dashboard will show goals and report statistics of changes, sales or deals over time.	✓
Dashboard will be adaptive to multiple size of screens. For example: Computer screen, laptop screen, tablet screen, phone screen, etc.	✓
User will be able to analyze the information via diverse charts provided by the dashboard, such as bar chart, line chart, pie chart, carpet chart, donut chart, etc.	✓
User will be able to produce chart with given data (with Plotly)	✓
User will be able to download chart, zoom in and out, view detailed data when hovering at chart, etc.	✓
Dashboard will display the latest data (nearest 6 months)	✗

➔ **Most requirement are met.**

Type	Non-functional requirement	Result
Operation	Dashboard should support multiple users at the same time.	✓
Performance	Dashboard should perform each function or user's action (loading, request, response) within seconds.	✓
Usability	Dashboard should be user-friendly and user-centric with simple and consistent interface.	✓
Usability	Dashboard should have a well-designed and easy-to-understand navigation through pages.	✓
Usability	Dashboard should provide: <ul style="list-style-type: none"> <li>- Access to manage information, privacy, security;</li> <li>- Instruction for advanced actions with "help", "FAQ" pages;</li> <li>- Updates about new version.</li> </ul>	✓
Design	Dashboard should have a consistent colour scheme, typography to not cause visual discomfort for user.	✓
Accessibility	Dashboard should be run from any browser.	✓
Reliability	Dashboard's functionality should be carried out as precisely as possible.	✓
Fault tolerance	Dashboard should be continue to run normally, although at a lower level, when any component fails.	✗
Extensibility	Dashboard be able to extend and improve over time, enable for the addition of new features as well as the updating of current ones.	✗
Security & Privacy	Dashboard should provide some level of protection in relation to personal data.	✗
Culture and politics	Dashboard should not have any element that conflicts with culture or politics	✓

➔ **Require more improvement in the future.**



## 9 Evaluation

This section presents an overview of the project and a critical assessment of the dashboard's accomplishment. This is also a place to discuss the problems and concerns that arose throughout the product's development.

### 9.1 Review of project process

Project process review covers the entire process from start to finish: Research, Requirements Gathering, Design & Implementation, and Testing.

I had made a plan in place for everything throughout the project, including fulfilling timelines for each phase. *The gantt chart for the plan can be found in Appendix section 11.5.1.* Although it must be admitted that everything was completed not very close to the set timeline, the final result of each phrase was quite satisfying.

**Research:** The research phase went smoothly. Followingly, the approach/framework was chosen since this is a crucial first step before moving onto another phase. My first choice was the Agile framework and I stick with that. However, after considering many aspects, the final method for this project was decided to be the Waterfall method. Because of that and combined with the plan in the Gantt chart, the tasks are guaranteed to be completed in sequence. There was also extensive studies analyzing designs with comparable applications, which provided a far better insight of what users want.

**Requirement gathering:** This phrase also went off without a hitch even though it was quite time-consuming. To account for this, I have invested a lot in this stage because I believed it had a direct influence on the whole process behind. Studies on all possible topics, from Literature Review to Oproduct Research, were done thoroughly and done well. They greatly supported my final decisions about UI design and data visualization functions.

**Design and Implementation:** This phrase was been greatly accelerated as a result of sequential working adapted from Waterfall method and a clear specification of requirements from Research phrase.

**Brief conclusion:** the project went as expected. It had some setbacks, but that's why there was plenty of time built into the plan to address any concerns.

### 9.2 Review of project product

This part will evaluate the quality and value that the product (a Dashboard for Data Visulisation with responsive design), includes 2 main parts: Product and Product development potential.

**Product:** The purpose of this product is to visualize data through scientific charts and graphs, to help users make better decisions. Although this is not considered a mature application and it is still a long way to get there, I still find this product development successful in terms of functionality and visual presentation. Some of the evaluation criteria are as follows:

*Table of Product Assessment*

Criteria	Result	Comment
Visibility of Application Design	✓	The dashboard site is made sure to be clearly visible to the user. Users know which page they are on thanks to the page title and easily access other pages through the navigation panel (navbar, sidebar).
Practicality	✓	The product meets the set requirements and has the potential to develop into a real-world application if there are more resources (time, cost, HR, etc.)
Consistency	✓	Consistency is maintained throughout the product. For a page, the color scheme, font, and layout are the same. For many pages, the

		layout of the navigation bar and the design of the buttons are the same.
<b>Uses of icons</b>	✓	The choice of suitable alternative icons helps save UI design space, save memory in the programming file, and increase the user's recognition as people process visual data better than textual. → That's also the main aim of this project: Dashboard for data visualisation supporting decision-making
<b>Design</b>	✓	The UI design is simple, aesthetic and provides a comfortable UX.
<b>Chart functionality</b>	✓	Offers users functions to work with charts such as zoom in and out, change axes. Allows user to download charts as images and generate new charts from available data via Plotly.

**Future developments:** If this dashboard is improved with more features, it will have a lot of potential.

- The addition of pages: Currently, the product has only one main page, called "Dashboard". Other pages like Home, FAQ, Settings should be added. Besides, reports on Goals, Sales, and Deals are being placed on the Dashboard main page. I hope to be able to extend them with their own subpages.
- Extension of interface design: More themes, more options for users about font size, font style, etc.
- Plotting charts and tables: The types of charts displayed on the dashboard are generated via Plotly tools. The application will be more powerful and independent if it is able to create its own table from the input information. This requires developers to work with JavaScript and its libraries (eg: ReactJS) and frameworks (eg: Express from NodeJS).
- Database with CRUD, REST API: To upgrade this dashboard, the database is extremely important. In the current version, the data to create charts is manually entered, only for the UI/UX part. As suggested above, it is possible to work with JavaScript extension libraries and back-end frameworks to work with data flow.

### 9.3 Reflection

This project is a challenging experience, yet, it is also rewarding for me. Despite the ups and downs during the development of the project, I am pleased with the end result and find the process an enjoyable journey. This part will go over everything I have learnt throughout the project development.

When I chose this topic, I determined that I needed to learn a new programming language: JavaScript (in addition to HTML and CSS). Along with the knowledge taught from the relevant modules, I have sought out online learning resources. Learning that new programming language was easier than I thought. It was only a matter of putting in a lot of effort and focus. What I enjoyed most is the designing/styling process for the website, it is a form of relaxing for me. During this phase, I was able to discover areas for improvement and make useful constructive pointers for modification, which I valued. Moreover, I believe that my attention to detail in the draught design has made this project more time efficient.

Apart from the above, this project has also taught me a great amount about software project management and development, which is beneficial for my personal development as well as my future career path. I was given a opportunity to experience throughout the whole development cycle, from the beginning to the end. A tiniest experience can have a big impact and hopefully I will be able to gain more bigger experience from my future work with real-life projects.

Finally, if I had the opportunity to enhance this project, I would like to add more features (as in section above). It's also a good idea to have a live client, I'll take their comments and make adjustments. This is closer to reality when I go to work. I understand that dealing with a real client will be more challenging, but I relish problem solving and thrive on challenges.

In conclusion, every piece of work in this project has given be a big step toward my future job as a Front-end Developer. It will be my memorable and valuable experience during my time studying here.

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[Accessed 05 March 2022].

## 11 Appendices

### 11.1 Proposal report

*Student Name: Han Gia Ha*  
*ID Number: 001052068*  
*Title of Degree: BSc (Hons) Computer Science*

29/10/2021 – FYP Proposal Report

# DASHBOARD FOR BUSINESS INTELLIGENCE, DATA VISUALISATION AND DECISION MAKING

Keywords: Performnace Dashboard, Business Intelligence(BI) & Data Visualization, Decison Support System, CRUD Operation Application.

## 1. BACKGROUND AND MOTIVATION

The rapid development in society as well as the continued advance of technology over the past decade have transformed the way we communicate and collaborate throughout the Internet. They also have profoundly affected business modelling, which requires the use of proper metrics to monitor business performance, often known as KPI – Key Performance Indicators (Chowdhary, et al., 2006). KPIs are shown to the analyst via a dashboard, which is a user interface (UI) that offers a view of all critical business indicators, a key factor in day-to-day operation to reflect the success of a modern organisation or enterprise. Furthermore, our previous manual and outdated methods were limited to providing information and assessing business behaviours, resulting in complete uncertainty in business owner's decision-making (SM & Belwal, 2017). Take that as motivation as well as by concentrating on the development of a Performance Dashboard, this project is to produce an efficient solution to these challenges and enable decision-makers to visualize the right metrics for successful market edge.

## 2. PROBLEM DOMAIN

### **A tendency in using dashboards for business/project management**

For small companies, a system capable of project processing is necessary as data processing and project control are done with manual paperwork, which results in a lack of time, which has a consequence on the preparation of project reports. Or even when it is done with Microsoft Word and Excel, employees are demanded high accuracy although data collection can take a long time. On the other hand, the use of a computerised system (or a dashboard in my project), can ensure that each action is not only carried out more effectively and efficiently, but also can provide exact and accurate reports. The availability of a project management information system can aid in the processing, control, and monitoring of ongoing project operations by allowing for the recording and reporting of project management results (Soleh, et al., 2020). Scheduling and human resource management, optimization of time and cost of functional quality on project quality have a major influence on boosting corporate performance (Rahayu, et al., 2017). Therefore, the application of information systems in business/project management is crucial that today's enterprises and organizations are utilizing information technology solutions to enhance their efficiency and market value by upgrading their systems and processes. To demonstrate this trend, studies by McGowan & Bohmer (1993), Jeng & Schiefer (2002) and Jeng, et al. (2003) have shown that there were many vendors offering sophisticated tools for representing business activity monitoring and data. Hence, Business Performance Management (BPM) delivers substantial benefits to business runners by allowing them to respond quickly to changes in their environment (Bhattacharya, et al., 2005).

**Dashboard Cutting-edge Business Intelligence (BI) and Data Visualzation, Enhancing Decison Making**

According to SM & Belwal (2017), competitive nature in the IT industry, investments, business directives, and business data are growing at an exponential rate. As a result, the business owner must take caution and consider all aspects while making decisions, which stimulates business intelligence (BI) to deliver actionable insight to make better choices. Consequently, there is a high need for a tool to evaluate the growth and leads the business to a lucrative route. A tool that is capable of seamlessly integrating technologies into a BI environment, provides methods like reporting, ad-hoc querying, and online analytical processing (Wu, et al., 2007). In short, a performance dashboard application can be seen as a brilliant solution to meet the demand mentioned above.

### 3. AIMS AND OBJECTIVES

#### 2.1- Aims

Cited from an article by Ogbeiwi (2017), a fundamental prerequisite to achieve a desired project is to have a clear and logical goal setting. The aims of this project, hence, will be listed following SMART objective framework:

##### *Specific*

The first purpose is to have a deeper and more comprehensive view of the aspects of the dashboard that can improve business management. By that it means more academic research and previous works in similar area will be studied and analysed in this paper.

*Secondly and mainly, to address the above concerns, this project aims to develop a UI web application with a real-time dashboard solution.* This dashboard plays a role in utilizing data visualization techniques to simplify complicated data sets to provide users with a quick overview of current performance and to maintain track of the department's capacity to meet service level objectives. Furthermore, our web responsive application supports component interoperability and offers a user interface with access to CRUD (Create, Read, Update, Delete) operations and data visualisation (e.g., tables and maps) to various devices from a computer to a phone screen. With front-end (UI) developed using HTML, CSS (Bootstrap library) and the main application using JavaScript (React/Vue library), the development will demonstrate how all of these models may be merged to create the final answer automatically for business management.

##### *Measurable*

About the product of this project, dashboard – a information management tool – will be created to track metrics, display data and outline business behaviour. Data sources will be obtained from public API sources or exported from an Excel database.

##### *Achievable*

In order to accomplish this project, I will:

- Improve front-end and JavaScript programming skills, learn ReactJS – a JS library;
- Not need for financial capability but need to maintain about 10 hours/week to study the requirements in the term 1 and 10-20 hours/week to build the app and report;
- Need feedback and guidance from supervisor.

##### *Relevant*

This project will be worthwhile if it is completed on schedule and achieved  $\geq 70\%$  as expected. This project is built not only for final year project but also to reflect my skills and knowledge gained during 3 years of university, and will be part of my portfolio when applying for a job. This project also represents my interest and career orientation by more focusing on UI/UX and front-end development.

##### *Time-bound*

To measure the progress of this project, a gantt chart will be made and can be found on Section 8. The plan consists of three main phases: pre-production, production and post-production.

#### 2.2- Objectives

##### *Researching for report*

- Research about the background and the tendency of using dashboard in business;
- Research about the effect of applying dashboard into business management;
- Research about previous works as the same field, write a literature review;
- Research about requirements needed to develop a dashboard.



### *Dashboard development*

#### **Initial layout**

- Study the feasibility, collect functional and non-functional requirements;
- Study figures and charts used in business analysis and management that should be shown in a dashboard, collect data source from public APIs;
- Design DFD, ERD, use case diagram, class diagram if needed;
- Design wireframe – a visual representation of an actual dashboard, design prototype if needed.

#### **Implementation (UI content)**

- Implement initial layout with CSS Grids/Flexbox and Bootstrap;
- Implement UI components;
- Customize UI components to work with data: displaying, paging, sorting, filtering, editing, grouping, exporting Excel, etc.;
- Make it responsive and make themes.

### *Testing and analysis*

- Plan for testing: UI testing, feature and function testing, etc.;
- Present testing results and analyse them: comparing expected and actual outcomes, limitations, etc.;
- Write instructions for use and description of the application;
- Write report.

## **4. INITIAL LITERATURE REVIEW**

Through literature study, other works that have been done previously in developing a variety of dashboards employing multiple technologies and techniques is reviewed. Authors Sloane, et al. (2006) offer novel advancements to a military medical informatics and business process reengineering research project. The JMAR Executive Dashboard Initiative (JEDI) was a Business Intelligence system. It facilitates making an informed medical decision. In the field of Smart Tourism, Albusaidi, et al. (2016) have also done an effort to achieve Smart Tourism by studying tourist behaviour and data. This data is used to create a knowledge-based dashboard in order to assess tourist satisfaction. As the majority of travellers/visitors leave electronic traces and reviews when searching for locations and booking, as well as feedback on tourism places' services. In business area, a study of Ashraf & Khan (2015) has pointed out the important metrics to include in BI Dashboards to enable decision makers correctly display the relevant indicators for an effective market edge. Based on call detail data, their study provides three business measures and a grading system for valued subscribers and displays the findings in an effective visualisation. Besides, in a paper from 2006, Chowdhary, et al. presented a model-driven method to build a dashboard to connect with business activities and expand it to generate reports of the company. The adaption of new technology to business in Marketing, Sales, and Customer Relationship Management (CRM), Fraud Detection, and Network Management, 61% of inbound calls has been addressed quicker with improved access information (Clarkson, et al., 2012). Comparable researches can be mentioned respectively as BI Service Architecture (Wu, et al., 2007), BI Dashboard For Business Reporting (Chowdhary, et al., 2006), Financial Market Analysis (Kumar, et al., 2010) and Facebook Data Warehousing and Analytics Infrastructure (Thusoo, et al., 2010) have all proved that application of BI dashboard could provide data warehouse and visualization and improve productivity.

## **5. PROPOSE METHODOLOGY**

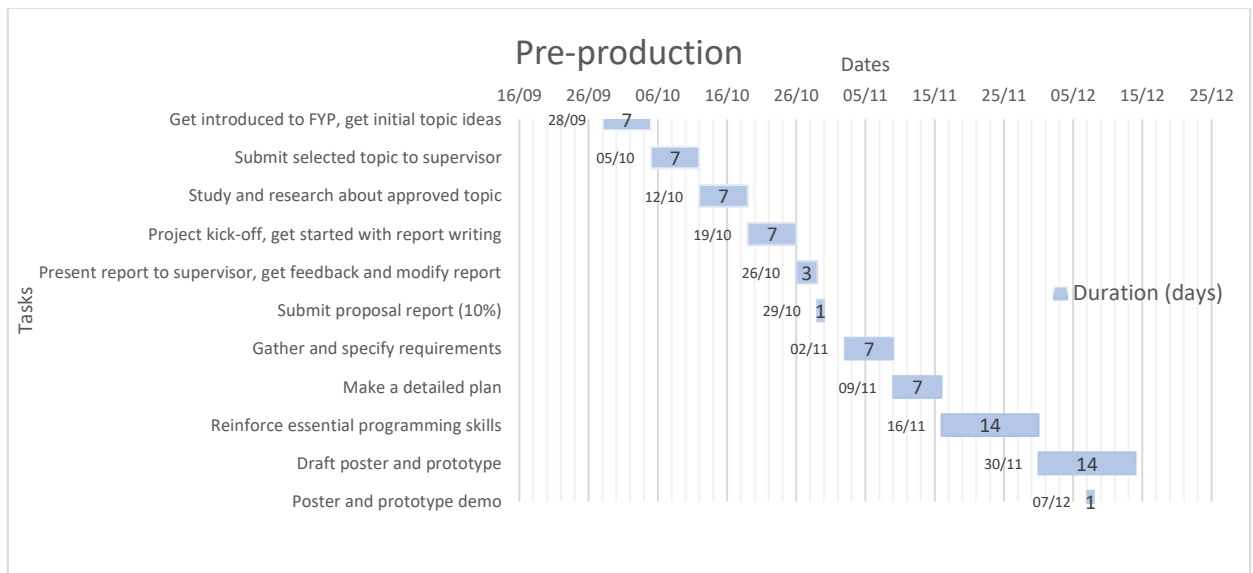
The waterfall method is the preferred way for maximising this project development strategy because specifications and deliverables are already well-defined in pre-production stage. Moreover, it is an individual project so there will be no demand for iteratively testing, discussing and fine-tuning. Sequential procedure will keep it easy for understand, simple for development, listed as below:

1. Requirements gathering: Answer questions about objectives, requirements, feasibility, quality about the project.
2. Design: Get an in-depth look at the design and functionality required of a BI dashboard. Draft wireframes, design each page and layout for each of them. Diagrams (e.g. DFD, ERD, use case diagram, class diagram) will be needed to link pages as well as functionality.
3. Coding and unit testing: Make and follow a coding plan of each part of the dashboard properly and efficiently as well as a detailed testing plan to ensure that no errors are missed.
4. Integration and system testing
5. Development and report documenting

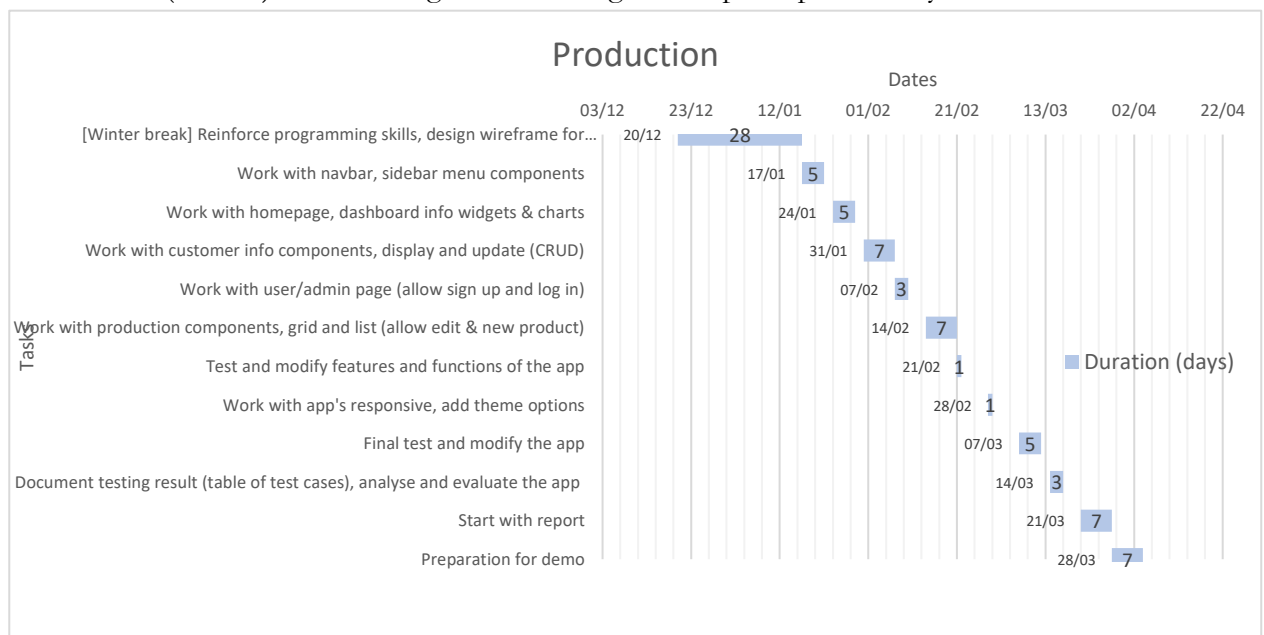
## 6. PROJECT PLAN

Based on Objectives (section 3B), dashboard implementation is divided into 3 stages as showing in charts below:

A- Pre-production (term 1): Focus on supplementing knowledge and skills

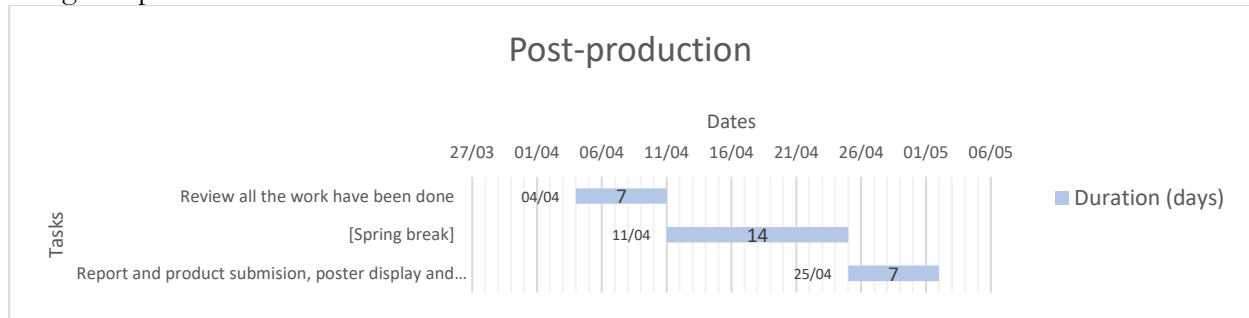


B- Production (term 2): With the goal of having a complete product by the end of March



C- Post-production (after winter break): Receive feedback from supervisor for revision, testing, report

writing and product demonstration



## 7. LSEPI – LEGAL, SOCIAL, ETHICAL AND PROFESIONAL ISSUES

Following the legal consideration stated by Soghoian (2008), the target's reputation is harmed as a result of the confused trademark. Therefore, any organization or enterprise uses a similar dashboard without being able to prove it belongs to their intellectual property will face legal issue regarding trademark and copyright. Furthermore, confidential data, information related to employees and customers, transaction information and management plans, etc. being disclosed, attacked or stolen will also lead legal problems related to information security.

As dashboard is accessible only to those who are relevant and have the authority to manage organization/enterprise information, therefore, it is not as vulnerable as other types of information found on public sources (i.e. websites, social media, etc.) Once data breach happens, both customers and company will be affected no matter who causes the leakage. Confidentiality agreements are required for everyone who can access and work with the data. Data leaked or published without consent is not only related to legal but also ethical issue.

Automated workloads will reduce the number of workers, require higher knowledge employees to work with new technology or the company has to train their staffs, which is also a concern in today's society. Dashboard provides new possibilities on business performance but also raise the risk of uncontrolled data leakage. Therefore, besides delivering smooth functions, it is also necessary to have clear information security and data privacy policies for the company's professional issues.

## 8. EXPECTED OUTCOMES

A BI dashboard based on CRUD operation application will be provided with UI designed from HTML, CSS (Bootstrap library) and the main application is built from JavaScript (ReactJS library) and consists of a custom report employing database (from Excel database or APIs public source) called and real-time transferred from a server code or a cloud service as well as a web responsive application that adapts different sizes of screen.

This product can be viewed as an information processing application. Business data such as transactions, customers, products, etc. after being imported, will be displayed visually through charts, tables, cards, and so on, which users can directly interact with in real time.

- Focusing on developing UI effects, such as auto-motion images, displaying information on hover or other animation effects, this dashboard is hoped to deliver a significantly more efficient user experience vs static pages (i.g. MS Excel).
- By applying CRUD information to the project, this dashboard provides a set of ways to work with data: adding, selecting/unselecting, editing, deleting information; sorting, filtering, grouping information in a table; exporting Excel, PDF and so on.

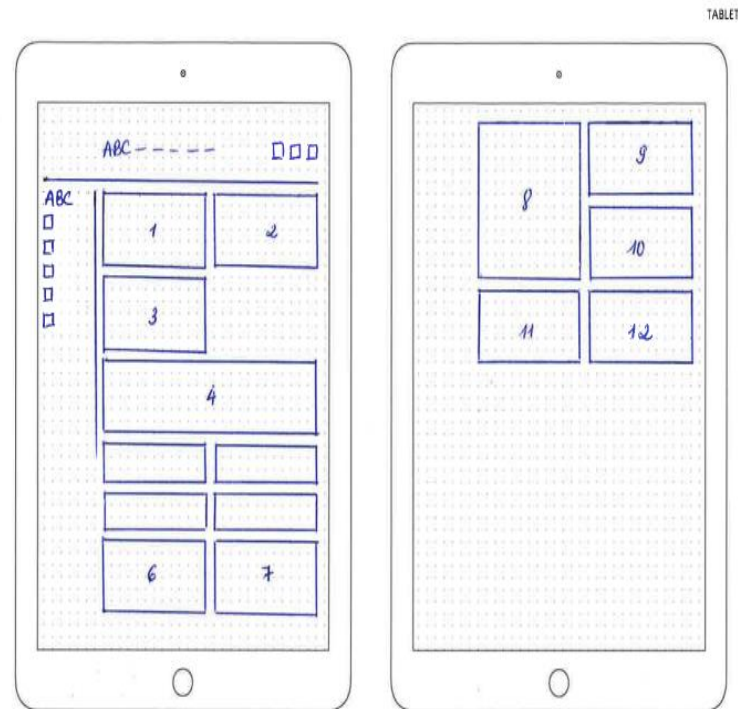
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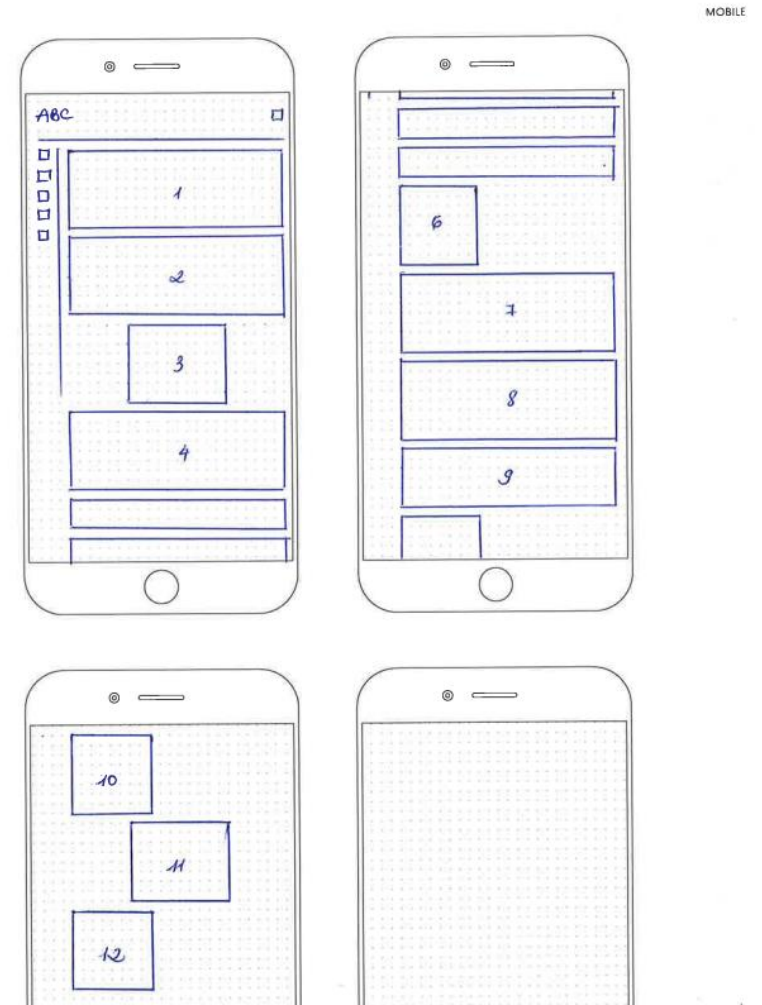
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## 11.2 Design

### 11.2.1 Paper-based design



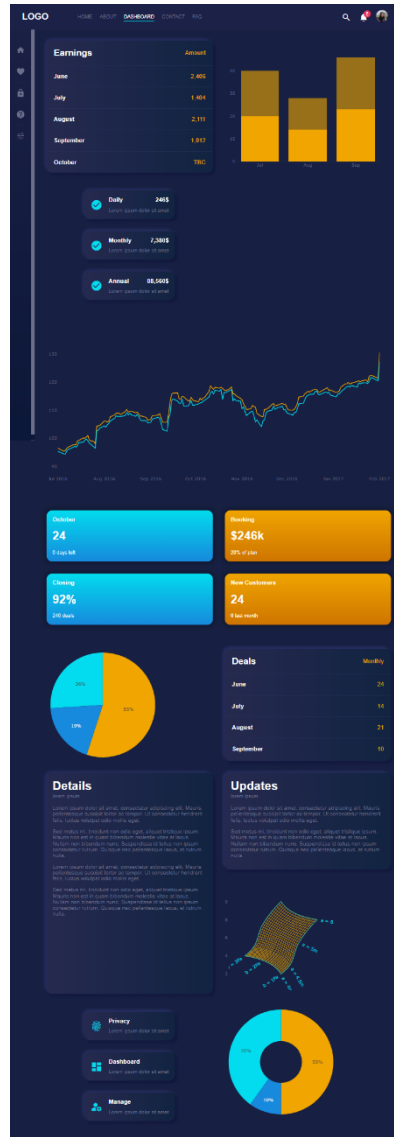
*Sketch 2 – Medium screen size*



*Sketch 3 – Small screen size*



Prototype @media 1150px



Prototype @media 1050px



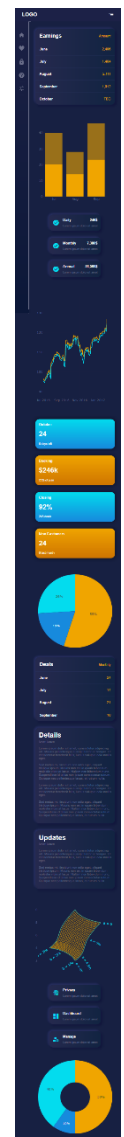
Prototype @media 800px



Prototype @media 750px



Prototype @media 700px



Prototype @media 400px

## 11.2.2 High fidelity prototype



*11.2.3 Colour scheme*

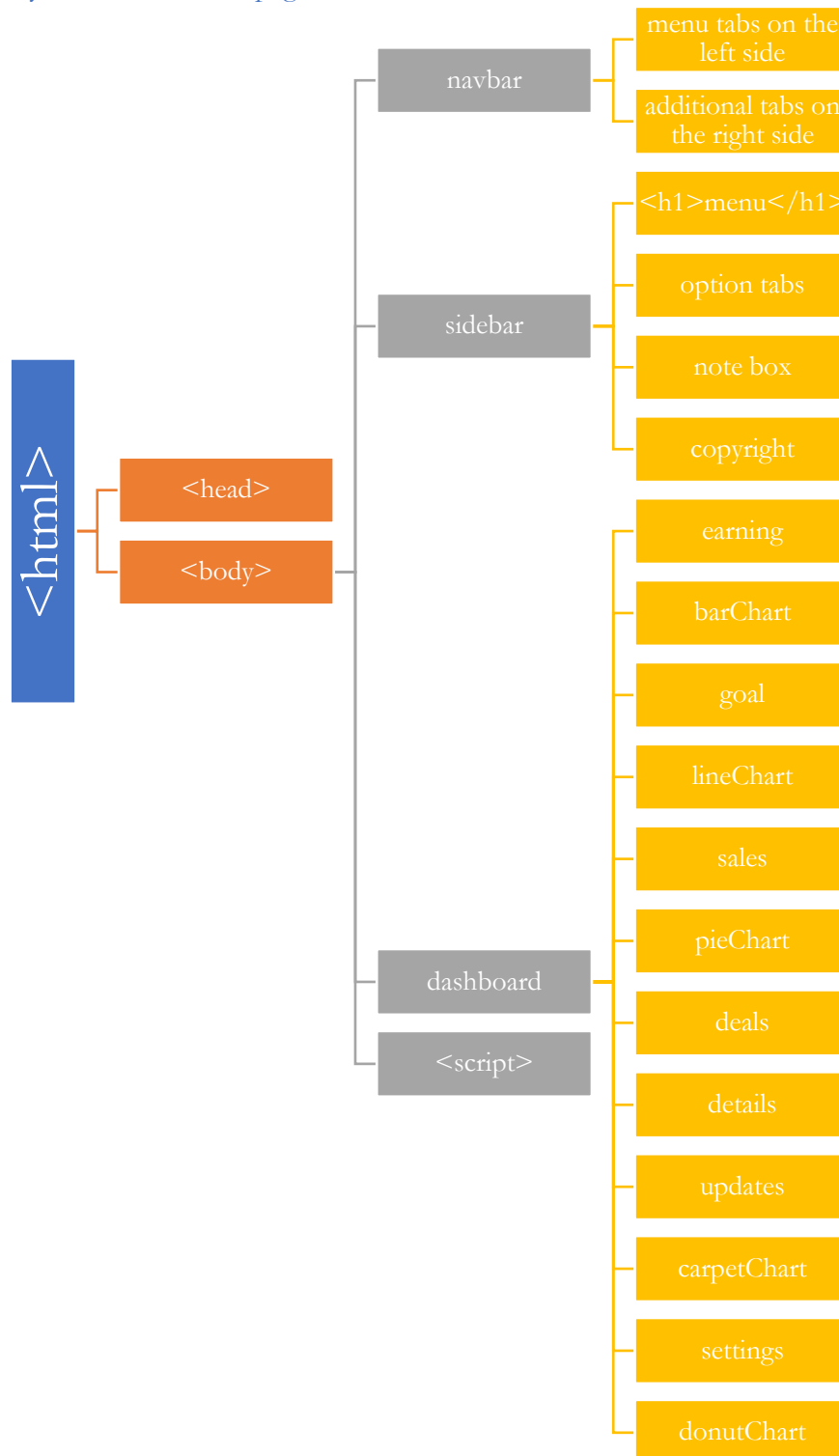
	Final	Neutral	Additional	
Background	172042	534340		
	0C1839	453735		
Navbar	1C2147	453735		
Sidebar	21284C	614F4B		
	1C2145	594744		
Note box	0E133D	4A3C39		
	1D1D4D	4F403C		
Panel	262A4F	614F4B		
	122442	534340		
Box shadow	293063	705A56		
	11163C	262C2A		
Charts & buttons	03DCEE	9FC088		
	178ADD	77A457		E63E6D
	F0A500	CC7043	EA335D	B42B51
	CF7500	9E4D2D	B52B4B	7D1935
Chart background	10183B	4A3C39		
	161E41	4F403C		
Text	FFF	FFF		
<p><small>	6B6F8A	7E6661		
Menu	FFF	E8C07D		
Notification	EA335D	EA335D		



## 11.3 Implementation

### 11.3.1 HTML

Hierachy chart for HTML page structure



A complete HTML page before CSS styling

LOGO

- [Home](#)
- [About](#)
- [Dashboard](#)
- [Contact](#)
- [FAQ](#)
- [Q](#)
- [A](#)
- [User](#)



Menu

- [Home](#)
- [Favorites](#)
- [Security](#)
- [Help](#)
- [Settings](#)

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- 

Earnings

Amount

- 

June

2,406

- 

July

1,404

- 

August

2,111

- 

September

1,012

- 

October

TBC

- 

Daily

2468

Lorem ipsum dolor sit amet

- 

Monthly

7,380\$

Lorem ipsum dolor sit amet

- 

Annual

\$8,560\$

Lorem ipsum dolor sit amet

October

24

- 

6 days left

Booking

\$246k

20% off plan

Closing

92%

249 deals

New Customers

24

- 

6 last month

- 

Deals

Monthly

- 

June

24

- 

July

14

- 

August

21

- 

September

10

- 

Details

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Privacy

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Dashboard

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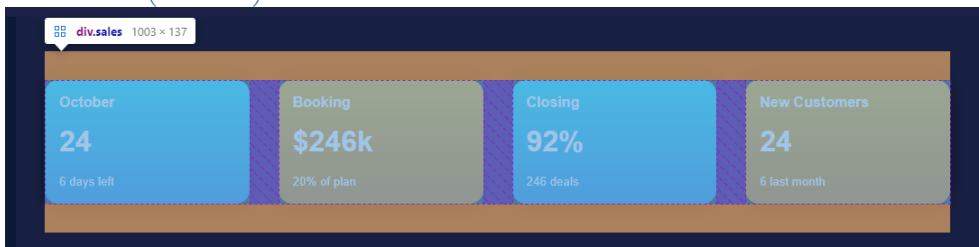
- 

Manage

lorem ipsum dolor sit amet

### 11.3.2 Responsive design

Sales (div.sales):



$Span = 4$

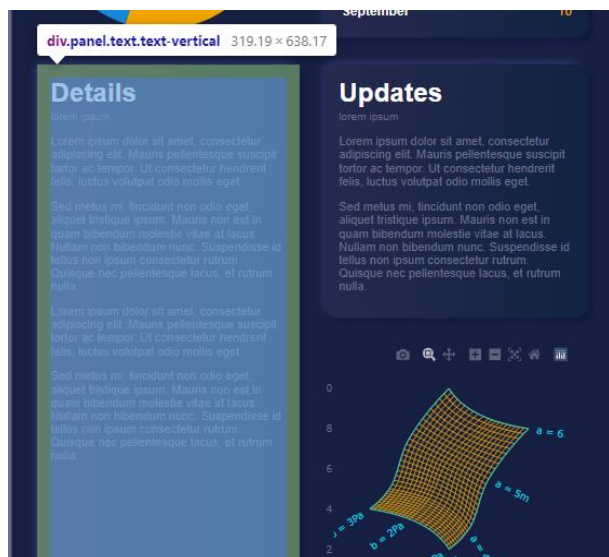


$Span = 2$



$Span = 1$

Details (div.panel.text.text-vertical) & Updates (div.panel.text.text-horizontal)

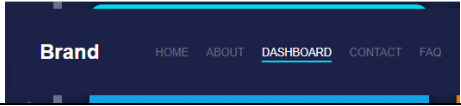
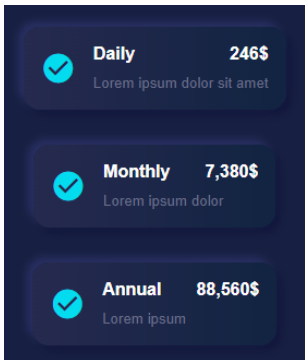
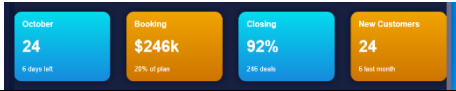


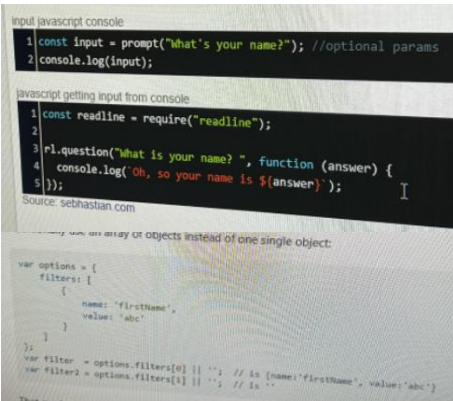
Details:  $x = 1, y = 2$ . Updates:  $x = 1, y = 1$ .

Details:  $x = 1, y = 2$ . Updates:  $x = 2, y = 1$ .

## 11.4 Testing

*Table of Test Cases*

Type	Case	Description	Status	Solution
Interface Design (CSS)	Margin	Margin does not fully cover dashboard panel, there is gap at the top and bottom 	Fixed	Set <i>margin = 0;</i>
	Scroll bar	A vertical bar on the right side of a window that allows users to scroll the contents up and down.	Passed	
	Navbar	Navbar is overridden by Sidebar, content is covered	Fixed	Change stack order with <i>z-index = 3;</i>
		Position fixed: Navbar is always fixed at the top of the page, not scrolling away with the content	Passed	
		Hover: Bold text effect when mouse hovers over menu tabs	Passed	
		"Dashboard" tab menu in active state	Passed	
	Sidebar	Position fixed	Passed	
		Scrollbar: An extra scrollbar for sidebar's content	Fixed	Because it couldn't be coded as the same syntax as main scroll bar, I added <i>overflow-y: scroll;</i> in CSS Sidebar styling.
	Dashboard (main panel)	Grid layout	Passed	
		Goals (div.goal): Frames don't have the same size 	Failed	Even though I tried setting values for <i>width, height</i>
		Sales (div.sales): Boxes have alternating colors 	Passed	Set <i>nth-child(odd){ }</i> and <i>nth-child(even){ }</i> selector
		Vertical text box (div.panel.text-text-vertical)	Passed	<i>Grid-row-start = 2;</i>
		Horizontal text box (div.panel.text-text-horizontal)	Passed	<i>Grid-column-start = 2;</i>

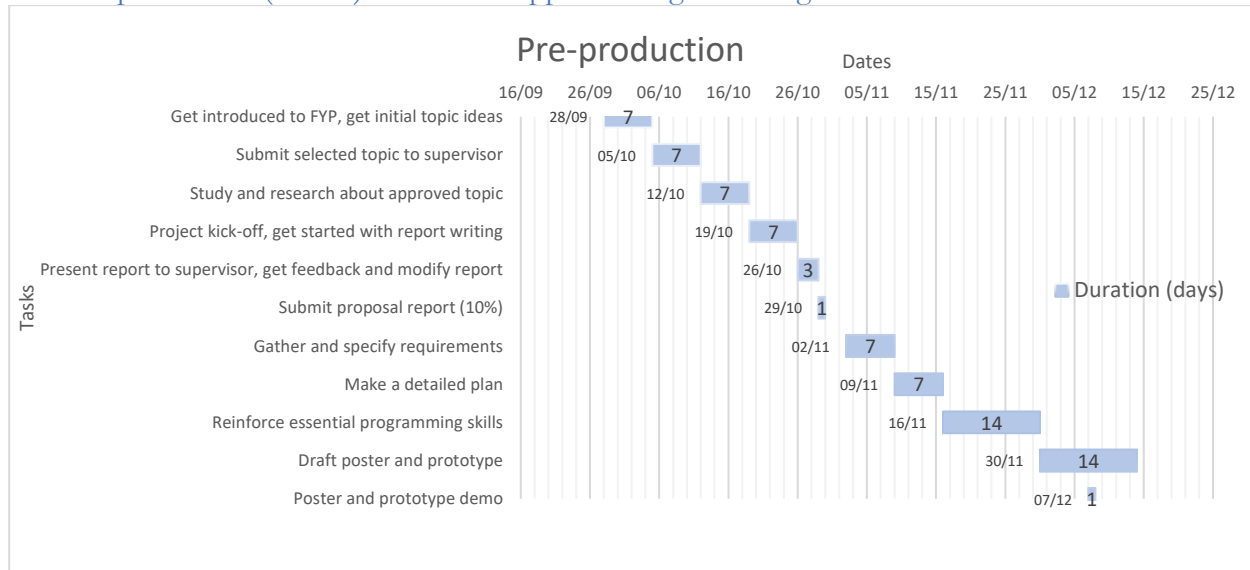
		Responsive	Passed	
Functionality (JavaScript)	Toggle button	Button to activate collapsible navbar/sidebar	Passed	
	Charts	Functionality to adjust charts adopted from Plotly	Passed	
	Take input from console to add new/change data of chart	<p>Failed to connect newly imported input with remaining JS code. Belows are tutorials I have tried and failed</p>  <pre> input javascript console 1 const input = prompt("what's your name?"); //optional params 2 console.log(input);  javascript getting input from console 1 const readline = require("readline"); 2 3 rl.question("what is your name? ", function (answer) { 4   console.log("Oh, so your name is \${answer}"); 5 }); Source: sebhastian.com  ... an array of objects instead of one single object:  var options = {   filters: [     {       name: "firstName",       value: "abc"     }   ] }; var filter = options.filters[0]    {}; // is {name: 'firstName', value: 'abc'} var filter2 = options.filters[1]    {}; // is {} That can be... </pre>	Failed	

## 11.5 Evaluation

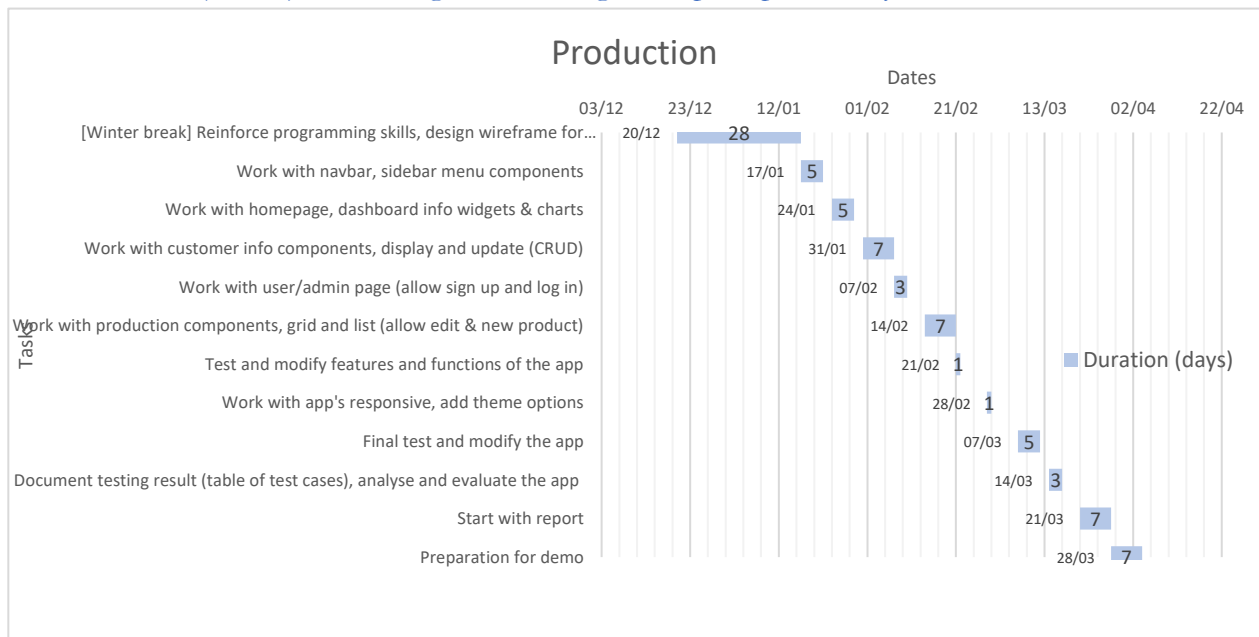
### 11.5.1 Gantt chart

This project process is divided into 3 stages as showing in charts below:

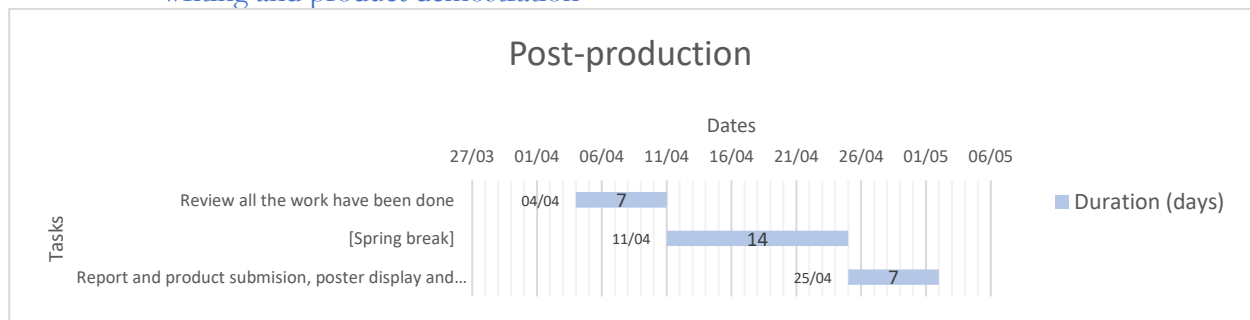
Pre-production (term 1): Focus on supplementing knowledge and skills



Production (term 2): With the goal of having a complete product by the end of March



Post-production (after winter break): Receive feedback from supervisor for revision, testing, report writing and product demonstration



## 11.6 Coding

### 11.6.1 HTML

```

1  <!DOCTYPE html>
2  <html lang="en">
3
4  <head>
5      <meta charset="UTF-8">
6      <meta name="viewport" content="width=device-width, initial-scale=1.0">
7      <meta http-equiv="X-UA-Compatible" content="ie=edge">
8      <link href="https://fonts.googleapis.com/icon?family=Material+Icons" rel="stylesheet">
9      <link rel="stylesheet" href="style.css">
10     <title>FYP Dashboard</title>
11 </head>
12 <body>
13     <!------- NAVIGATION BAR ----->
14     <nav class="navbar">
15         <div class="container">
16             <div>
17                 <h1>Brand</h1>
18
19                 <!------- LEFT MENU ----->
20                 <div class="menu">
21                     <ul>
22                         <li>
23                             <a href="#">Home</a>
24                         </li>
25                         <li>
26                             <a href="#">About</a>
27                         </li>
28                         <li>
29                             <a href="#" class="active">Dashboard</a>
30                         </li>
31                         <li>
32                             <a href="#">Contact</a>
33                         </li>
34                         <li>
35                             <a href="#">FAQ</a>
36                         </li>
37                     </ul>
38
39                     <!------- RIGHT MENU ----->
40                     <ul class="options">
41                         <li><a href="#">
42                             <span class="material-icons">
43                                 search
44                             </span>
45                         </a></li>
46                         <li><a href="#" class="notification">
47                             <span class="material-icons">
48                                 notifications
49                             </span>
50                         </a></li>
51                         <li><a href="#">
52                             
53                         </a></li>
54                     </ul>
55                 </div>
56             </div>

```



```

57     <div class="menu-btn">
58         <span class="material-icons">
59             segment
60         </span>
61     </div>
62 </div>
63 </nav>
64 <!------- CLOSE NAVIGATION BAR ----->
65
66 <!------- SIDEBAR ----->
67 <nav class="sidebar">
68     <div class="container">
69         <h3 class="title">Menu</h3>
70         <ul>
71             <!-- HOME -->
72             <li>
73                 <a href="">
74                     <span class="material-icons">
75                         home
76                     </span>
77                     <span>Home</span>
78                 </a>
79             </li>
80             <!-- FAV -->
81             <li>
82                 <a href="">
83                     <span class="material-icons">
84                         favorite
85                     </span>
86                     <span>Favorites</span>
87                 </a>
88             </li>
89             <!-- LOCK -->
90             <li>
91                 <a href="">
92                     <span class="material-icons">
93                         lock
94                     </span>
95                     <span>Security</span>
96                 </a>
97             </li>
98             <!-- HELP -->
99             <li>
100                 <a href="">
101                     <span class="material-icons">
102                         help
103                     </span>
104                     <span>Help</span>
105                 </a>
106             </li>
107             <!-- SETTING -->
108             <li>
109                 <a href="">
110                     <span class="material-icons">
111                         tune
112                     </span>
113                     <span>Settings</span>
114                 </a>
115             </li>
116         </ul>

```

```

117 <!-- BOX -->
118 <div class="note">
119   <h1>What's New</h1>
120   <p>
121     Stay up to date on the most recent software updates in our new version!
122   </p>
123   <a href="#" class="btn">Learn More</a>
124 </div>
125 <div class="sidebar-footer">
126   <p>&copy; Han Ha</p>
127 </div>
128 </div>
129 </nav>
130 <!------- CLOSE SIDEBAR ----->
131
132 <!------- EARNING TABLE ----->
133 <main class="dashboard">
134   <div class="panel list">
135     <li>
136       <h2>Earnings</h2>
137       <span>Amount</span>
138     </li>
139     <li>
140       <h4>June</h4>
141       <span>2,406</span>
142     </li>
143     <li>
144       <h4>July</h4>
145       <span>1,404</span>
146     </li>
147     <li>
148       <h4>August</h4>
149       <span>2,111</span>
150     </li>
151     <li>
152       <h4>September</h4>
153       <span>1,012</span>
154     </li>
155     <li>
156       <h4>October</h4>
157       <span>TBC</span>
158     </li>
159   </div>
160   <!------- CLOSE EARNING TABLE ----->
161
162   <!------- BAR CHART ----->
163   <div id="barChart"></div>
164   <!------- CLOSE BAR CHART ----->
165
166   <!------- GOAL REPORT ----->
167   <div class="goals">
168     <div class="panel goal">
169       <span class="material-icons">
170         check_circle
171       </span>
172       <!-- DAILY -->
173       <div>
174         <div class="goal-title">
175           <h4>Daily</h4>
176           <h4>246$</h4>

```

```

177     </div>
178     <small>Lorem ipsum dolor sit amet</small>
179 </div>
180 </div>
181 <!-- MONTHLY -->
182 <div class="panel goal">
183     <span class="material-icons">
184         check_circle
185     </span>
186     <div>
187         <div class="goal-title">
188             <h4>Monthly</h4>
189             <h4>7,380$</h4>
190         </div>
191         <small>Lorem ipsum dolor sit amet</small>
192     </div>
193 </div>
194 <!-- YEARLY -->
195 <div class="panel goal">
196     <span class="material-icons">
197         check_circle
198     </span>
199     <div>
200         <div class="goal-title">
201             <h4>Annual</h4>
202             <h4>88,560$</h4>
203         </div>
204         <small>Lorem ipsum dolor sit amet</small>
205     </div>
206 </div>
207 </div>
208 <!------- CLOSE VERTICAL REPORT ----->
209
210 <!------- LINE CHART ----->
211 <div id="scientificChart"></div>
212 <!------- CLOSE LINE CHART ----->
213
214 <!------- SALES REPORT ----->
215 <div class="sales">
216     <!-- BOX 1 -->
217     <div>
218         <h4>October</h4>
219         <h1>24</h1>
220         <small>6 days left</small>
221     </div>
222     <!-- BOX 2 -->
223     <div>
224         <h4>Booking</h4>
225         <h1>$246k</h1>
226         <small>20% of plan</small>
227     </div>
228     <!-- BOX 3 -->
229     <div>
230         <h4>Closing</h4>
231         <h1>92%</h1>
232         <small>246 deals</small>
233     </div>
234     <!-- BOX 4 -->
235     <div>
236         <h4>New Customers</h4>

```

```

237     <h1>24</h1>
238     <small>6 last month</small>
239 </div>
240 </div>
241 <!------- CLOSE SALES REPORT ----->
242
243 <!------- PIE CHART ----->
244 <div id="pieChart"></div>
245 <!------- CLOSE PIE CHART ----->
246
247 <!------- DEALS REPORT ----->
248 <div class="panel list">
249     <li>
250         <h2>Deals</h2>
251         <span>Monthly</span>
252     </li>
253     <li>
254         <h4>June</h4>
255         <span>24</span>
256     </li>
257     <li>
258         <h4>July</h4>
259         <span>14</span>
260     </li>
261     <li>
262         <h4>August</h4>
263         <span>21</span>
264     </li>
265     <li>
266         <h4>September</h4>
267         <span>10</span>
268     </li>
269 </div>
270 <!------- CLOSE DEALS REPORT ----->
271
272 <!------- VERTICAL DETAIL BOX ----->
273 <div class="panel text text-vertical">
274     <h1>Details</h1>
275     <small>lorem ipsum</small>
276     <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Mauris pellentesque suscipit tortor ac tempor.
277     <p>Sed metus mi, tincidunt non odio eget, aliquet tristique ipsum. Mauris non est in quam bibendum molestie
278     <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Mauris pellentesque suscipit tortor ac tempor.
279     <p>Sed metus mi, tincidunt non odio eget, aliquet tristique ipsum. Mauris non est in quam bibendum molestie
280 </div>
281 <!------- CLOSE VERTICAL DETAIL BOX ----->
282
283 <!------- HORIZONTAL DETAIL BOX ----->
284 <div class="panel text text-horizontal">
285     <h1>Updates</h1>
286     <small>lorem ipsum</small>
287     <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Mauris pellentesque suscipit tortor ac tempor.
288     <p>Sed metus mi, tincidunt non odio eget, aliquet tristique ipsum. Mauris non est in quam bibendum molestie
289 </div>
290 <!------- CLOSE HORIZONTAL DETAIL BOX ----->
291
292 <!------- CARPET CHART ----->
293 <div id="carpetChart"></div>
294 <!------- CLOSE CARPET CHART ----->
295

```

```

296 <!------- SETTIING BARS ----->
297 <div class="goals">
298   <div class="panel goal">
299     <span class="material-icons">
300       fingerprint
301     </span>
302     <!-- BOX 1 -->
303     <div>
304       <div class="goal-title">
305         <h4>Privacy</h4>
306       </div>
307       <small>Lorem ipsum dolor sit amet</small>
308     </div>
309   </div>
310   <!-- BOX 2 -->
311   <div class="panel goal">
312     <span class="material-icons">
313       dashboard
314     </span>
315     <div>
316       <div class="goal-title">
317         <h4>Dashboard</h4>
318       </div>
319       <small>Lorem ipsum dolor sit amet</small>
320     </div>
321   </div>
322   <!-- BOX 3 -->
323   <div class="panel goal">
324     <span class="material-icons">
325       manage_accounts
326     </span>
327     <div>
328       <div class="goal-title">
329         <h4>Manage</h4>
330       </div>
331       <small>Lorem ipsum dolor sit amet</small>
332     </div>
333   </div>
334 </div>
335 <!------- CLOSE SETTIING BARS ----->
336
337 <!------- DONUT CHART ----->
338 <div id="donutChart"></div>
339 <!------- CLOSE DONUT CHART ----->
340 </main>
341
342 <script src='https://cdn.plot.ly/plotly-2.4.2.min.js'></script>
343 <script src='https://cdnjs.cloudflare.com/ajax/libs/d3/3.5.17/d3.min.js'></script>
344 <script src="./main.js"></script>
345 </body>
346 </html>

```

## 11.6.2 CSS

```

1  body {
2      margin: 0;
3      font-family: Helvetica, sans-serif;
4      color: #fff;
5      background-color: #172042;
6      min-height: 100vh;
7  }
8
9  * {
10     box-sizing: border-box;
11 }
12
13 h1, h2, h3, h4 {
14     margin: 0;
15 }
16
17 a {
18     text-decoration: none;
19     color: #fff;
20 }
21
22 p {
23     color: #6b6f8a;
24     font-size: 0.9em;
25 }
26
27 small {
28     color: #6b6f8a;
29 }
30
31 ul {
32     list-style-type: none;
33     margin: 0;
34     padding: 0;
35 }
36
37 /* width */
38 ::-webkit-scrollbar {
39     width: 10px;
40 }
41
42 /* Track */
43 ::-webkit-scrollbar-track {
44     background-color: #0c1839;
45 }
46
47 /* Handle */
48 ::-webkit-scrollbar-thumb {
49     background-color: #6b6f8a;
50 }
51
52 /*===== Navbar =====*/
53 .navbar {
54     text-decoration: none;
55     background-color: #1c2147;
56     z-index: 3;
57     position: fixed;
58     width: 100%;
59 }
60
61 .navbar .container {
62     max-width: 1250px;
63     padding: 1em 2em;
64     margin: 0 auto;
65 }
66
67 .navbar .container > div {
68     display: grid;
69     grid-template-columns: 1fr 6fr;
70     align-items: center;
71 }
72
73 .navbar .menu,
74 .navbar .social-media {
75     display: flex;
76     justify-content: space-between;
77     align-items: center;
78 }
79
80 .navbar ul {
81     display: inline-block;
82 }
83
84 .navbar ul li {
85     display: inline-block;
86     margin: 0 0.5em;
87 }
88
89 .navbar ul a {
90     font-size: 0.8em;
91     text-transform: uppercase;
92     color: #6b6f8a;
93     padding-bottom: 0.2em;
94     transition: 0.3s;
95 }
96
97 .navbar ul a:hover {
98     color: #fff;
99 }
100
101 .navbar .active {
102     border-bottom: 2px solid #03dcee;
103     color: #fff;
104 }
105
106 .navbar .container .menu-btn {
107     display: none;
108 }
109
110 .options span {
111     font-size: 2em;
112     color: #fff;
113 }
114
115 .profile-img {
116     width: 2.5em;
117     border-radius: 50%;
118 }
119
120 .notification { position: relative; }

```

```

121
122 .notification::before {
123     content: '5';
124     position: absolute;
125     top: -1.5em;
126     right: -0.5em;
127     width: 1.5em;
128     height: 1.5em;
129     background: #ea335d;
130     color: #fff;
131     border-radius: 50%;
132     text-align: center;
133     line-height: 22px;
134 }
135
136 /*==== Sidebar =====*/
137 .sidebar {
138     position: fixed;
139     left: 0;
140     top: 0;
141     height: 100%;
142     padding: 5em 2em 0 2em;
143     background: linear-gradient(0deg, #0c1839, #1c2145);
144     max-width: 18em;
145     overflow-y: scroll;
146 }
147
148 .sidebar .container {
149     position: relative;
150     height: 100%;
151 }
152
153 .sidebar .title {
154     font-weight: 400;
155     color: #6b6f8a;
156 }
157
158 .sidebar ul {
159     margin: 1em 0 3em 0;
160 }
161
162 .sidebar li {
163     display: block;
164     padding: 1em 0;
165     border-bottom: 1px #21284c solid;
166 }
167
168 .sidebar ul a {
169     display: flex;
170     justify-content: flex-start;
171     align-items: center;
172 }
173
174 .sidebar a .material-icons {
175     margin-right: 0.7em;
176     color: #6b6f8a;
177     transition: 0.3s;
178 }
179
180 .sidebar a:hover .material-icons {

```



```

181     color: #fff;
182   }
183
184   .note {
185     background: linear-gradient(90deg, #0e133d, #1d1d4d);
186     box-shadow:
187       0 0 10px rgba(0, 0, 0, 0.5),
188       inset 5px 5px 0 #10183b,
189       inset -5px -5px 0 #161e41;
190     padding: 1.5em;
191     border-radius: 15px;
192   }
193
194   .btn {
195     background: linear-gradient(90deg, #178add, #03dcee);
196     box-shadow: 0 0 10px rgba(0, 0, 0, 0.5);
197     font-size: 1.2em;
198     border-radius: 2em;
199     display: inline-block;
200     padding: 0.5em 1.5em;
201   }
202
203   .sidebar-footer {
204     padding: 3em 1em 1em 1em;
205   }
206
207   /*===== Dashboard =====*/
208   .dashboard {
209     background: #172042;
210     padding: 2em;
211     display: grid;
212     grid-template-columns: 1fr 1fr 1fr;
213     justify-content: center;
214     grid-gap: 2em;
215     position: absolute;
216     top: 4.1em;
217     right: 0;
218     width: calc(100% - 18em);
219     overflow-x: hidden;
220   }
221
222   .panel {
223     background: linear-gradient(90deg, #262a4f, #122442);
224     box-shadow:
225       -5px -5px 8px #293063,
226       5px 5px 8px #11163c;
227     border-radius: 15px;
228     overflow: hidden;
229   }
230
231   /*List panel*/
232   .list li {
233     display: flex;
234     justify-content: space-between;
235     align-items: center;
236     padding: 1.2em;
237   }
238
239   .list li:not(:last-child) {
240     border-bottom: 1px #2a335e solid;

```

```

241 }
242
243 .list span {
244 |   color: ■ #f0a500;
245 }
246
247 /*Goal panel*/
248 .goal {
249 |   padding: 1em;
250 }
251
252 .goals, .goal, .goal-title {
253 |   display: flex;
254 |   justify-content: space-between;
255 |   align-items: center;
256 }
257
258 .goal-title h4:nth-child(1) {
259 |   margin: 0 2em 0 0;
260 }
261
262 .goal-title {
263 |   margin-bottom: 0.5em;
264 }
265
266 .goals {
267 |   flex-direction: column;
268 }
269
270 .goal {margin: 1em 0;}
271
272 .goal span {
273 |   color: ■ #03dcee;
274 |   margin-right: 0.5em;
275 |   font-size: 2em;
276 }
277
278 /*Sales panel*/
279 .sales {
280 |   grid-column-start: span 3;
281 |   display: grid;
282 |   grid-template-columns: repeat(4, 1fr);
283 |   grid-gap: 2em;
284 |   margin: 2em 0;
285 }
286
287 .sales > div {
288 |   box-shadow: 0 0 15px ■ rgba(0, 0, 0, 0.5);
289 |   border-radius: 15px;
290 |   padding: 1em;
291 }
292
293 .sales h1 {
294 |   margin: 0.5em 0;
295 }
296
297 .sales small { color: □ #fff; }
298
299 .sales > div:nth-child(even) {
300 |   background: linear-gradient(0deg, ■ #cf7500, ■ #f0a500);

```

```

301 }
302
303 .sales > div:nth-child(odd) {
304   background: linear-gradient(0deg, #178add, #03dcee);
305 }
306
307 /*Text Panel*/
308 .text {
309   padding: 1em;
310 }
311
312 .text-vertical {
313   grid-row-start: span 2;
314 }
315
316 .text-horizontal {
317   grid-column-start: span 2;
318 }
319
320 /*Charts*/
321 #scientificChart {
322   grid-column-start: span 3;
323 }
324
325 @media screen and (max-width: 1150px) {
326   .dashboard, .sales {
327     grid-template-columns: 1fr 1fr;
328   }
329   #scientificChart, .sales {
330     grid-column-start: span 2;
331   }
332   .text-horizontal {
333     grid-column-start: span 1;
334   }
335 }
336
337 @media screen and (max-width: 1050px) {
338   .sidebar {
339     max-width: initial;
340     text-align: center;
341     padding: 5em 1em 1em 1em;
342   }
343   .sidebar a span:not(.material-icons),
344   .note,
345   .sidebar-footer,
346   .title {
347     display: none;
348   }
349   .sidebar a .material-icons {
350     margin: 0;
351   }
352   .dashboard {
353     width: calc(100% - 4.1em);
354   }
355 }
356
357 @media screen and (max-width: 800px) {
358   .navbar .container {
359     display: flex;
360     justify-content: space-between;

```

```

361     align-items: flex-start;
362 }
363 ▾ .navbar .container > div {
364     grid-template-columns: 1fr;
365 }
366 ▾ .navbar .menu {
367     flex-direction: column;
368     align-items: flex-start;
369     height: 0;
370     overflow: hidden;
371     transition: 0.7s;
372 }
373 ▾ .navbar ul:nth-child(1) li {
374     display: block;
375     margin: 1em 0;
376 }
377 ▾ .navbar ul:nth-child(1) li:nth-child(1) {
378     margin-top: 1.5em;
379 }
380 ▾ .navbar ul:nth-child(2) li:nth-child(1) {
381     margin-left: 0;
382 }
383 ▾ .navbar .container .menu-btn {
384     display: inline-block;
385     cursor: pointer;
386 }
387 ▾ .navbar .container .menu-btn span {
388     font-size: 1.7em;
389 }
390 ▾ .navbar .container .nav-toggle {
391     height: 16em;
392 }
393 }
394
395 ▾ @media screen and (max-width: 750px) {
396 ▾ .dashboard, .sales {
397     grid-template-columns: 1fr;
398 }
399 ▾ #scientificChart, .sales {
400     grid-column-start: span 1;
401 }
402 }
403
404 ▾ @media screen and (max-height: 700px) {
405 ▾ .sidebar .container {
406     height: auto;
407 }
408 }
409
410 ▾ @media screen and (max-width: 400px) {
411 ▾ html {
412     font-size: 13px;
413 }
414 }

```

### 11.6.3 JavaScript

```

1  //Get The Elements
2  var menu = document.querySelector(".menu");
3  var menuBtn = document.querySelector(".menu-btn");
4
5  //Toggle the navbar menu on click Open/Close
6  menuBtn.addEventListener("click", function () {
7    menu.classList.toggle('nav-toggle');
8  });
9
10 /*===== Charts =====*/
11 var config = { responsive: true };
12
13 //Bar Chart
14 var barChartTrace1 = {
15   x: ['Jul', 'Aug', 'Sep'],
16   y: [20, 14, 23],
17   name: 'North Store',
18   type: 'bar',
19   marker: {
20     color: '#f0a500'
21   }
22 };
23
24 var barChartTrace2 = {
25   x: ['Jul', 'Aug', 'Sep'],
26   y: [20, 14, 23],
27   name: 'South Store',
28   type: 'bar',
29   marker: {
30     color: '#f0a500',
31     opacity: 0.6
32   }
33 };
34
35 var barChartData = [barChartTrace1, barChartTrace2];
36 var layout = {
37   barmode: 'stack',
38   paper_bgcolor: '#172042',
39   plot_bgcolor: '#172042',
40   showlegend: false,
41   margin: {
42     l: 30,
43     r: 30,
44     b: 30,
45     t: 30,
46     padding: 1
47   },
48   font: {
49     color: '#6b6f8a'
50   }
51 };
52
53 Plotly.newPlot('barChart', barChartData, layout, config);
54
55 //Scientific Chart
56 d3.csv("https://raw.githubusercontent.com/plotly/datasets/master/finance-charts-apple.csv", function (err, rows) {
57   function unpack(rows, key) {
58     return rows.map(function (row) {
59       return row[key];
60     });
61   }

```

```

61     }
62
63     var trace1 = {
64         type: "scatter",
65         mode: "lines",
66         name: 'High',
67         x: unpack(rows, 'Date'),
68         y: unpack(rows, 'AAPL.High'),
69         line: { color: '#f0a500' }
70     };
71
72     var trace2 = {
73         type: "scatter",
74         mode: "lines",
75         name: 'Low',
76         x: unpack(rows, 'Date'),
77         y: unpack(rows, 'AAPL.Low'),
78         line: { color: '#03dcee' }
79     };
80
81     var data = [trace1, trace2];
82     var layout = {
83         paper_bgcolor: '#172042',
84         plot_bgcolor: '#172042',
85         showlegend: false,
86         margin: {
87             l: 30,
88             r: 30,
89             b: 30,
90             t: 30,
91             padding: 1
92         },
93         font: {
94             color: '#6b6f8a'
95         },
96         xaxis: {
97             range: ['2016-07-01', '2017-02-01'],
98             type: 'date'
99         },
100        yaxis: {
101            autorange: true,
102            type: 'linear'
103        }
104    };
105
106    Plotly.newPlot('scientificChart', data, layout, config);
107 });
108
109 // Pie Chart
110 var pieChartData = [{
111     values: [19, 26, 55],
112     labels: ['March', 'April', 'June'],
113     type: 'pie'
114 }];
115
116 var pieChartLayout = {
117     paper_bgcolor: '#172042',
118     plot_bgcolor: '#172042',
119     piecolorway: ['#f0a500', '#03dcee', '#178add'],
120     showlegend: false,

```

```

121     margin: {
122         l: 10,
123         r: 10,
124         b: 10,
125         t: 10,
126         padding: 1
127     },
128     height: 300,
129     width: 300
130 };
131
132 Plotly.newPlot('pieChart', pieChartData, pieChartLayout);
133
134 // Donut Chart
135 var donutChartData = [{
136     values: [10, 40, 50],
137     labels: ['Sep', 'Oct', 'Nov'],
138     hole: .4,
139     type: 'pie'
140 }];
141
142 Plotly.newPlot('donutChart', donutChartData, pieChartLayout);
143
144 // Carpet chart
145 var carpetChartData = {
146     type: 'carpet',
147     a: [4, 4, 4, 4.5, 4.5, 4.5, 5, 5, 5, 6, 6, 6],
148     b: [1, 2, 3, 1, 2, 3, 1, 2, 3, 1, 2, 3],
149     y: [2, 3.5, 4, 3, 4.5, 5, 5.5, 6.5, 7.5, 8, 8.5, 10],
150     aaxis: {
151         tickprefix: 'a = ',
152         ticksuffix: 'm',
153         smoothing: 1,
154         minorgridcount: 9,
155         minorgridcolor: '#f0a500',
156         gridcolor: '#f0a500',
157         color: '#03dcee'
158     },
159     baxis: {
160         tickprefix: 'b = ',
161         ticksuffix: 'Pa',
162         smoothing: 1,
163         minorgridcount: 9,
164         minorgridcolor: '#f0a500',
165         gridcolor: '#f0a500',
166         color: '#03dcee'
167     }
168 };
169
170 var carpetChartLayout = {
171     paper_bgcolor: '#172042',
172     plot_bgcolor: '#172042',
173     showlegend: false,
174     margin: {
175         l: 10,
176         r: 10,
177         b: 10,
178         t: 10,
179         padding: 1
180     },

```



```
181     font: {  
182       color: '#6b6f8a'  
183     },  
184     height: 300,  
185     width: 300  
186   };  
187  
188   Plotly.newPlot('carpetChart', [carpetChartData], carpetChartLayout);|
```