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Data Storytelling with Dashboard: Accelerating Understanding Through Data Visualization in Financial Technology Company Case Study

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Abstract

In the rapid development many organisation rely on context data to support as well as to assist its decision making process. Consequently, Business Intelligence (BI), Dashboard, and Data Visualization emerged as primary tools in early 1990s as a way to help practitioners, data analyst, and data scientist to present context data into an actionable information for decision making process. However, despite its robust and powerful tools, recent study done by Kaggle's survey in 2017 resulted that in the last five years, many companies were not able to create effective data-driven dashboard due to complex dataset, poor dashboard design, and insufficient storytelling. Hence, understanding of who is going to use dashboard, choosing which data and metrics to visualize in the right context, knowing how to convey information, driving engagement, and persuading audiences are essential in current business practices. This study is aimed to help practitioners to understand the impact of effective dashboard can have on decision making process, to design leveraging dashboard, and to present the dashboard in storytelling. A literature study is performed to gather all relevant information resulted in guidelines for dashboard creator. Case study in financial technology company is applied to experiment and to test the guidelines for assisting dashboard creator to present data-driven insight to the stakeholder.

1. INTRODUCTION

Large global enterprises have a long story been exploiting the benefits of Business Intelligence. In the past almost every Fortune 2000 company has a data warehouse or some variant *(*Eckerson, 2005). While nowadays in the first decade of 21st century, Business Intelligence has becoming the primary driver to support process innovation for organizations to provide a meaningful insight, to support decision making, and to drive organisation performance (Business Application Research Center , 2019). Watson and Wixom (2007) argue that Business Intelligence has become a strategic initiative and is used as an instrument to spur business effectiveness and innovation.

Business Intelligence (BI) itself can be defined as *"the process, tools, and technologies required to turn data into information and information into knowledge and plans that drive effective business activity" (*Eckerson, 2005). For the first time in 1958, IBM researcher H.P.Luhn introduced the term BI. He was realized that the automated information was being increased rapidly and this would be necessary to manage information. Luhn introduced a BI system as an automated system that would automatically abstract information from documents, encode the extracted information in a meaningful ways, and then distribute the information to relevant parties (Luhn, 1958). The goal of a BI is thus to supply relevant information to the right time and right people to support these action points in a quick and efficient manner through the use of technology.

Traditionally, implementing a BI tool or technology required to have data centre and to employ teams of BI specialists. Further, the information given by the traditional BI is commonly delivered in static reports with rows and columns which in the past is sufficient and acceptable for support the decision making within organization. Nevertheless, since rapid development of data science has continued immensely, particularly on the frontiers of machine learning and deep learning, nowadays companies seek a new solution to explore raw data combined with powerful and sophisticated analytic tools to gain insights for better decision making (Presthus & Canales, 2015). Their decisions are no longer have to be made in the row or column

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but more into visual based on evident experiments and more accurate forecasts.

This study is aimed to help practitioners to understand the impact of effective dashboard can have on decision making process, to design leveraging dashboard, and to present the dashboard. Based on various sources, guidelines is created to support future dashboard creator. Therefore, this study will discover the following research questions:

- What is Dashboard?
- How to design and to create effective Dashboard?
- How to present the Dashboard in storytelling?

2. METHODOLOGY

Theoretically, this paper will discuss the important of effective dashboard as a tool or a technology to support decision making process and the essential of storytelling to communicate the dashboard. This study uses literature reviews including academic papers, journals, reports, white papers and textbooks as secondary resources. Guideline on how to build effective dashboard is given. Finally this study provides a single case study to test the guideline into real business world. Experiment and testing are implemented for the period of 10 (ten) months working experience in one of financial technology company, named Mekar (PT Sampoerna Wirausaha).

2.1 Terminology

Dashboard

In the era of Industry 4.0, we received at least 5 (five) times more information than we had in 1980s. As a consequences, the way that we share information may influence to define the size of our audience. According to SAP Business Objects Lumira, it was found that data visualization helped person to recognize patterns and to interpret data faster. Therefore, it makes user easy to understand complex datasets, to explore data, and to provide insight in an efficient way. Another study done by IBM Smarter Planet Report in 2015 showed that in the last two years 90% of the world data has been created and the majority of the created data was visual.

Most companies have a massive amounts of data at their disposal, yet fail to utilize it in any meaningful way. But a powerful new business analytics tool is enabling many firms to leverage their data in key business decisions and processes with impressive results. "*When you are driving down the road, a quick glance at your car's dashboard gives you a lot of information. In an instant, you know how fast you are going, how much fuel you have remaining and weather the engine is overheating. The dashboard tells you the total miles the car has been driven and often, the mileage of this particular trip. Your peek at the dashboard allows you to see the time of day, weather your lights are on (or bright) and if the turn indicators are flashing. All this information is available by a fleeting look at the dashboard. Many new car dashboards offer even more useful data and indicators*" (Lockwood, 2005). In the following the data presentation through a dashboard, a concept driven from automobile to enterprise is presented (Figure 1). Dashboard can be defined as: "*a visual display which can provide the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so that the information can be monitored at a glance"* (Stephen, 2004).

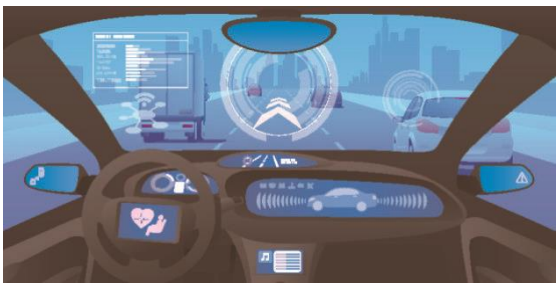


Figure 1.
Business Dashboard

The characteristics of dashboard

The fundamental characteristic of dashboard is clear. It is a single screen display and it displays the most important information to keep focus on one or more objectives (see Figure 2). With several charts or graphs, the dashboard can translate large complex data into the meaningful visual representation. An effective dashboard will also be able to speed up company decision making, track performance outcomes, and increase productivity (Tableau, 2019). Therefore, in order to accelerate understanding the complete overview and make fast data driven decisions, company needs to create effective dashboard which can combine storytelling and data at glance (Accenture Technology Labs, 2014). What is actually happening across datasets, correlate patterns across multiple metrics, and provide high level of summary are the ingredients of effective dashboard. The following are supporting attributes requires for dashboard to do its job effectively:

- High-level summaries with charts or graphs. The information displayed in charts or graphs. It consists of high-level summaries. It quickly tells you what is happening, but not why it is happening. Diagnosis requires further investigation and detail. A dashboard can

serve as the starting point for this investigation, letting you drill down into further detail to perform an analysis.

- Concise, clear, and intuitive display mechanisms. Display mechanisms that clearly state the message without taking much time. Therefore the entire collection of information will fit in a single screen.
- Customized. The information on a dashboard must be tailored specifically to the requirements of a given person, group, or function.
- Key Performance Indicator (KPI). The term of KPI is also known as Key Success Indicator (KSI). This KPI is a metric measuring how well the organization or individual performs an operational, tactical, or strategic activity that is important for the current and future success of organization. In the most cases, the dashboards are including this KPI that can help the organization to do some measurements.
- Right – time information. The dashboard should simply deliver the right information to the right people at the right time so the organization can make optimal business decisions. Right time puts the emphasis on the business value of information, not its latency.
- Web Server. A web server acts as the access mechanism for the dashboard. The web server provides the gateway between the dashboard user and the application itself. All user information is presented through the Web browser interface.

In the following an example of executive dashboard is given (Figure 2).

Type of Business dashboard

According to their role, dashboards can be categorized into: operational, tactical, and strategic (see Table 1). Operational dashboards emphasize monitoring more than analysis or management; tactical dashboards emphasize analysis more than monitoring or management; and strategic dashboards emphasize management more than monitoring or analysis. (Eckerson W. W., 2006). The operational dashboards monitor the core operational processes. They are mainly used by front-line workers and the supervisor who deal directly to the customers. The information is delivered in the detail format. In additional, the most information or data in operational dashboards are updated on an intra-day basis; in vary from minutes to hours, depending on the application. The tactical dashboards measure the organization processes and projects that are interest to a limited group of people. Manager and business analysis use tactical dashboards to compare performance of their projects, to budget plans, forecasts, or last period's results. Furthermore the tactical dashboards are usually updated daily or weekly with both detail and summary data. They tend to emphasis more in analysis than monitoring or management. The strategic dashboards monitor the execution of strategic objectives. They are frequently implemented using a scorecards approach. The goal of a strategic dashboard is to align the organization in the same direction of achieving the objectives. This type of dashboard is usually updated weekly or monthly. In additional they give the manager a powerful tool to communicate strategy, gain visibility into operations, and identify the key drivers of performance and business value

2.2 Guideline on how to create or to design effective dashboard

Once the characteristics and the type of dashboard are defined, dashboard creator could start to design the dashboard. To begin with, designer needs to select the supporting dashboard tools. This study recommends to use the following dashboard tools: .net Charting, Software FX, Dundas, Nevron, and InfoSoftGlobal (Suprata, 2006). The elimination step is reduced from the existing tools available in the market to the list of 32 (thirty-two) recommended tools to the list of 12 (twelve) recommended tools and resulted in those mentioned 5 (five) tools. The criteria is based on the following 8 (eight) criteria:

1. Ease of use : the need of expertise or required user experience;
2. Price : the development license, client license, website license and server license;
3. Support and documentation : good documentation, technical support, and help support;
4. Architecture : specific architecture for the tools;
5. Client Architecture: specific hardware for the end-user and platform of the end-user;
6. Data acquisition : access to the database;
7. Delivery method : live connection requirement;
8. Charting or graph features: the charting gallery and feature to support storytelling dashboard.

Traditionally, creating dashboard required to have data centre and to employ teams of dashboard specialists. Nevertheless, in current technology development dashboard tools are created to support end user with no technical background. In this case, the recommended dashboard tools are aimed to accommodate end-user with non-technical expertise and advance experience with a flexible drag-and-drop interface to design and to create effective dashboard. Once the dashboard tools are selected, the following guideline is given to help companies

on how to create and to design an effective dashboard (Accenture Technology Labs, 2014).

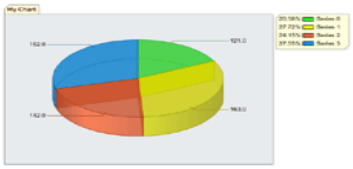
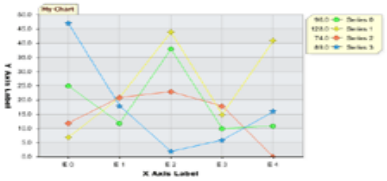
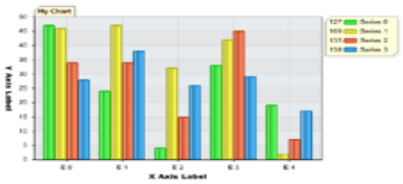
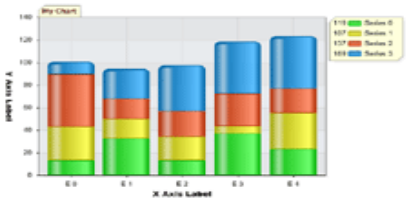
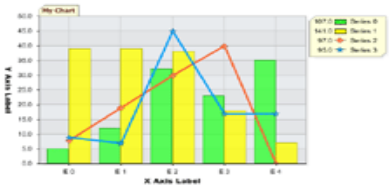
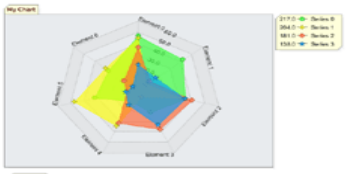
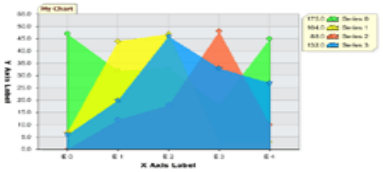
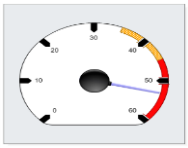
1. **Define audience.** Before start designing and creating dashboard, dashboard creators require to have a deep understand of who is going to use the dashboard. In this step, profiling audience will include understanding audience's background, aims, and needs. Accordingly, dashboard creators should be able to tailor which type of dashboard, the language, narrative or explanations, and the presentation style.
2. **Frame insights.** Once the audience is set, dashboard creator can directly align with the audience's aims and needs. It should be supported with narrative explanation to the visualization. In this step finding and refining the data are the key step to be considered. All of relevant data sources should be connected internally and externally, and the data source should be able to be accessed anytime and everywhere. All datasets are thus connected together.
3. **Establish the setting or context**. This step will focus on how and where the data will be shared. As an example the data can be shared via mobile, web-based presentation, or face-to-face presentation. Selection to proper visualization is a must so that all graphs and charts are clear, accessible and actionable. Which visualization type is best going to represent the key insights? There are plenty chart types to be chosen including bar, pie, area or bubble chart, line, area, gauge chart. In the following is the common use component text, graph or chart to be used when creating a dashboard (Table 2). Once it is decided on the chart that is fitted, it is time to get data in there and start creating an appealing and compelling data visualization.

Figure 2. An example of executive dashboard (Klipfolio, 2019)

Table 1
Type of dashboard according to Eckerson (2005)

	Operational	Tactical	Strategic
Purpose	Monitor operations	Measure progress	Execute strategy
Users	Supervisors, specialist	Managers, analysts	Executives, managers, staff
Scope	Operational	Departmental	Enterprise
Information	Detailed	Detailed/Summary	Detailed/Summary
Updates	Intra-day	Daily/weekly	Monthly/quarterly
Emphasis	Monitoring	Analysis	Management

Table 2.
Charts and Graphs Components

Charting Type	Purposes	Example
Simple text	Simple text can be used to present a number	91%
Tables	Tables is good be used to communicate multiple different units of measure	Table A B C Category 1 15% 22% 42% Category 2 40% 36% 20% Category 3 35% 17% 34% Category 4 30% 29% 26% Category 5 55% 30% 58% Category 6 11% 25% 49%
Pie Charts	A chart that represents the distribution or participation of each slice (item) over a certain total that is represented on the overall pie value. It is appropriate for models such as revenue contribution by product.	
Line Charts	Line Charts: A single or multi-line chart ideal for showing tendency over a period of time. It is appropriate for models that are emphasizing a continuing sequence of data or a trend line.	
Column Chart and Bar Chart	A single or multi-column chart is an ideal for showing or comparing items over a period of time or in a specific range of values.	
Stacked Column Chart and Stacked Bar Chart	A powerful chart that allows comparing several variables over period of time. Each one of the cost components is presented in a different color and each portion represents a different variable. The total bar size represents the total cost.	
Combination Chart	A combination column and line chart ideal for displaying a range of values and a trend line for those values.	
Radar Charts	A chart that allow easy comparison of values in a radial layout.	
Area Charts	Area chart can be considered a subset of a line chart, where the area under or above the line is shaded or colored. It is good for simple comparisons with multiple series of data. By setting contrasting color, the area chart can show the comparison between two or more series.	
Gauge Charts	A gauge chart (dial chart) represents one or more values as needles on circular or semicircular surface.	

4. **Focus on storytelling elements.** Once the dashboard is created, the subsequent step is to select on appropriate visualization and style to present the key insights. The dashboard can be successful once the insights will result in actionable outcome. In order to maximise the potential value, dashboard should be presented in a storytelling format. In some cases, key insight will be delivered in exploratory or explanatory style supported by narrative text to present insights, patterns or trends during the data analysis phase. The exploratory style. In other cases, objective or persuasive version can be implemented with support of clear data. In the persuasive style audience will be guided in to a specific conclusion or call to action. This study recommends dashboard creator to analyse the story plot by using Freytag's Pyramid. According to Gustav Freytag in 19th Century, the common patterns to create story are illustrated in Figure 3.

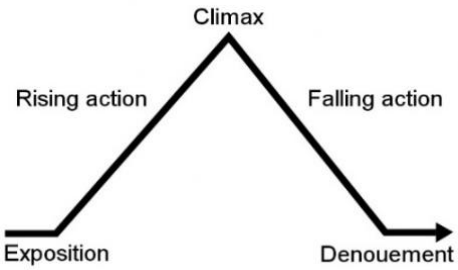


Figure 2 :
Plot Structure Freytag's Pyramid

In the exposition, author introduces the characters and setting by providing background and describing the situation. The rising action is happened once the story is created and got more exciting. Then, the climax can be occurred once the great tension of the story is told. Continue to the falling action where the story will soon end. And finally the denouement phase is coming to end the story by showing the solution to the main problem of conflict. The following is the comparison on how data looks on the storytelling diagram:

Table 3.
How does data look on the storytelling diagram?

The Story	The Data
Exposition	The data source, the aim of data
Rising action	What can be found in data?
Climax	Key findings or Key Insights
Falling Action	Details, Context, Interpretation, and Explanation
Denouement	Key finding and their importants

(Source: Berezhnaya, 2019)

5. **Consolidate and practices.** As the final step, dashboard creator should gather feedback during the process and present the story with supported clear data visualization to a test audience and iterate it as it is needed. In the following all steps are illustrated

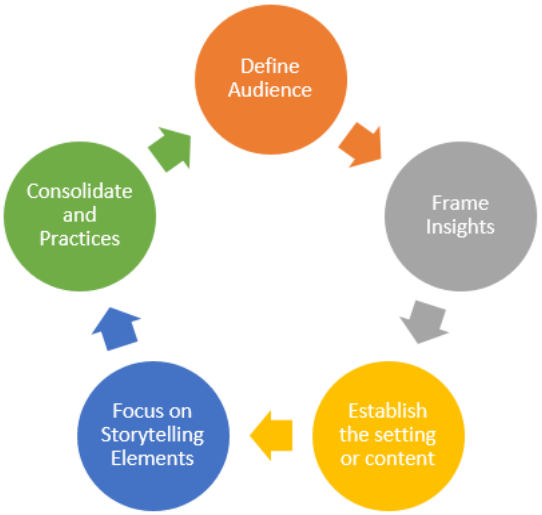


Figure 3 :
Dashboard Guideline

2.3 Case Study - Dashboard Solution at Mekar, PT. Mekar Investama Sampoerna, Jakarta

Mekar (PT Mekar Investama Sampoerna) is fully supported by the Putera Sampoerna Foundation. Mekar's vision is to improve access to finance to small businesses that have a positive economic and social impact in Indonesia. The company delivers its value by connecting funders with businesses needing finance using financial technology, peer-to-peer (P2P) platform. In order to enable its business value, Mekar partners closely with (non-bank) financial institutions which are present all over Indonesia. Technology is used by Mekar to improve access to finance for small business in Indonesia. This is done by engaging wealthier Indonesians to finance the less wealthy entrepreneurial Indonesians. By doing this, Mekar is able to develop its business sustainably across Indonesia. In 2019 Mekar partners with 20 (twenty) credit cooperatives, rural banks and financial institutions covering more than 200 (two hundred) branches across the country (Mekar, 2019).

On one hand, Mekar find, select and pre-hind the businesses and on the other hand Mekar selects the least risky borrowers for wealthier Indonesians to finance the businesses. Mekar uses https://mekar.id as the web platform for this service. As the business is expanding rapidly year to year, Mekar needs to find other solution that would enable its stakeholders including investors, funders, and its employees to quickly gauge and be alerted to inter-day lending activity (as opposed to month-end static

report reviews), and to be empowered to analyse and proactively address issues. The solutions needed to be easy for its stakeholders to navigate, and yet provide the power to do more in depth analysis as required. Further, as it is commonly used the information needed to be accessible on the web.

3. RESULTS AND DISCUSSION

The implementation was occurred during the working period of 10 (ten) months, starting at February 2017 until November 2017. Product developer manager was assigned to lead the development teams consists of employees from various departments, namely marketing, finance, user experience (UX) and user interface (UI) design, and information technology department. In the first 2 (two) months, product developer manager was asked to find the needs of Mekar Funders and collecting all necessary information to find solutions for the given challenges. In the user story format (As a user I want to…, so that I can…, with a minimum requirement…), the list of requirements were created. Using Agile philosophy, the development teams were collaboratively and productively managed to work together to create a tactical dashboard solution. The meeting was organized by product developer manager in the daily meeting setting. Scrum methodology was used as an approached to emphasize collaboration, functioning software, team self-management, and the flexibility to adapt to emerging business realities. The product developer manager was assign as a scrum master for developing the dashboard solutions. In the following the requirement mapping is illustrated in Figure 5.

The dashboard solutions were thus built incrementally conforming the guideline of this study.

1. **Define audience.** Mekar developed Mekar Funding Portal (MFP) infrastructure to accommodate business requirements and enable the company running MFP business model in an efficient, effective, and accountable way. The MFP was mainly used by funders or investors to provide them with the tactical dashboard where an overview of high-level summary and the KPIs of their Investment including the amount of profit, the amount of loan, and industrial trends presented.
2. **Frame insights.** This dashboard is a solution comprised of a data warehouse, sourced on-the-hour from the daily lending system with two different user interface – one, an easy to use, web-based, point and click dashboard for the funders and investors and a second more powerful tool for more complex analysis. The following is the architecture
3. **Establish the setting or context.** The dashboard was created to be accessed via website and mobile. Texts, tables, and pie charts were mostly used for the graphical and visualization since it is appropriate for models to show revenue contribution of each portfolios. The dashboard was comprised of a set of analysis “drill paths” which were in turn made up of a number of charts and graphs with one-click drill down capability. The drill paths were tailored to Mekar different group, allowing them to view all necessary information in the context of their own needs. Besides security logons, access to drill paths various according to each user’s access rights. Hence, this dashboard solution helps Mekar stakeholders to track trends, proactively identify portfolios, minimize risk, and manage costs in operation. The business value provided on this business dashboard are:
   - Easy to use trend tracking;
   - Up to date inter-day information;
   - Immediately pinpoint actions on investment;
   - Excel export option;
   - 24 x 7 Access through the website and mobile.
4. **Focus on storytelling elements.** The dashboard was created by implementing Plot Structure Freytag’s Pyramid and focus on exploratory style to present the investment insight and patters or trend during the investment period of time.
5. **Consolidate and practices.** As the final step, the dashboard was presented in each 3 (three) months lending partner or investors gathering. Feedback mechanism was created based on the insight from focus group discussion (FGDs). Due to the confidential nature of the data, the records of interview and FGDs were nor presented in this article. The following was the questions discussed in each FGDs:
   - Which organization are you?
   - What is your job title and your main area of responsibility within the organization?
   - Have you used a performance management dashboard before?
   - How often do you use the MFP business dashboard?
   - When you first started using the Business Dashboard, and What was your first impression?
   - Has the Business Dashboard helped you to get an overview and to monitor your investment?
   - How often would you prefer an update of the data in the business dashboard?
   - What kind of information would you like to see in the next dashboard version?
   - Below is a print screen of the existing business dashboard with all given information and overview? Can you please rank the importance of each functions?

- What do you think about the layout?
- Do you have any other suggestions for this MFP portal?

Tactical Dashboard at Mekar Funder Portal is illustrated in the Figure 6. Due to the confidential nature of the Dashboard, only test data is shown in Figure 6.

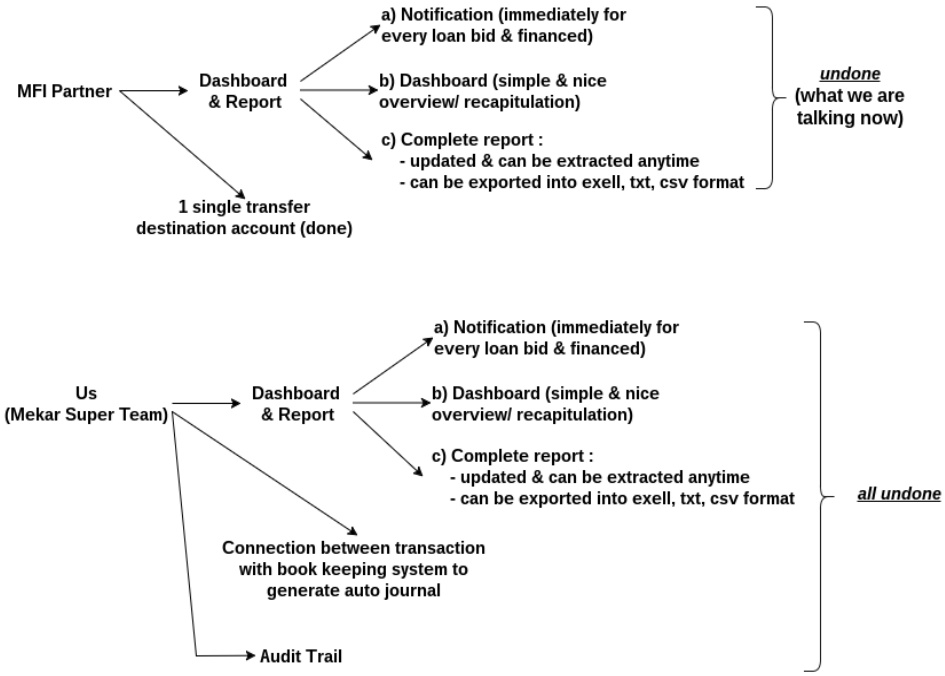


Figure 4.
The functional requirement of MFP tactical dashboard

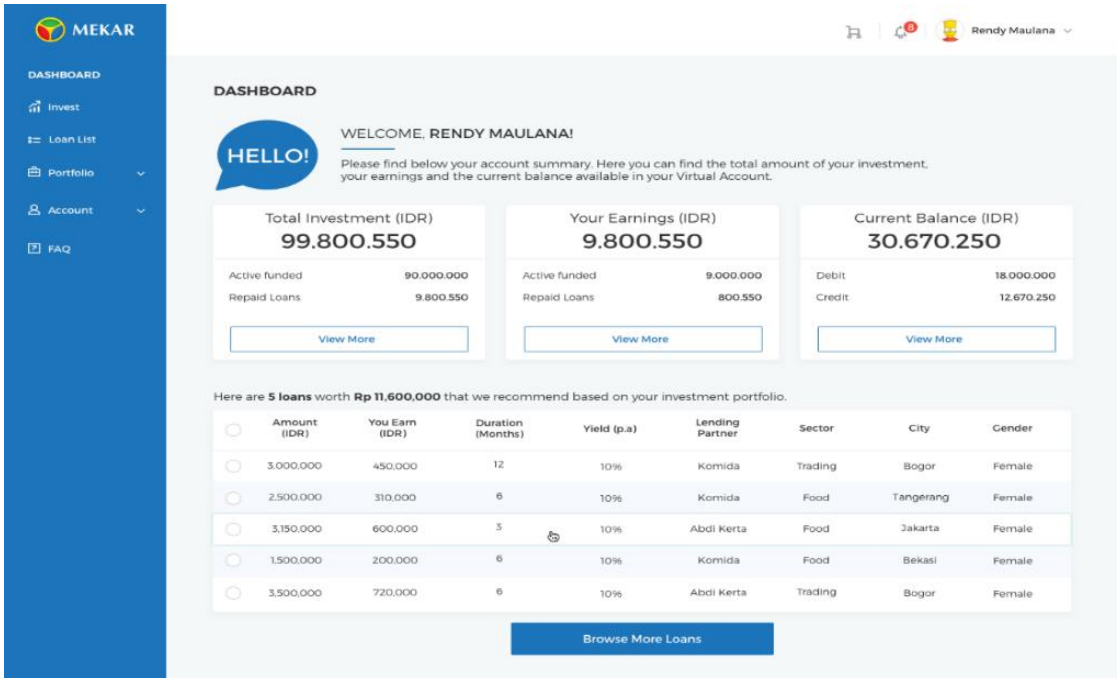


Figure 6.
Tactical Dashboard Mekar Funding Portal (MFP)

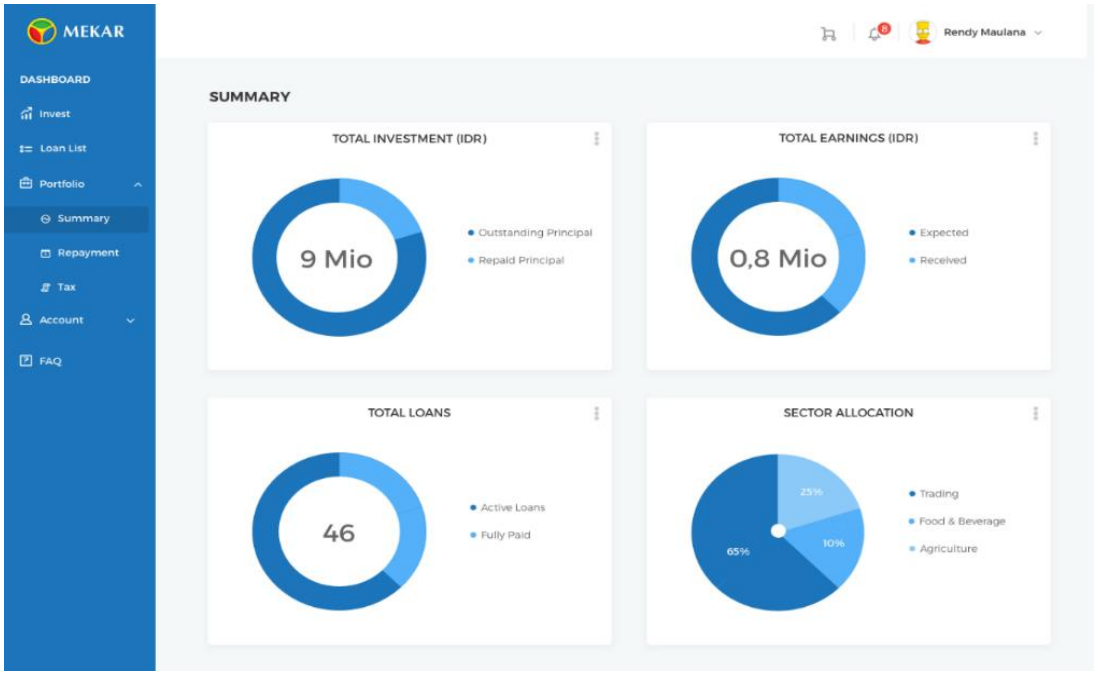


Figure 6.
Tactical Dashboard Mekar Funding Portal (MFP) (Cont'd)

4. CONCLUSIONS

In this era of big data, many companies are seeking a new solution to present its data and insights in a certain way so that it can reach an actionable outcome. In response to this need, this study has developed an approach and guideline on how to create, to design, and to present effective dashboard by combining the art of storytelling with the science of data. Hence, this study helps practitioners to drive innovation in accelerating understanding through data visualization. The guideline consist of the following steps: define the audience, frame insights, establish the setting or context, focus on storytelling elements, consolidate and practices. These guideline steps are implemented and tested in a financial technology company. Result of this study showed that the company was able to persuade the investors and funders to invest in the company portfolios.

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