Building A Sales Dashboard for A Sales Department by using Power BI

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Laurea University of Applied Sciences **Abstract**
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Business Intelligence can be defined as a solution which facilitates companies to make an intelligent decision in business processes. It can be a service to effectively organize and transform data into information, which is a knowledge basis in decision-making. With the help of an appropriate business intelligence solution, a company can play an active role in timely monitoring business performance, quickly responding to external business environment.

In this thesis project, the commissioning sales department, a vendor of transformer instruments, requires a power BI sales dashboard to monitor monthly sales performance. Thus, the purpose of this thesis is to build a sales dashboard displaying monthly sales performance by visualizing data in power BI. Power BI is a business intelligence software developed by Microsoft. Technical skills are not highly required when using power BI.

This thesis can be divided into two parts: a theoretical part and an empirical process. Theories include history and definition of business intelligence, an architecture of business intelligence, an introduction of power BI and a specification of its four building blocks. The empirical process builds the sales dashboard by power BI.

Since this is a software development process, it applies user-centric design as a guideline. There are four steps in user-centric design: gathering users' requirements, specifying the requirements, building a prototype and the real product, and finally evaluate the product. As for gathering users' requirements, a qualitative interview and benchmarking were selected. To evaluate the final sales dashboard, an interview was carried out again to collect comments from users.

Based on the results of evaluation, this sales dashboard meets with the requirements of department. The process of information delivery becomes smoother between visualized data and users than before. By viewing sales dashboard, users can clarify sales performance in current month. Moreover, the empirical steps specified in this thesis can provide a guide for the department to follow and improve in the future.

Keywords: Sales Dashboard, Power BI, Data Visualization, Business Intelligence

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1 Introduction

In an information age, a huge amount of data is generated in daily business process. When facing unorganized, large volume of data, companies have difficulty to understand and make use of them. Moreover, to quickly responding to an external business environment, it requires to make timely decisions correctly. Therefore, business intelligence has evolved into an indispensable solution to mine data, transform data to information to knowledge, which contributes in decision-making process. With the upgrade of business intelligence technology, technical expertise is not the only one who can participate to process and analyse data. Non-technical people can also utilise business intelligence software to achieve business objectives (Vercellis 2009).

By facilitating with user-friendly business intelligence software, some business units can less rely on supports from IT department. For example, to generally monitor a sales performance in a sales department, employees can make simple reports to view the details rather than asking technical colleagues to provide them. It can save time and improve work efficiency to create more value on sales performance (Vercellis 2009). In other words, it is necessary for companies to apply an appropriate business intelligence solution to solve out business problems.

1.1 Case Company Background and Problem Statement

Maschinenfabrik Reinhausen GmbH (MR) has specialized in power engineering industry for 150 years and the headquarters is in Germany. In 2006, MR established a subsidiary located in Shanghai, China，which is mainly responsible for sales in Chinese region. Messko brand, a transformer instruments manufacturer, is the second largest branch in MR China in terms of recent sales performance (MR: Success in Global Niches n.d.).

MR China is the commissioned company in this thesis project. The author had a four-month traineeship in Messko sales department. Besides the sales documents related work, making monthly sales report is required. The report is a simple Excel power pivot based on the excel files exported from SAP to reflect monthly sales performance. It serves to Messko sales employees, especially to sales director. At the end of each month, sales director mostly concerns about month to month sales amount. During traineeship period, author observed that reports were rarely used in department except for several important numbers checked by director. Additionally, when holding sales meeting, director even made new parallel graphs rather than directly using report. It seems that the sales reports hardly make a difference in the department.

After discussing with sales director and some employees, we found several reasons behind this problem. First of all, the users of reports are ambiguously targeted. So, report creator did not

know what data and information to display. Secondly, the representation style of report was still a collection of data. Some after-reading feedbacks from employees showed that they almost had no intuitive grasp of these reports. Instead of spending time on reports, they thought it was more efficient to rely on personal working summaries. Thirdly, director indicated that report lacked an overall view of sales performance. There were less logic connections among each section. As a result, it is necessary to move drawbacks and to improve the reports.

1.2 Research Objectives

Based on what have mentioned above, the aim of thesis project is to design a sales dashboard using power BI for Messko sales department to reflect monthly sales performance. It delivers data and information related to users. The representation is intuitive and appealing. The displayed contents should have a holistic view and priority to avoid plenty of focuses in a single dashboard. Furthermore, since data and information no longer serve mostly to decision-makers, the complete design process should be transparent inside department. The final dashboard can be regarded as an initiative and standardized version. Users still can follow the design process or modify it if there is new requirement appeared.

1.3 Thesis Structure and Limitation

The first chapter introduces background of case company and business problem. Research objectives and questions are indicated to point out thesis direction, while the structure and limitation shows a thesis framework and constraints. Chapter 2 specifically lists the research methodologies applied in this thesis: user-centric design, interview and benchmarking. Chapter 3 and chapter 4 are the theoretical parts demonstrating history, definition and architecture of business intelligence. Basic knowledge of power BI is also included which paves the way for following empirical part. Chapter 5 describes a subsequent design process of sales dashboard. The final chapter is the conclusion of thesis project followed by suggestions for commissioning company.

Concerning the limitation of project, the final project outcome cannot be generalized because the aim of dashboard serves to Messko sales department, while the internal data and information are absolutely private. However, the entire empirical process can be used for reference by other companies which may have similar problems.

2 Research Methodology

The project is aimed to design a sales dashboard via power BI for Messko sales department. Meanwhile, through the design process, employees are supposed to highlight the importance of business intelligence in their work finally. In the empirical research part, user-centric design approach is utilised in the sales dashboard design process. Qualitative interview is carried

out in user requirement gathering stage and final evaluation respectively, in which the sales director, two area sales managers, one order processing employee and current dashboard creator who is also another order processing employee within sales department will be interviewees. Both qualitative interviews are semi-structured, and researcher will build interview guides aligned to research purposes.

In addition, benchmarking is the second research methodology to support to make users' requirements specific. By selecting benchmarking dashboards with department and comparing diverse features, researcher can more accurately meet users' requirement and provide other professional knowledge for users.

2.1 User-centric Design

A user-centric design (UCD) approach refers to put users to the central place when designing and developing a new product (Novoseltseva 2017). Compared to human-centric design, UCD highly concentrates on the needs and requirements of users instead of a wider range of people. In other words, UCD can be a subcategory of human-centric design. In terms of data management related projects, users, rather than huge amounts of data, are the heart in a design process because data provides benefits to users. Therefore, aesthetics is not only the dominant issue for designing a data visualizing user interface. It is critical for the design project to fit for the ultimate usage as well (Catarci, Dix, Kimani and Santucci 2010).

In ISO 13470 (International Organization for Standardization 2010), it summarizes that there are four activities in user-centric design including "Understand and specify the context of use, understand and specify the user and business requirement, design the product, evaluate the design." The first step is to identify what remains the same as before when developing a new system, while the second step emphasizes aspects to get changed. During the initiating stage, users are indispensable roles to participate. However, they cannot always be on a leading position. Designers are supposed to apply expert knowledge as facilitating roles. As for designing phase, it is necessary to build a prototype showing an estimated outcome. In the final activity, "effectiveness, efficiency and satisfaction" (Catarci et al. 2010) included in "usability" are usually used as assessment standards for evaluating a design work, which successfully avoids developing poor usable systems with high cost.

In a dashboard project integrated with user-centric design approach, Users should be taken precedence over data. Instead of pursuing to access to widest datasets, designers need ground requirements from targeted users first, and quickly provide the most relevant information through dashboards (Lapointe 2008).

2.2 Interview

According to Catarci et al. (2010) and Novoseltseva (2017), interview is a typical research technique in user-centric design. The sample size is relatively low and it is usually carried out in requirement gathering and evaluation stages. In this project, qualitative interview is carried out to collect company's requirements and to evaluate dashboard. Qualitative interview aims for qualitative outcome that is called in-depth interview as well. It is semi-structured, in which interviewer follows an interview guide and catches key points came up by interviewees. Meanwhile, it is critical to hear diverse descriptions and understandings from respondents.

Brinkmann (2013) states that qualitative interview is a subsequent process containing four steps: preparing, interviewing, analysing and reporting. To prepare an interview, researcher should utilise appropriate sampling strategies to select qualified candidates. The potential interviewees can share their credible information in a comfortable environment. It is beneficial to conduct a pilot testing to identify some improper aspects of questions or other issues (Turner 2010). Next step is to design interview questions aligned with research purpose. Brinkmann (2013) also mentions that "how" questions are frequently asked in qualitative interview instead of "why", because interviewees more familiar to describe a phenomenon rather than summarizing the causes. In addition, to gain optimal answers, researchers should consider logical order when asking questions. Recording interviews is also indispensable for following analysing phase. As for analysing interview data, researchers discover the similarities and distinctions based on interview transcripts. Interpreting data without misunderstanding is equally important. In terms of the final step, reporting is to transform the interview process to text-based documents in an academic way. The context should follow the standards and guarantee accuracy (Brinkmann 2013).

Concerning analytical methods of qualitative research, thematic analysis is widely used to analyse collected qualitative data. It provides a relatively great of flexibility for researcher to choose theoretical framework. Basically, it has six steps: familiarizing with data, coding data, identifying themes, reviewing and refining themes, defining themes, concluding and reporting. The six steps help researcher to extract core idea from large-sized and unstructured qualitative data. It is critical to interpret data rather than simply to categorize and describe them (Clarke & Braun 2006).

To be specific, after researchers transcribe verbal data, they need read and re-read context to get familiarized. During the process, researchers gain a holistic view of transcripts to better understand the meaning of context. They can make notes or write down initial ideas beside text, which benefits to generate codes. The second step is to produce codes based on previous prepared work. According to Saldana (2009), code refers to a word or a short phrase to capture essence of a portion of text-based data. Generating codes requires researchers to

discover distinctions and similarities from raw data, to explore potential connections. In this step, raw data can be categorized into various units based on common features. The codes can be descriptions directly taken from text or abstracts according to related literature (Castleberry & Nolen 2018). To avoid being ambiguous about what to code, researchers can establish a coding strategy in advance by reviewing literature and previous researches. It guides researchers to code appropriately (Saldana 2009). After ensuring codes, researchers start to categorize codes into different themes. Theme is a broader concept than code. It requires a deeper interpretation for context and codes standing on an upper stage. Researchers find out the relationships among codes and create themes or sub-themes. They can use some visualized tools to display the hierarchy. The fourth phrase is to review themes. Apparently, not all of the themes created last step is meaningful. The qualitative data within eventual themes should logically cohere, while there are typical differences between themes. The fifth step is to describe the content of each theme. It is vital to be clear about the essence of individual theme and data. Finally, to write down a valuable report, the analysed data should go from a descriptive level to interpretive level, displaying a logic, concise, multi-dimensional analytical outcome (Clarke & Braun 2006).

2.3 Benchmarking

Benchmarking is the process of comparing the organizational operations with its competitors or the best companies with similar practices. It is an effective tool for self-evaluation and learning. Benchmarking requires continuously comparing products, services, strategies and other aspects with competitors or first-class enterprises, in order to identify the most excellent organizational practices and to compensate self-insufficiencies. It can be applied into many business operations. For example, when trying to meet customers' demands, company can utilise benchmarking studies to collect valuable information by researching successful operations from other organizations. This process help identifies the performance gap between the average and the best within industry. In addition, based on the studies, company can set realistic goals to achieve rather than being ambiguous in finding out direction (Patterson & Keppler. 1996).

Benchmarking has diverse types depending on its purposes and real situations. In this thesis project, functional benchmarking is used to learn what contents and features of a sales dashboard include for monitoring monthly business performance from benchmarking sales dashboards. Functional benchmarking focuses a comparison carried out in a specific function, such as logistics, finance, within an industry-class or a world-class. There is probably no direct competitive relationship between company and the benchmarking partners, which means that it is less difficult to have access to the information from benchmarking partners. Inspired by other successful cases, the company can improve its management process and various business functions in an open benchmarking environment (Leonard & Mohamed 1994).

According to Patterson and Keppler, Benchmarking is a continuous process based on “PDCA Cycle” (1996 53). It refers to plan, do, check and act. In the planning stage, the company should identify what to benchmark. Customers can be a critical source to know insufficiencies of company. Based on the information, the company can ensure the benchmarking topic and characteristics. Simultaneously, benchmarking participators inside company should have an open-minded attitude to engage into research activities. They are supposed to actively allocate individual time and to deal with problems. Then, benchmarking team can start to write plans. Next stage is to collect benchmarking data from partners. It is important for company to gather data and information according to the topic and desired outcome. After that, company should begin to check and analyse collected data, in order to find out the performance gap between the current state and desired state. In terms of acting stage, it is the final and essential step to change and revolute business processes. Since benchmarking is cyclic, evaluating final work and getting feedbacks are equally imperative to facilitate the following loop.

3 Business Intelligence

In daily business process, a huge amount of data is produced and stored in the database with great hidden value, which is an indispensable information asset for company to proactively occupy markets in rapidly changing business environment. However, data cannot be directly utilized into decision-making process, since the majority of formats are inconsistent, not context-based. Therefore, it is critical to exploit, analyse data and to discover information behind them (Loshin 2003). Business intelligence offers an access to collect, store, aggregate, analyse, report and visualize complex data to end users, such as data warehouse, data mart, data mining and data visualization. With the help of business intelligence, cost for data storage and management are decreased, while the information and knowledge successfully assist clients to avoid risks and to deeply get insight into their business value (Loshin 2003). The following sub-sections introduce the history, definition and architecture of business intelligence, offering a detailed structure of business intelligence to readers.

3.1 History of Business Intelligence

Joly (2016) states that IBM invented hard disk drive for data storage instead of filing cabinets in 1956. Simultaneously, Peter Luhn, a computer scientist from IBM, formally applied the term “Business Intelligence” into a journal article, in which he pointed out that business intelligence can be utilized as an automatic system for generating information to targeted organizations in various industries (Timo 2013).

In fact, it is still difficult to achieve data management in hard disk. Then, database came to the world bringing a new method to store and manage data around 1970, which was followed by some business tools to facilitate data management, for example, SAP. However, there was only one-dimensional report and the data was extracted from multiple data sources. To solve

out the problem, data warehouse entered and got popularities in the early 1980s. It offered an access for storing data in one place. Until now, data warehouse still occupies one of the critical parts in business intelligence system (History of Business Intelligence n.d.).

Based on previous step-by-step improvement, it came to Business Intelligence 1.0 era. From late 1990s to early 2000s, there were two basic functions of business intelligence including data and reports, or aggregation and visualization. Business intelligence system had more complete architecture and working process to meet demands of organization or a specific department. Meanwhile, instead of relying on technical support from IT department, business intelligence system began to provide self-service to evolve more non-technical end users (The History of BI: The 2000's and now 2014).

In the mid of 2000s, a rapidly changing business environment stimulated business enterprises to innovate information technology within business intelligence application for analysing near real-time data. The specific outcomes were connection between BI and web sources, mobile BI application, cloud BI platform and etc, which all belongs to business intelligence 2.0 era. (The History of BI: The 2000's and now 2014).

3.2 Definition of Business Intelligence

In a broad sense, Watson defines business intelligence is a "a broad category of applications, technologies, and processes for gathering, storing, accessing, and analysing data to help business users make better decisions" (2011, s.3). According to Vercellis (2009), business intelligence supports business decision makers to generate imperative information and knowledge by exploring data with the collaboration between various mathematical models and analytical methodologies.

From their perspectives, business intelligence mainly provides services for business end users in organizations and companies, commonly focusing on decision-making process but not be limited. In other words, to make better decisions and drive business to greater profit, correctly gathering and structuring data, turning data into valuable information and knowledge is the key workflow in business intelligence practice. Similarly, Loshin emphasizes the importance of knowledge with the ability to create "profitable actions" (2003, 6), aiming for dealing with business problems and increasing business performance.

3.3 Business Intelligence Architecture

During the past few of decades, business intelligence architecture has gone through an evolutionary process. The typical components are data source, data warehouse, business analytical methodologies, business performance management and end—user interface (Delen, Sharda and Turban. 2014). In this thesis, a more complete business intelligence architecture (see

figure 1) consisted of five layers will be specifically introduced as following (Ong, Siew and Wong 2011).

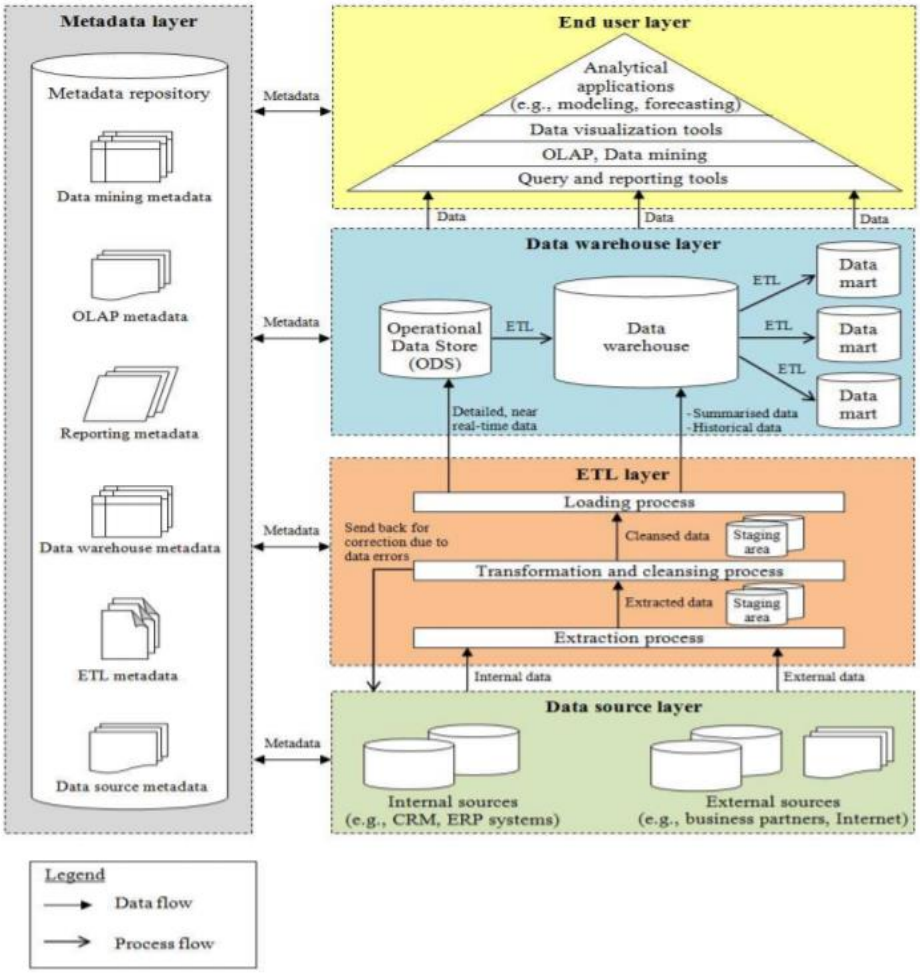

Figure 1 Five-layered Business Intelligence Architecture

3.3.1 Data Source Layer

In a business intelligence architecture, data source is like a foundation for building a house. It can be classified as internal and external data source. Internal data source means that data come from some operation systems inside an organization, such as customer relationship management (CRM), enterprise resource planning systems (ERP). The data basically are operational data, which is real-time, not historical. External data refers to the sources that originate from business partners, business intelligence vendors, government, Internet and etc (Ong et al. 2011).

For ensuring effectiveness of the business intelligence outcome, users should identify where data sources are exactly from. Meanwhile, data quality should be concentrated on, which can increase the reliability and validity of data.

3.3.2 ETL Layer

ETL layer refers to a process for extracting, transforming, cleansing and loading data. Extraction is the process of identifying and collecting data. In this stage, it is critical to select complete data with potential value and significance. As mentioned above, data may come from multiple internal and external sources. Consequently, the data formats, presenting styles are inconsistent. Data may be duplicated or partly missing as well. According to business rules and logic, data form should be standardized and converted to the form as required, which simplifies maintenance work and reduces analysing obstacles in the next layer. In addition, data cleansing is imperative to make data correct and accurate. After being transformed and cleansed, data need storing in a repository that is data warehouse, which is a loading process. (Ong et al. 2011).

ETL process provides a delivering path for data between source and objective. It is extremely important before operating data in data warehouse. When the data is loading into data warehouse, business analyst and decision maker get the access for further processing (Delen et al. 2014).

3.3.3 Data Warehouse Layer

Data Warehouse is a repository of recent and historical data with consolidated formats to support decision-making process. Recent data is stored in an operational data store（ODS）after ETL process, which usually support short-term decision-making or daily management. It would be regularly loaded into data warehouse integrated with historical data for systematic analyse. Once data is loaded into data warehouse, it is not allowed to change, delete and update.

Compared with operational database oriented to products, data is categorized by subject in data warehouse, such as sales, finance, logistics and customers. Subject is an abstraction of business data, organizing and structuring data at a higher level. Data warehouse is a subjected-oriented, integrated, time-variant and non-volatile data collection for mainly supporting managerial decision analysis (Delen et al. 2014).

Apart from ODS and central data warehouse, data mart is also one of the components in this layer. If data warehouse serves to the whole organization, data mart is targeted to a specific business unit or department. A data mart, usually containing a single subject, is a subset of a data warehouse (Delen et al. 2014). It is like a smaller data warehouse, but only storing data for a short period. Sometimes, due to high cost of applying a data warehouse, small companies prefer to choose independent data mart in a department.

3.3.4 End user Layer

As shown in figure 1, end user layer is displayed as a pyramid shape. In this layer, users can use front-end applications actively interacting with data in data warehouse, involving data mining, OLAP, data reporting and visualizing tools. Each layer in this pyramid aims for different organizational level. The bottom layer containing query and reporting tools which are frequently used by operational management level, while the highest with analytical applications facilitate top management level. Querying tools allow users to quickly access to data and reporting tools can generate required reports for users, such as ad hoc reports, budget reports (Ong et al. 2011).

Online Analytical Processing (OLAP) is cube-shaped, providing a multidimensional data analysis in data warehouse (see figure 2). OLAP has several critical functionalities: slice and dice, drill down or up, roll-up and pivot. It help users view and analyse data fast from multiple perspectives. Moreover, data mining techniques can be integrated to quickly identify necessary data in the data pool (Microsoft 2016.)

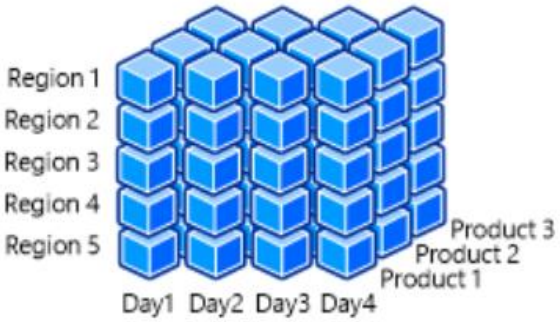

Figure 2 An OLAP Cube

The next layer contains data visualizing tools, like dashboards and scorecards. Users can directly explore and communicate with the information behind data. According to the subjects and features of data, designers should choose appropriate charts and graphs to help management level better monitor business performance (Delen et al. 2014). The analytical applications facilitate decision makers improve business operations and optimize business strategy (Ong et al. 2011).

3.3.5 Metadata Layer

Metadata refers to use data to describe data. It helps to understand traditional data. Delen et al. (2014) highlights that metadata makes a difference in creating knowledge by enriching information. Take ETL metadata as an example. ETL is to extract, transform and load data into data warehouse. Therefore, ETL metadata involves information such as data sources, business rules. Similarly, OLAP metadata introduces dimensions, levels, hierarchies of data. In other

word, metadata is included in other four layers in the business intelligence architecture. It is necessary for organizations to concentrate on building a metadata strategy (Ong et al. 2011).

Overall, the role of business intelligence is to make company's decision-making process reliable and reduce blindness. Therefore, each layer should provide useful reference for company. Based on the requirement from users and business environment, business intelligence system can quickly respond and reflect business problems, so that decision makers could solve them timely.

4 Microsoft Power BI

One of the powerful BI vendors is power BI developed by Microsoft. It is capable of collecting complete data from various data sources, rationally organizing and visualizing data, then quickly sharing outcomes with users. Instead of relying on IT department or data administrators in an organization, power BI provides self-service for end users to establish reports and dashboards by themselves. In other words, power BI is a less technical-oriented business intelligence tool and it is user-friendly for beginners.

4.1 An Overview of Power BI

Power BI is a cloud-based business analytical and visualizing tool for business users to monitor business performance and interact with data. It allows to connect data from local files, Microsoft share points, enterprise data warehouse and other sources. In addition, for Excel users, they can publish the insights created in Excel to power BI, such as pivot tables, dashboards. In other words, power BI encompasses four traditional excel add-ins: power query, power pivot, power view and power map which is user-friendly to those who are accustomed to use excel (Microsoft 2018).

There are three components included in power BI services: power BI desktop, power BI service, and power BI mobile app. Power BI desktop has the strongest integrated abilities to connect, transform and visualize data. After connecting with data sources, imported data can be transformed and cleansed in query editor. Then, users build data model, visualise data through creating reports or dashboards, and publish finally. Usually, users publish visualized contents in power BI service. It is also convenient for users to make changes and manage visualised outcomes based on requirement. In terms of power BI mobile application, it can be downloaded and installed on Android or IOS devices. Without limitations of time and locations, users can directly view and interact with published data (Microsoft 2018).

The way to use power BI services depends on the user's role in a team or an organization. For example, the colleague who mainly works with data processing and reports creation might prefer power BI desktop, while another sales executive whose job is to monitor the progress of sales work and get insight into a new sales opportunity primarily chooses mobile app.

These three services collaborated with each other provide a holistic business intelligence solution for users in different business scenarios (Microsoft 2018).

4.2 From Excel Add-in to Power BI

Before the releasing of power BI, Excel is the primary choice for statistical analysis. No matter what the size of dataset it is, Excel can support to process data, design graphics and charts for business users. To strengthen the ability of analysis, Microsoft has gradually released several add-ins integrated into Excel that are power query, power pivot, power view and power map.

Power Query is a technology for connecting with data sources, shaping data to meet requirements. User can transform data facilitated by query editor. Each transforming step would be documented appearing in the list, and users are able to view each step and change the names of steps. As for advances query editor, users can type their own conversion by M language.

Power pivot, as a data modelling add-in, is to build relationships among tables, create data models and calculations. According to Clark (2017), sometimes, there is a dilemma in business analytical scenarios caused by a rigid analysis in data warehouse and a loose analysis in isolated Excel worksheets. Conducting an analysis in data warehouse requires a long-run support from IT department, while analysis based on Excel worksheets cannot ensure the validity and security issues of data. Therefore, extracting data from data warehouse and analysing them through power pivots can increase work effectiveness and decrease IT involvement.

Power View and power map are data visualization technology for designing interactive charts, graphs, 3-D maps and other appropriate visualized effects. Based on the visualization, business executives can timely view the trend and identify the problems. Meanwhile, decision makers carry out solution to solve problems and improve business performance.

According to Microsoft (2018), the four add-ins mentioned above are integrated into power BI services. In power BI desktop, data are collected from varying sources, get transformed and cleansed in query editor. All the changes would be applied into data modelling section called “Model Designer” (Clark 2017). Similar to power pivot in Excel, users are allowed to build relationships, create calculated columns, measures for deeply exploring valuable information behind data. Then, users design, customize visualizations, share the results within an organization or a larger group. To get an ideal business intelligence solution, users may spend majority of time on working with power BI desktop. Simultaneously, depending on different roles in a work process flow, users also utilize online service and mobile app to enrich the whole solution.

4.3 Building Blocks of Power BI

Powell (2018) states that a business team, in a self-service BI approach, owns the greatest flexibility to control dataset and visualization layer and to tailor business intelligence solution, while BI center or IT department provides technical support as a supplementary role. To create helpful reports or dashboards for management-level use, it is imperative to get clear about the four building blocks of power BI: visualization, dataset, report, dashboard and the relationships among them.

4.3.1 Visualization

Microsoft (n.d.) generally defines visualization is to visually display collected data by using various charts, graphs or other visualization types. Nowadays, people rely on data visualization in business intelligence solutions increasingly. Comparing with directly facing a large amount of complex data, humans are better at processing visualized data representation, for example, as a pie chart or a histogram. With the facilitation of computer graphics processing technology, data visualization tools support users to more easily comprehend the periodic business performance, view trend and carry out relative action plans quickly.

When conducting a data visualization project, visualization designers should think how to make users to access to data in a comprehensible way. The ultimate objective for data visualization is to effectively deliver information and knowledge to decision-makers without a misleading. Therefore, comprehensibility, applicability and choosing appropriate visualization types are extremely critical (Mckay 2018).

4.3.2 Dataset, Report and Dashboard

In terms of a power BI dataset, it is a data model empowering data queries, relationships among fact tables and dimensional tables, and measures (Powell 2018). Dataset is also defined as a collection of data from multiple data sources. Power BI includes abundant data connectors, which enables user to combine various data from Excel files, SQL database and other sources and then to create a dataset (Microsoft 2018).

After creating a dataset, users can design reports or dashboards. A power BI report is a collection of visualization types designed on several pages. The report is usually designed through power BI desktop and published in online services, and users are able to view it via power BI application on mobile devices (Microsoft 2018). It is necessary for designers to conduct a report planning before design work, such as getting clear about the targeted users, business questions and creating a supportive dataset. Therefore, the report can be ensured to align with end users' requirements (Powell 2018).

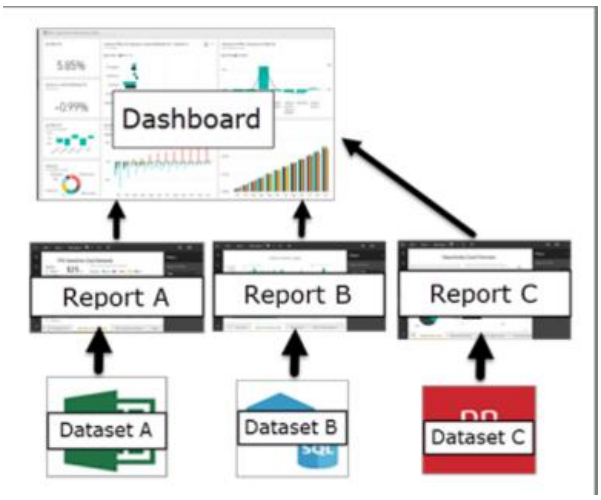

Figure 3 Connection of datasets, reports and dashboards

Similar to report, dashboard is a communicating means to display data extracted from report (see figure 3). One of typical differences is that dashboard only contains single page, which means that the presenting information is more concise and targeted. In a rapidly changing business environment, a timely dashboard creates added value for quickly managing performance, acquiring and comprehending information (Microsoft 2018).

To design a valuable dashboard, there are multiple elements that should be focused. Firstly, Skorka (n.d.) indicates that a dashboard should provide accurate contents related to users. Decision makers explore the information hidden in complex data. Therefore, visualized data on dashboard is the critical source for making decision. Before designing dashboard, designer need identify what data are required by users. Secondly, Skorka (n.d.) highlights the importance for choosing appropriate visualized techniques to help users easily understand data. Dashboard delivers data and information to users, like a storyteller. It is necessary for dashboard to provide a clear and intuitive view. Thus, users have no more barriers to interpret contents (Colhoun & Srinivasan n.d.). Thirdly, designer should identify the users of the dashboard. Such as the size and type of users, when and where users utilize dashboard. Based on them, it is clearer to create user scenarios and customize dashboard. Simultaneously, as the dashboard has a limited space, a combination of graphics and texts should be the most representative and can accurately deliver the valuable information to executives or managers. It needed, detailed data can be provided through supplementary reports (Colhoun & Srinivasan n.d.). Finally, dashboard is not enough as a tool to display data and to inform users. It is imperative to trigger actions. Users gain insights in terms of a deep understanding of current situation and business problems from dashboard. Based on them, users should take actions to solve problems and make improvement, which is essential value of a dashboard (Skorka n.d.).

5 User-centric Design of Dashboard

5.1 Requirement Gathering

In user-centric design, gathering users' requirements is the initial step to acquire customers' demands by using effective methodologies. In this thesis project, qualitative interview and benchmarking are selected to collect Messko employees' requirements of new sales dashboard.

5.1.1 Interview

In terms of interviews, four employees are chosen as interviewees depending on personal positions in department. There are two objectives which are identifying problems of current Messko report and collecting new requirements for building new sales dashboard in terms of content and representation feature. Due to issues of locations, interviews are conducted through video and conversations are recorded by phones. Based on records, researcher transcribe verbal data into texts and analyse them by using thematic analysis. Analysing transcripts goes through six steps. The first step is to familiarize transcripts. Researcher read and re-read them, while timely making notes beside texts. The notes include documenting key points of replies and what reflections researcher may produce. Making notes can help to interpret transcripts and generate codes. Next step is to codify data. Generating codes is to discover similarities of data and categorize them. In each transcript, some words and opinions may have homogeneous starting points, potential connections and share similar characteristics. Researcher should find out the patterns and group them (Saldana 2016). Furthermore, coding cannot be accurately achieved once. It may be conducted for several cycles, because researcher hardly interpret transcripts in detail at the first time. The third step is to find out themes based on codes. It is a hierarchical structure of codes and themes. Compared with codes, themes are conceptualized, more abstract and have typical features which can easily be distinguished.

To be more specific, the first code -- **not intuitive** is mentioned by four interviewees:

> *"Firstly, although required measures are displayed on report, the measures are only represented as data. They are not intuitive enough. If I check them by myself, it would take lots of time. Sometimes, I hope to know other measures, but it would be still plenty of data. As a result, I make a simple histogram or other simplified graphics by myself." (Ren Jia)*

> *"Although content is approaching satisfactory, the representation style is always data. I know that they provide original data files extracted from SAP. The final report should not still contain a large amount of data since we need to figure out, for example, an increasing trend by ourselves." (Chen Haisheng)*

> *"Although I am not a professional report maker, I do not think that the current style is appropriate. For example, as for the sales net value, it is directly listed data, which can make a sense if there is no requirement to display a developing trend. However, ranking area sales managers' sales performance cannot only be represented as data. It should be added some lines, which is clearer to us." (Jin Shun)*

> *"To be honest, it is a little boring when you see it again and again. The power pivot extracts several key values from original data set, and they are still data." (Wang Qing)*

Based on transcripts above, the representation of power pivot is still data. Users think that it is difficult for them to efficiently explore information from a large set of data. Users prefer to make simple graphics by themselves to present a developing trend, for example. Moreover, they suggest to display visualized information with charts or graphics, which is more intuitive for them to read.

Ambiguous targeted audience comes from:

> *"I remembered that I listed some critical measures at the beginning and Wang Qing made this power pivot based on my requirements." (Ren Jia)*

> *"Basically, at the end of each month, when they finalize the reports, I require them to send year to year net sales value and total sales amount of current month to me." (Ren Jia)*

> *"The first time when I finish making it, I send it to director to get approved for this power pivot. Then, he agrees to use it. At the end of each month, I would report monthly net sales value of Messko in EUR and CNY to Ren Jia." (Wang Qing)*

> *"I will check it before reporting my sales work to Ren Jia each month, especially some critical numbers. Sometimes, in sales meeting, we will discuss about sales performance based on reports." (Chen Haisheng)*

Sales director mentions that he gives requirements for the power pivot at the beginning and Wang Qing creates the first version and gets approval from director. Then, the power pivot is available in Messko department and other team members can utilize it. Although they are the users of Messko report, their requirements are not collected by Wang Qing. In other words, the power pivot serves to the whole department, but the audience is limited to director at the beginning, which is ambiguous.

Less attention by team is come up by the power pivot builder and other two employees as well:

> *"My current task is to report several numbers to Ren Jia. Apart from that, I do not think that this report makes a difference in our sales work. Other colleagues do not focus on it too much. I prefer to say that the report only serves to sales director rather than the whole Messko team". (Wang Qing)*

> *"I will check it before reporting my sales work to Ren Jia each month, especially some critical numbers. Sometimes, in sales meeting, we will discuss about sales performance based on reports. But I seldomly use it in other time." (Chen Haisheng)*

> *"I am personally concerned about measures of products. Although there is not enough information on the power pivot, it still gives me a basic view. In fact, I would not pay too much attention on it." (Jin Shun)*

The power pivot does not get too much attention in department unless employees' real demands from work. This situation can be partly caused by ambiguous targeted audience at the beginning. Builder does not gather requirements in Messko department except the sales director.

Manually refresh is raised by power pivot builder:

> *"And also, I always need to build a new power pivot based on the excel workbook monthly." (Wang Qing)*

When he gets the Excel workbook, he always needs to build a new monthly power pivot manually. It takes part of his working hours and the whole process is repetitive work for him.

The codes extracted from interview transcripts could be categorized as "problem". The theme is defined as shortcomings of current power pivot. Only being clear about problems of current Messko report can avoid these shortcomings and build a valuable dashboard.

Sales Net Value is emphasized by all interviewees:

> *"My personal sales performance, sales net value, investigating sales amount of my key customers and products sales." (Chen Haisheng)*

> *"Generally speaking, there are three parts I am concerned about. Month-to-month sales net value, area sales managers' sales performance and customers." (Ren Jia)*

> *"I check sales net value for current month in power pivot most of time. It directly shows sales performance." (Jin Shun)*

> *"At the end of each month, I would report monthly net sales value of Messko in EUR and CNY to Ren Jia. It is really important in our department. He quite focuses on these numbers." (Wang Qing)*

> *"Especially when I need compare sales net value this year with last year, for example, it is better to display as graphics, rather than doing calculations by us." (Ren Jia)*

The sales net value is a critical measure in Messko department. It reflects a total sales performance in general. This measure has already been existing in Excel workbook extracted from SAP. In power pivot, the sales net values of each year are listed in a table. Users can check year-to-year sales net value and month-to-month sales net value by applying filter. However, sales director points out that sales net value can be displayed as graphics which is easier for compare.

A rank of ASMs' personal sales performance is come up by two interviewees and individual developing trend of ASMs' monthly sales performance is also required:

> *"My personal sales performance and others', since every ASM cares about the sales champion." (Chen Haisheng)*

> *"Firstly, area sales managers' performance, of course, should be focused because it measures individual sales work. A rank of ASMs' personal sales performance from highest to lowest is possible. And also, individual developing trend of ASMs' monthly sales performance is needed." (Ren Jia)*

Area sales managers and sales director care about individual sales performance. They require to rank their sales performance personally. Based on the rank, team leader can directly check whose performance is the highest or the lowest. For the ASM whose performance is unsatisfactory, sales director could carry out modifications to allocate sales task. Moreover, sales director wonders individual sales performance trend by month. It allows to compare personal sales performance in several months.

ASMs' sales performance by transformer manufacturer and product is also concerned by area sales manager:

> *"investigating sales amount of my key customers, like transformer manufacturer and products sales." (Chen Haisheng)*

Area sales manager can know individual sales performance by their customers and sold products. It is more detail-focused, which needs the measures of sales net value, transformer manufacturer and product information.

The information related to area sales manager are categorized in sub-theme called “ASMs’ sales performance”. This part is quite focused by Messko department. Thus, it should be labelled with high level of importance.

Concerning for content related to customer, **sales net value by transformer manufacturer and OEM group** is mentioned in interview. Moreover, **project name** is required by sales director:

> *“And uhm… as for customers, sales net value of each OEM group or transformer manufacturer is critical for me. What is the sales value of my key customers? What about the percent?” (Chen Haisheng)*

> *“For example, net sales value by critical OEM group, area sales managers’ performance by customers. What projects do we participate? What are the outcomes of these projects?” (Ren Jia)*

In the Excel workbook, customers can be found in columns of “OEM group” and “transformer manufacturer”. The department requires to display information of sales net value of customer. Meanwhile, each order is related to a project. Sales director need the information of project and corresponding customer. All of the information related to customers are categorized in sub-theme named “customers’ sales performance”.

Two interviewees think that **sales net value of each product**, **sales performance of product by ASM** should be added:

> *“For me, I think that Wang Qing can add some information about products, like how much is OLI sold? And, it is possible to make a graphic about sales of each product by area sales manager.” (Chen Haisheng)*

> *“For me, I want to add information about products. For example, what is the sales net value of Trasy series?” (Jin Shun)*

They can be categorized in the sub-theme called “product sale performance”. In power pivot, there is no information about products, because sales director does not require them at the beginning, and report builder hardly collects requirements from remaining employees. Now, some employees who care about information of products require to add this part in dashboard. The three sub-themes and sales net value are categorized in a theme called content.

Appropriate visualized tool is mostly focused by department:

> *"Each measure should be matched with appropriate representation styles. Depending on targeted content, you should use appropriate method to display it." (Ren Jia)*

> *"Firstly, you can make changes for representation styles. It is not necessary to make it more beautiful. It should clearly demonstrate information by using proper tools." (Jin Shun)*

> *"Actually, it is possible to design some charts instead of directly displaying data. I know, in fact, only displaying data is not proper and less effective." (Wang Qing)*

To effectively deliver information to users, different information should be visualized by appropriate tools. For example, if users want to view a developing trend of sales net value, line charts could be more appropriate than only displaying data.

Information priority and **organized in order** is mentioned by sales director and power pivot builder:

> *"For me, the point is that the most concerned part can be displayed firstly, for example, sales net value, ASMs' performance and the second is…, the third part is… and so on. In the new sales dashboard, everybody can easily catch up with the important information" (Wang Qing)*

> *"Another point is that the information should be organized in order. We can easily know which part is about ASM, which graphic tells customers' sales performance. I really do not want to find something in a mess." (Ren Jia)*

The information displayed on dashboard interface is supposed to organized in order depending on level of importance. Each graphic should be added a name and users can easily know what it is rather than finding the information by themselves.

aesthetic consideration is put forward by one interviewee:

> *"I mean we should have some aesthetic considerations to attract attention from my colleagues. It may use theme colour, and have a clear layout." (Wang Qing)*

The new sales dashboard should add aesthetic considerations by using appropriate colour. The layout is clear, which means that the users can quickly navigate to the important information, and they can understand the potential relationships between graphics.

Mobile phone and **laptop** are required**:**

> *"I come to office two days in a week on average. Majority of time are spent on waiting for airplanes in airports. Aha, just a joke. Because we are salesmen, actually, staying in Shanghai to deal with daily issues is hard. Uhm, except for order processing employees, area sales manager and I are regularly on business trips. If possible, I wish that it is available in mobile phone when I am not in my office." (Ren Jia)*
>
> *"Since I work in office more than others, I want to use it on my laptop." (Wang Qing)*

In Messko department, due to everyone's different working environments, some employees who have frequent business trips require to use dashboard on mobile devices. Others who stay in office more think using laptop is enough.

Theme	Sub-theme	Code
Problem		not intuitive ambiguous targeted audience less attention by team manually refresh
Content	sales net value	
	ASMs' sales performance	A rank of ASMs' personal sales performance ASMs' sales performance by transformer manufacturer and product
	customers' performance	sales net value by transformer manufacturer and OEM group project name
	products performance	sales net value of each product sales performance of product by ASM
Representation feature		Appropriate visualized tool Information priority and organized in order
		aesthetic consideration
Device		Mobile phone laptop

Table 1 Code, Sub-theme and Theme of Thematic Analysis

Table 1 is the extracted code, sub-theme and theme based on the interpretation of interview transcripts. It demonstrates problems existing in power pivot. Then, interviewees come up with requirements for new sales dashboard in terms of content and representation. Moreover, they also require that the dashboard can be available in mobile device in case of business trips. The result guides sales dashboard designer to create required contents on dashboard. Additionally, representation feature is also considered when designing interface.

5.1.2 Benchmarking

Apart from requirements gathered from interview, benchmarking is carried out to show what a dashboard interface looks like. Because the current state of commissioning department is that they have no relevant experience of designing sales dashboard by using power BI, it is beneficial for them to know how to design their own sales dashboard by learning real-world scenarios. The objective of benchmarking is to facilitate Messko department to determine layout, components and visualized tools of sales dashboard canvas.

The first benchmarking dashboard (figure 4) is an online resource offered by Enterprise DNA. It illustrates a company's sales summary based in Australia. Readers can have easy access to look through information at a glance.

Figure 4 Power BI Sales Dashboard from Enterprise DNA

Layout: The dashboard can be generally divided into two sides. The left side includes name of dashboard and four slicers and the other side visualized information in a comprehensive way. As for slicers, users can check filtered information of displayed on right side by actively choosing time interval and products. Designer can display imperative slicers together for easily navigating to desired information. In right side, 6 tiles are suitably aligned with each other

horizontally and vertically. It makes full use of limited space to demonstrate sales performance. Concerning colour, the dashboard keeps a consistency to effectively avoid interrupting thinking.

Components: 6 components are well-structured following a logical order. The top tile is called “Key Business Performance Trend” embedding five typical trends. The middle tiles are “Regional Sales Performance” and “Sales by Month and Year per Channel” telling general sales performance from distinct perspectives. The bottom tiles are displaying “top 5 territories and cities”, “customer sales performance”. In which “top 5 territories and cities” closely follow “Regional Sales Performance” because they are all related to geographical issues. Therefore, designer should consider logical connections among components to make information more comprehensible.

Visualized Tools: In top tile, line charts are utilised to visualize trends marked with values. It is good at displaying data changing over time which is ideal to show trends in a setting time interval. As for displaying sales performance, comparing two or more values is common. Column chart is an appropriate option indicating data distribution with a series of horizontal or vertical stripes of distinct heights. There is no direct data label, but when hovering on the stripes, specific sales values can be displayed. In terms of visualizing information related to geographical issues, map is a great facilitator to vividly show regional sales performance.

The following dashboard is made via power BI as well. It allows users to drill down and explore various information and features by interacting with charts and diagrams.

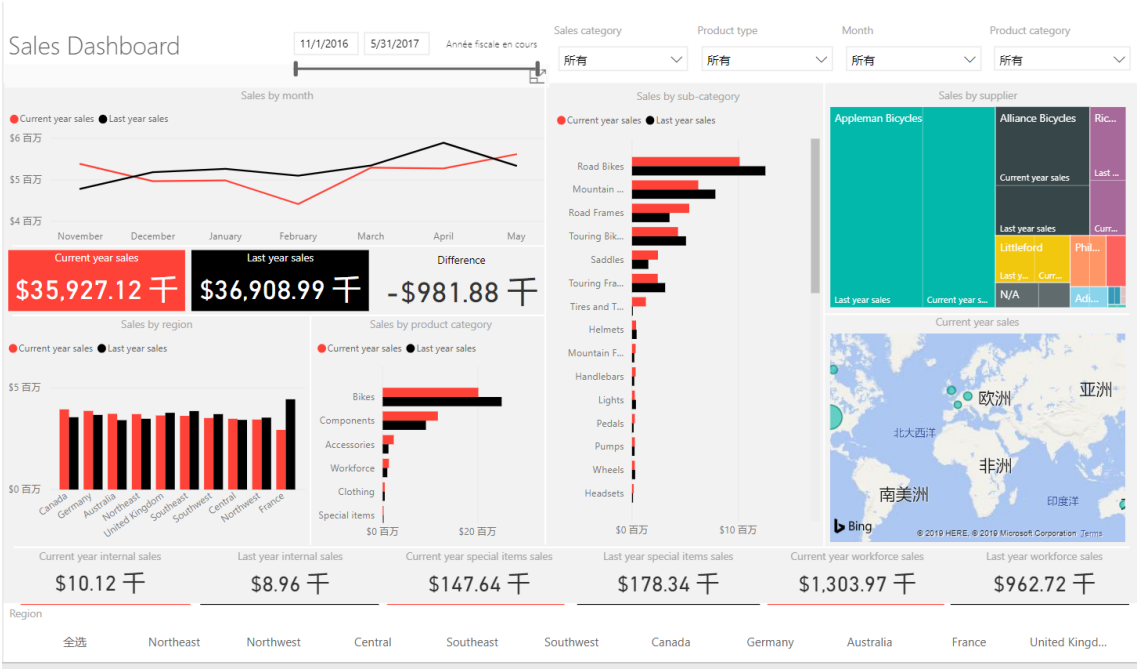

Figure 5 Interactive Sales Dashboard from Faction A Squad

Layout: It starts with slicers on the top of dashboard. Users can easily get access to filtered information via slicers. Different tile is perfectly aligned with each other. Moreover, designer do not make typical changes of colour. tiles with same colour themes are moved together to display a comfortable visualization.

Components: This sales dashboard mainly compare sales performance between current year and last year from products and sales category. Meanwhile, regional sales performance is visualized by map and users can choose different region name to navigate as well. In terms of "Sales by Product Category" and "Sales by Product Sub-category", since this dashboard is built on power BI report canvas, drill down function is available to go to next level in the hierarchy.

Visualized Tools: To compare sales performance between current year and last year, majority of visualized tools contain two variables. "Sales by Month" tiles can directly show numbers, while combining with line charts. Tiles with column bars, especially "Sales by Product Category" and "Sales by Product Sub-category", are not labelled with specific numbers. It is difficult for users to check sales value. What's more. Except for several sub-categorized products, the rest can hardly be compared intuitively by using column bars. Designer should choose more appropriate visualized tools or it can only display main products with top sales performance.

Both sales dashboards are built on Power BI report canvas. The commissioning department and researcher still decide to build dashboard on Power BI dashboard canvas. Messko sales dashboard mainly provides an overview of monthly sales performance. It displays visualized sales information of current month from several perspectives related to users. In fact, before designing dashboard, report should be built first and designer pin desired tiles to dashboard, in which slicer and drill up/drill down functions are only available in report canvas. Therefore, department expects to build a detail-focused report as well, containing three pages: responsible ASM, customer and product. When users look through dashboard and click tail, they can be redirected to relative page of sales report and check details.

5.2 Interfaces Prototyping

Before building real dashboard and report, it is imperative to build prototypes. Based on requirements collected from interviews and benchmarking, prototypes of dashboard and report will be built via Microsoft power point. Each slide is utilized as a canvas of power BI displaying visualized contents. Report mainly provide sales performance in a long term, while dashboard prefers to show sales information of current month.

5.2.1 Report Interfaces

To build dashboard, designer should build report first and pin live tiles to dashboard interface. There are three pages in Messko sales report covering “Area Sales Manager (ASM)”, “Customers” and “Products”.

In three report pages, the first common feature is that they have same slicers in left part. In “Product Hierarchy 1” and “Currency” slicers, users are allowed to choose different product category and currency to check sales performance in the right part. Meanwhile, “Year” and “Calendar Year and Month” slicers can help display various information in a specific time interval. Another common tile is “Sales Net Value” In left-top corner. According to analyzed results from interview, it is one of the most critical values concerned by department. Besides, readers often start to view page from left-top corner. Thus, it is more convenient for them to check this important value in each page.

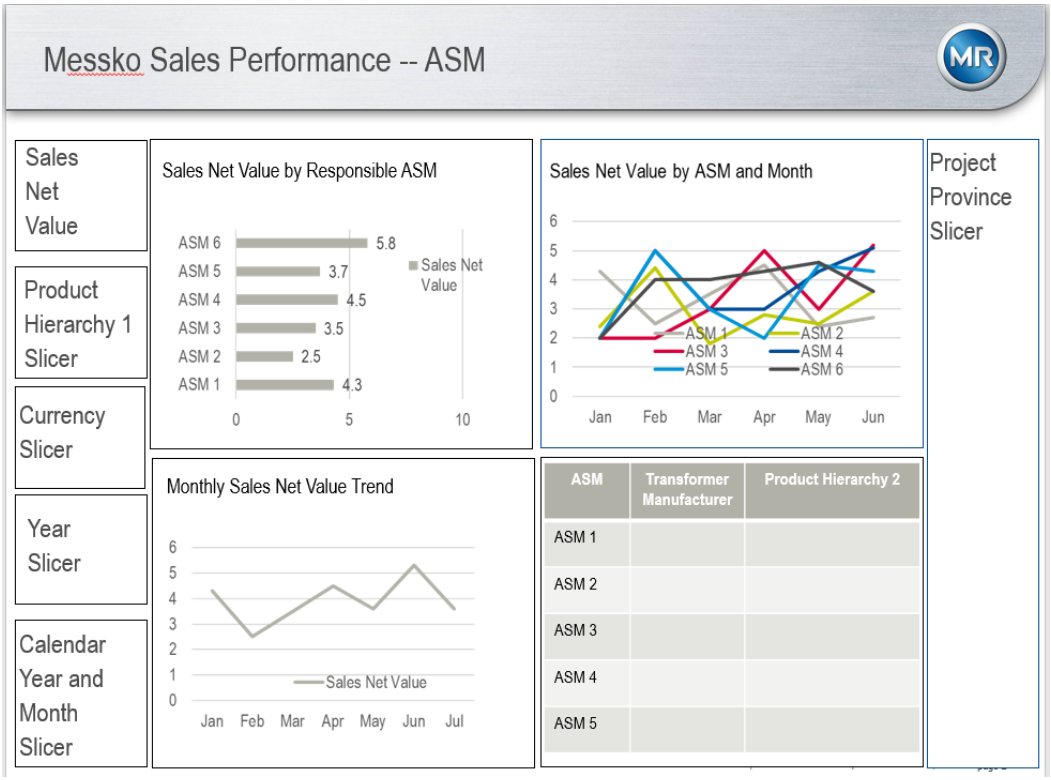

Figure 6 Report Prototyping Interface of ASM Sales Performance

In “Messko Sales Performance – ASM” page, there are four tiles in the middle and one slicer in right part. “Sales Net Value by ASMs” tile is the rank of sales area managers’ sales performance visualized by horizontal bar. The beside tile is ASMs’ individual monthly sales performance with line chart. The information presented in this chart emphasize personal trend in an intercepted timeline, while “Monthly Sales Net Value Trend” tile in the lower left part shows a total sales net value developing trend. The last tile is a detailed table showing

transformer manufacturers and related product categorized in product hierarchy 2 of each area sales manager. However, to avoid feeling difficult to look through information in this table, a “Project Province” slicer is added next to it. Users can navigate to specific transformer manufacturer by selecting province because there is geographical connection between names of transformer manufacturer and province.

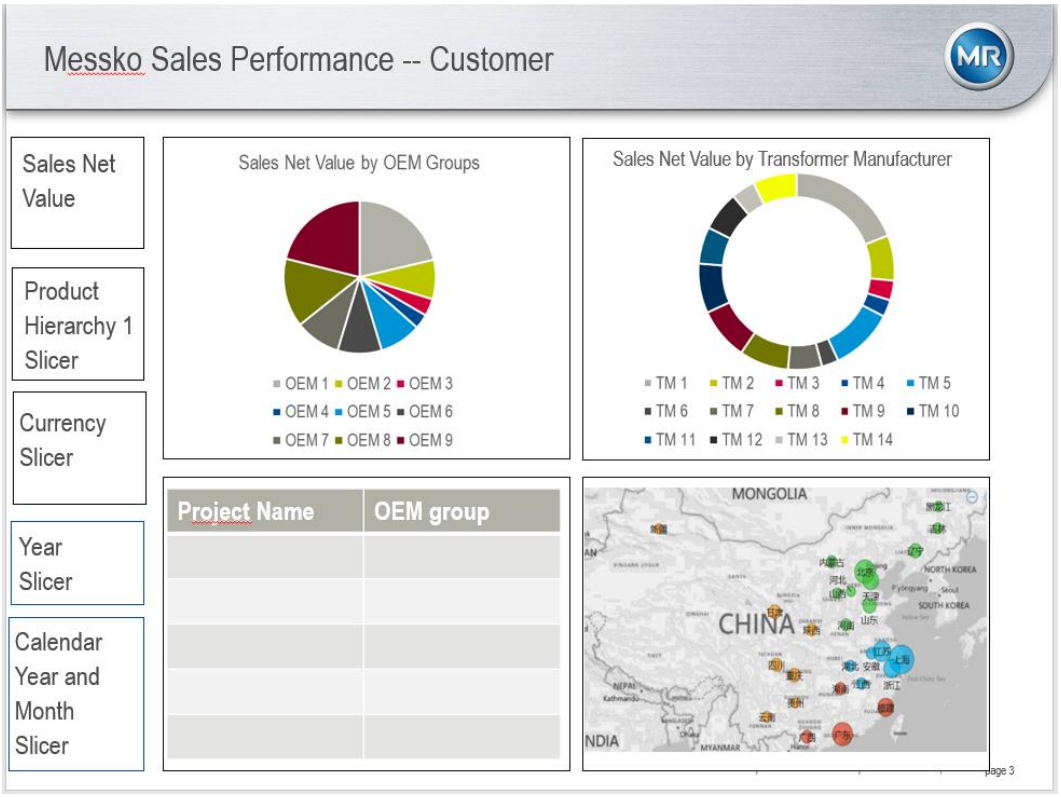

Figure 7 Report Prototyping Interface of Customer Performance

As for “Messko Sales Performance – Customer” page, Performance of OEM groups and transformer manufacturers are focused by department. Each OEM group may contain more than one transformer manufacturer. However, there is no complete hierarchical relationship between them because some transformer manufacturers are independent, not belonging to any OEM. In other words, “drilling down/up” function cannot make a difference here. Therefore, designer choose pie chart and doughnut to present customers’ performance. The legend categorizes each customer group by various colours, while specific sales value and percentage are labelled inside. The bottom left tile is a table with “Project Name” and “OEM groups” and a map is near to the table that displaying locations of each project. Users are able to directly view locations of projects on map, zooming in and out to check performance in specific provinces.

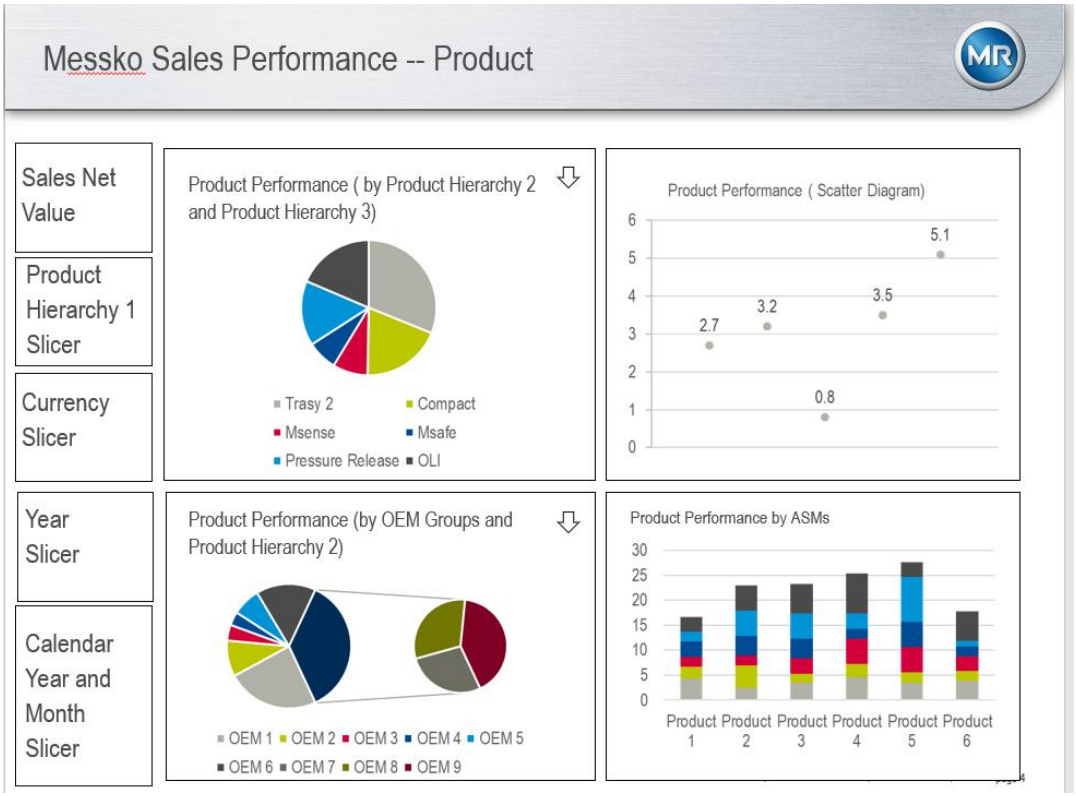

Figure 8 Report Prototyping Interface of Product Performance

The last page of report is about product performance of Messko department. Actually, it was overlooked by department in previous Excel power pivot. Based on results of interviews, order processing employees think that information of products is also important for them rather than only focusing on ASMs' and customers' performance. Thus, this page is added in sales performance report.

Basically, there is a hierarchy of "Product Hierarchy 2" and "Product Hierarchy 3" in which drilling up/down can be applied. The pie chart in top left tile is a drill down donut chart to systematically display sales net value of each product. Similarly, the tile below pie chart is another hierarchical structure of "OEM Groups" and "Product Hierarchy 2". Users can check product performance of each OEM. In the right part, there is a scatter diagram presenting performance of products in "Product Hierarchy 2" with number labels. The last tile is a stacked column chart showing ASMs' performance based on product.

5.2.2 Dashboard Interface

Power BI dashboard contains only one page and it can be created from report. Designer pin live visualizations to dashboard. The following figure is interface of sales dashboard.

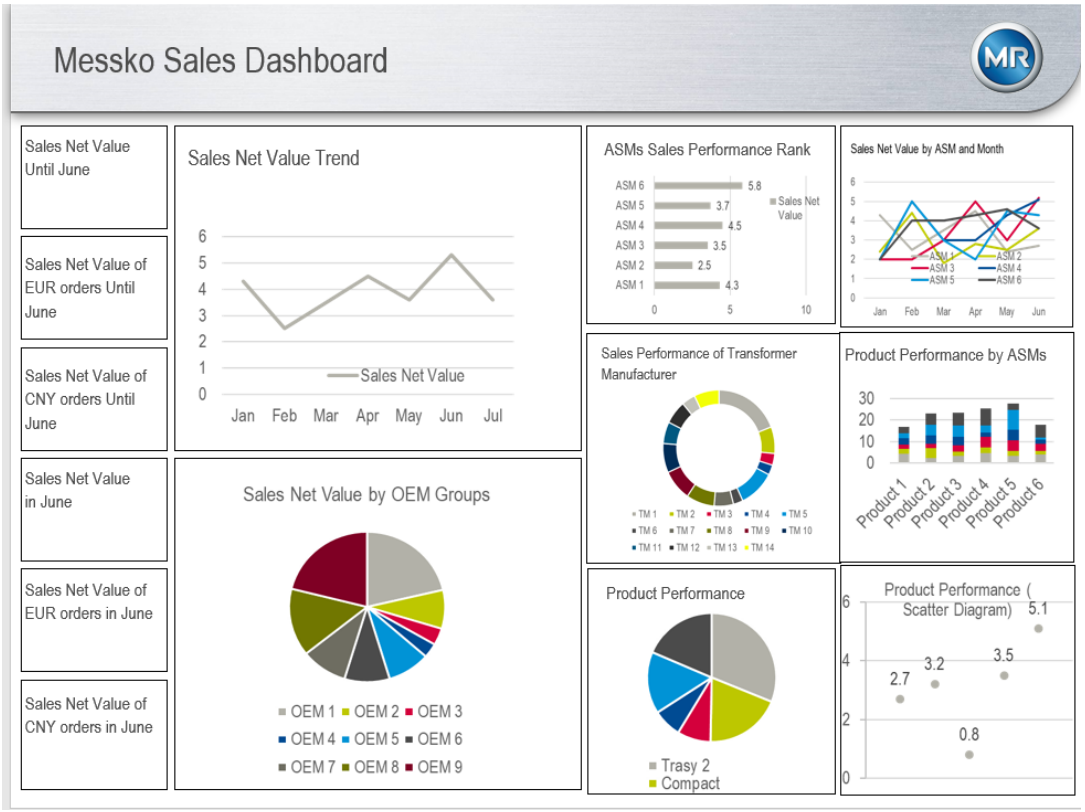

Figure 9 Dashboard Prototyping Interface

According to people's habits, it is acknowledged that reading from top to bottom and from left to right is the most common feature. Therefore, designer decides to put the most important contents in the left side and upper corner. However, Power BI dashboard does not support slicer and drilling down. The visualizations in dashboard do not contain slicers and drilling function. Six tiles, in the left part, are "sales net value until current month", "sales net values of EUR and CNY orders until current month", "sales net value of current month", "sales net values of EUR and CNY orders of current month". These six numbers are mostly concerned by department. In the upper side, "sales net value trend" and visualizations of ASMs' sales performance are pinned to dashboard. Then, customers' performance tiles are followed, mainly showing details of "OEM groups" and "transformer manufacturer". The final three tiles, in bottom right corner, are products performance from product page of report.

5.3 Building Process

5.3.1 Calculation in Excel workbook

There are two kinds of sales orders in Messko department: EUR orders and CNY orders. To get sum of sales net value of two kinds of orders, sales net value of CNY orders should be converted to EUR depending on real time exchange rates of current month.

After getting exchange rate, add the rate in cell “$AD$1” of Excel worksheet, then filter column “Currency” to display “CNY” only. Apply the formula “=U2722/$AD$1” in column “Sales Net Value in EUR”. Now, sales net value of all CNY orders is converted to EUR. Similarly, column “S+OH net value in EUR” can apply formula “=W2722/$AD$1” to unify currency. After finishing calculation, the Excel workbook can be prepared to import into power BI.

5.3.2 Connecting to Data Source

The Excel workbook has been already exported from SAP and saved as a local file. Power BI supports to directly import data file. However, one requirement from interview results is that report can be regularly and automatically refreshed. Although importing file from local host cannot achieve it, importing file from one drive for business is able to be scheduled refreshed. When connecting to a file saved in one drive, data of report and dashboard can be displayed as the file. If there is a change in the one-drive file, the change can be synchronously updated in report and dashboard in one hour. Or, if users prefer to view report and dashboard right now, they can manually refresh dataset. Assuming that the file is imported from local host, it cannot be refreshed unless importing a new workbook, which wastes time a lot.

Importing file from one drive for business can be done in power BI service. Open the website and click “Get Data” in the bottom right corner, then click “get” under “file” and “OneDrive – Business” is available. The file can be connected and imported to power BI. The file should be formatted as table. Otherwise it cannot be imported.

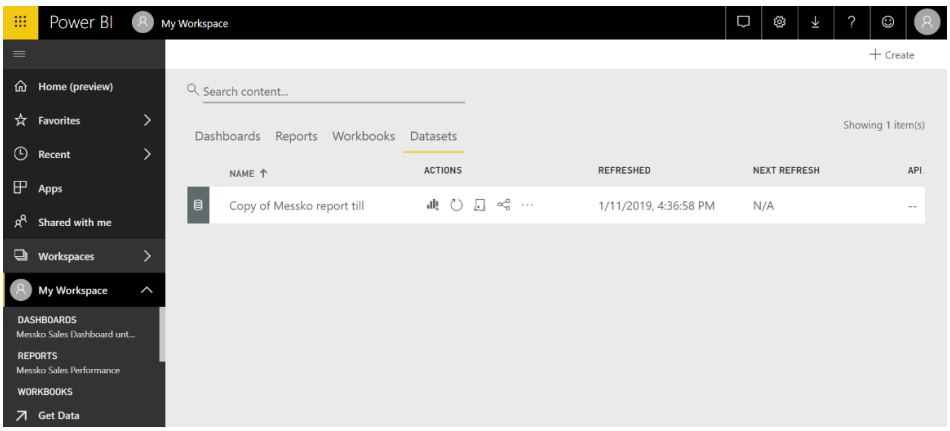

Figure 10 Dataset in Power BI Service

In figure 10, imported file becomes the dataset in power BI service. It is also available in power BI desktop. Open power BI desktop and click “get data”. There are multiple data sources. In this case, “power BI” is selected and click “power BI dataset”, then the live

dataset can be connected and available in power BI desktop (see figure 11). Designer is able to create report on it.

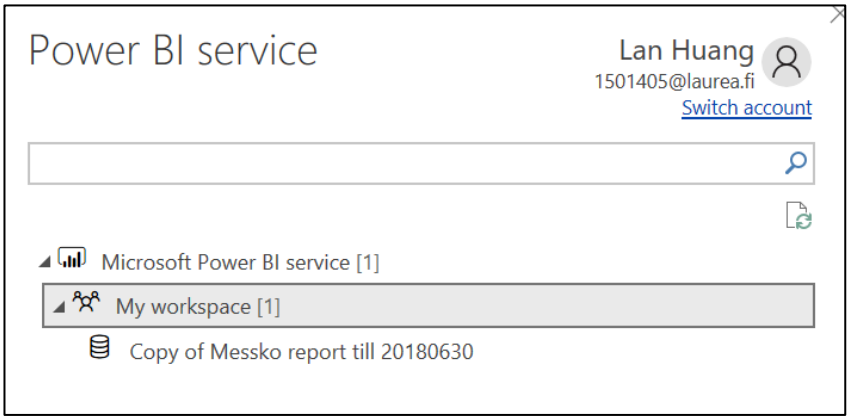

Figure 11 Connecting to live dataset in power BI desktop

5.3.3 Creating Report

After loading dataset in power BI desktop, report can be directly created. There are totally three pages in Messko sales report: Area Sales Manager (ASM), Customer, Product. Visualized information is based on users' requirements and analysed results from interview and benchmarking. To create a visualization, the idea is to choose a field from fields pane and add it in filter, then change visualization tool depending on specific content, if the visualization tool is not appropriate.

Slicers and company logo are common features in three pages. As for the company logo, select image button from Home tab, upload image from local file and move it on the top of canvas. Then, insert a text box to add names of each page. In terms of slicers, four slicers are created in the left side in each page. The first slicer is by choosing "slicer" in visualization and adding "Product Hierarchy 1" in Field. The second slicer is to add "Currency" in field. The following slicer is to add "Year" in field and the final one is to add "Calendar Year/Month". Four slicers are created in the first page and are synchronized in other two report pages (see figure 12). When creating Calendar Year/Month slicer, due to data format in dataset, month and year cannot be completely displayed. To deal with this problem, designer change the format in Excel workbook saved in one drive, and the dataset is refreshed as well.

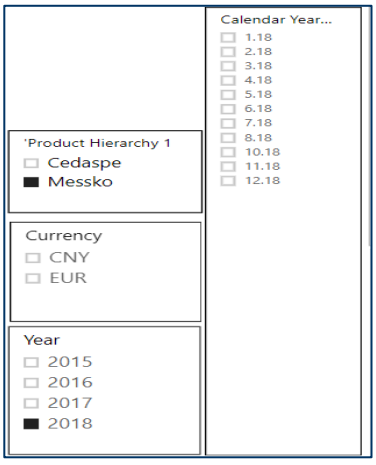

Figure 12 Slicers across Three Report Pages

Sales net value is focused by the whole team. Based on the benchmarking outcome, the important information should be put in the front of canvas since people's reading habit is

accustomed to from top to bottom and from left to right. As a result, the sales net value is decided to be present in the top left corner. The idea is to directly show data. So, choose visualization tool “card” in visualization pane. Then drag measure “sales net value in EUR” in fields. The value displayed on card can be changed by customizing slicers. This card is available in three report pages.

In the first page – **Responsible ASM**, except for four slicers and sales net value, it remains four tiles in the middle and one slicer in the right side (see figure 13).

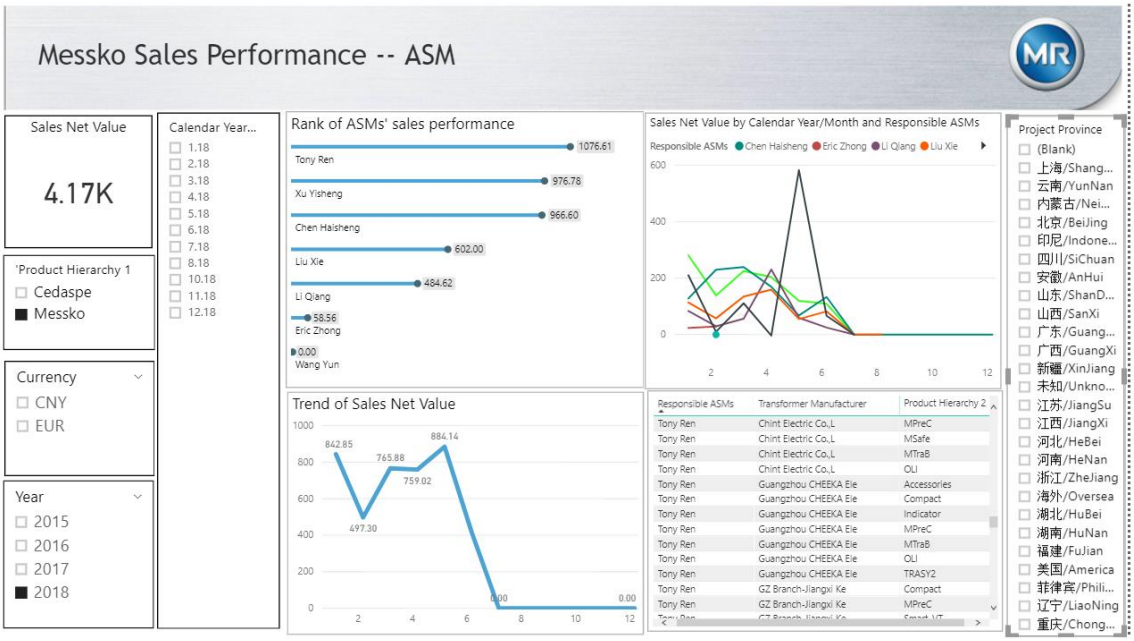

Figure 13 Report Page -- Responsible ASMs

The upper left tile is a rank of ASMs’ sales performance. It presents individual sales net value from the highest to the lowest. To make this visualization, import “horizontal bar chart” from marketplace. Drag “Responsible ASMs” and “Sales Net Value in EUR” to “category” and “measure” respectively. To directly show labels of value, turn on “Bar Labels” in format and specific numbers can follows bars. To ensure the order is from the highest value to the lowest, the data should be sort by “Sales Net Value in EUR”, which can be selected in “more option”.

The tile next to it is sales net value by calendar year/month and responsible ASMs. It compares each ASMs’ sales net value by month. The visualization tool is a line chart, in which the axis is “calendar year/month”, legend is “Responsible ASMs” and value is “Sales Net Value in EUR”. Designer chooses to turn off data labels to avoid a visual mess. Users can hover on lines and data will be automatically displayed.

The bottom left tile is a trend of sales net value by month. Line chart is still selected as the visualization tool. Axis is “calendar year/month” and value is “Sales Net Value in EUR”. Meanwhile, data label is turned on. Users can check a developing trend of sales net value, knowing which month has an ideal sales performance, for example.

The final tile is a table of transformer manufacturers and sold products related to corresponding ASM. Choose “table” in visualization and drag “Responsible ASMs, transformer manufacturers, product hierarchy 2” in values. The data visualized is detailed-focused, allowing users to search for specific information. Furthermore, to efficiently navigate to transformer manufacturers, a slicer of “project province” is added besides it, since each transformer manufacturer has a location. Users can check province in this slicer, and manufacturer located in the province will be directly shown.

The second page is called “**Customer**”. Figure 14 is the interface of this page. The information displayed is mainly related to “transformer manufacturers” and “OEM Groups” which are customer categorizations of Messko department.

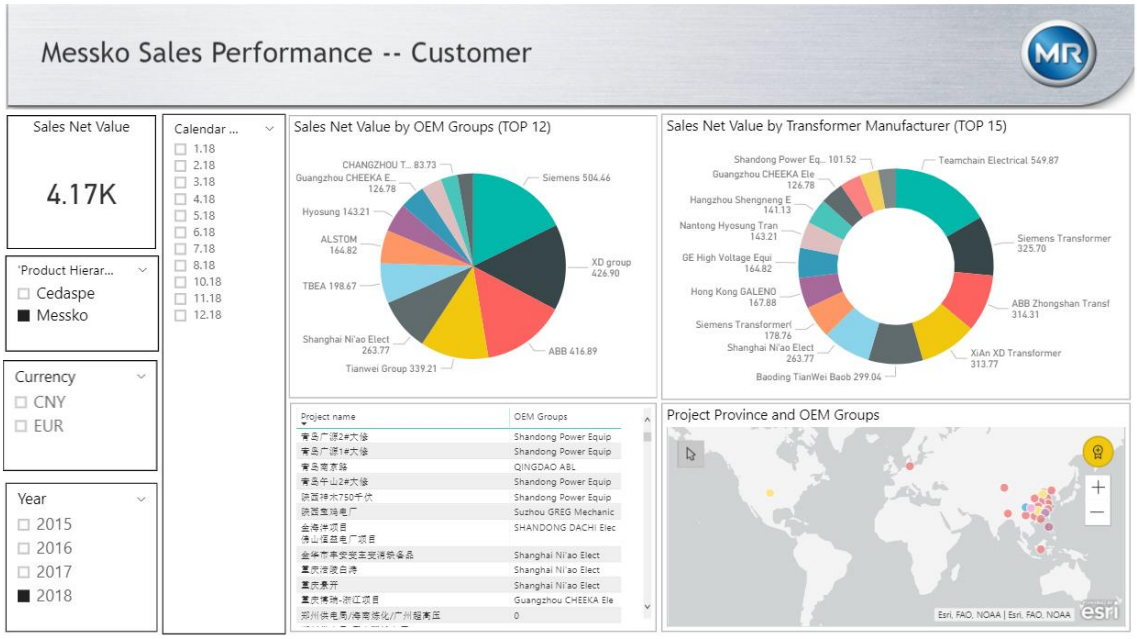

Figure 14 Report Page – Customer

The top left tile is sales net value by OEM groups. Designer chooses pie chart to visualize information. “OEM Groups” is legend and “Sales Net Value in EUR” is in values. In detail labels, choose “category, data value” and the names of OEM groups with specific sales net values can be present besides pie chart. When hovering on different legend, percent of total of each OEM group is displayed in bracket. However, there are numbers of OEM groups in pie chart, which makes pie chart unclear. Designer decides to filter TOP 12 OEM groups displayed on the chart. In visual level filters, expand “OEM Groups” and select “Top N” in the first drop-down

menu. Then, input “12” besides “Top N” and apply filters. Now, the pie chart shows OEM groups with top 12 sales net value.

The tile next to it is sales net value by transformer manufacturer. It is visualized by donut chart. The legend is “transformer manufacturer” and “Sales Net Value in EUR” is in values as well. Similarly, due to large amount of transformer manufacturers, visualized information displays manufacturers with top 15 sales net value.

The bottom left tile is a table of project names and OEM groups. Each sales order is based on a project and related OEM groups participate in the project. OEM groups are mainly resellers who sell Messko products to end users. The table allows users to check details of OEM groups with related projects. Meanwhile, a map of project province and OEM groups is following. In this map, users can check each OEM Group by navigating to related project province. Choose “ArcGIS Map” in visualization. Then drag “project province” to location and “OEM Groups” to color. Related information is available on map by hovering on each coloured point.

The final page is about Messko **product** (see figure 15). In the dataset, there is a hierarchy of different product categories. Therefore, drilling down function can be applied.

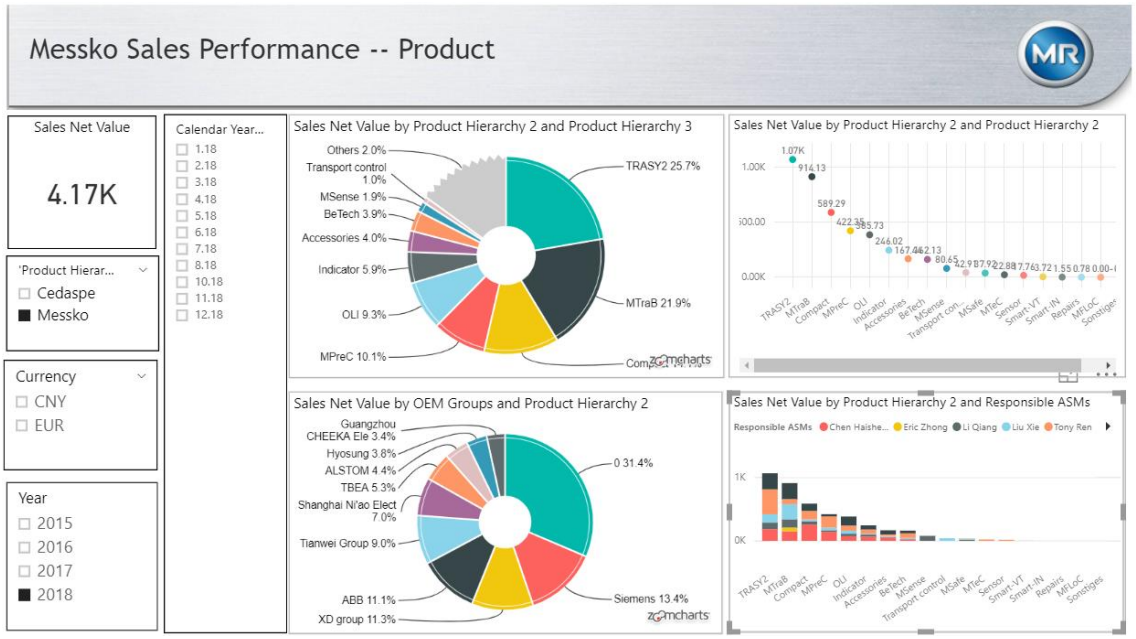

Figure 15 Report Page – Product

The first tile is a donut chart displaying sales net value by product hierarchy 2 and product hierarchy 3. Import “drill-down donut chart” from market place, then put “product hierarchy 2”, “product hierarchy 3” in category and “sales net value in EUR” in values. Now, a donut chart of sales net value by product hierarchy 2 is directly displayed. When clicking single part of chart, the donut chart drills down to product hierarchy 3 correspondingly.

Similarly, drill down donut chart is also applied to display a hierarchical connection between OEM groups and product hierarchy 2. By clicking a single part of OEM groups in donut chart, for example, Siemens. Then, donut chart drills down to product hierarchy 2 related to Siemens. Both donut charts have data labels with names of products or OEM groups and percent of total.

The upper right tile is dot plot chart to show sales net value by product hierarchy 2. Import "dot plot chart" from marketplace. "product hierarchy 2" is the axis and legend simultaneously, while "sales net value in EUR" is in values. The products belonging to product hierarchy 2 are ranked by individual sales net value from the highest to the lowest. It is also recommended to turn on data labels in chart to show specific sales net value.

The last tile is visualized by stacked column chart. It demonstrates sales net value by product hierarchy 2 and responsible ASMs. The axis is "product hierarchy 2" and legend is "responsible ASMs", while "sales net value in EUR" is in value. Each column is stacked by sales net value of ASMs who sells the same product. Users can hover on different column, and details of sales net value, responsible ASMs, product will be displayed.

Until now, all the report pages are successfully built. The next step is to publish the report to power BI service and build the dashboard on it, since power BI desktop is unable to support dashboard function.

5.3.4 Publishing Report to Power BI Service

Once the report is finished, dashboard can be built. However, dashboard cannot be built on power BI desktop, since it is only available on power BI service. Consequently, "publish" can be used to upload report to power BI service and designer is able to make dashboard.

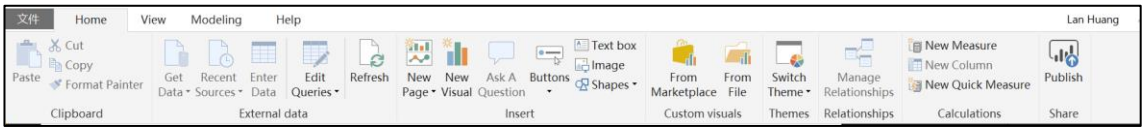

Figure 16 Home Tab in Power BI Desktop

Now, click "publish" button on Home tab. Then, the dataset and report are uploaded to power BI service. Users can find them in "My Workspace" in power BI service. Meanwhile, the report is also available as **.pbix** file. Users can directly open this file and check it on power BI desktop.

5.3.5 Creating Dashboard

Basically, to create a power BI dashboard, designer pins visualizations from report to dashboard canvas. Take the following visualization (see figure 17) as an example. When clicking a visualization, there are three hover icons on top right corner, in which the first one is allowed to pin this tile to a dashboard.

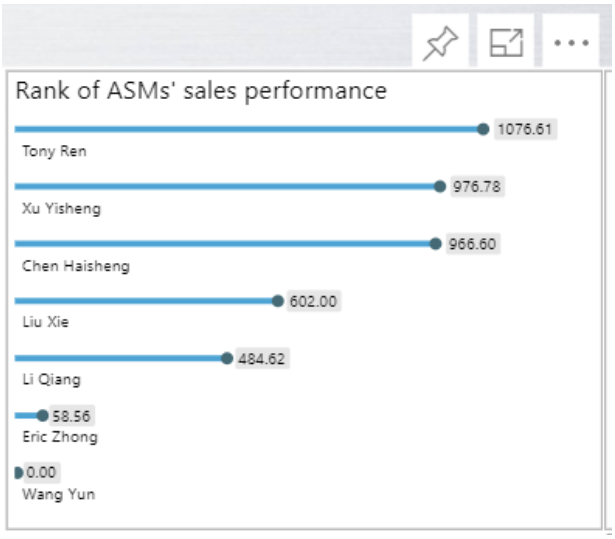

Figure 17 A Tile in Report Page

Click “pin” icon, and a dialog box comes to the interface. This visualization can be pinned to an existing dashboard or a new dashboard. Now, the visualization is available in a dashboard. In this project, the name of dashboard is called “Messko Sales Dashboard in June”.

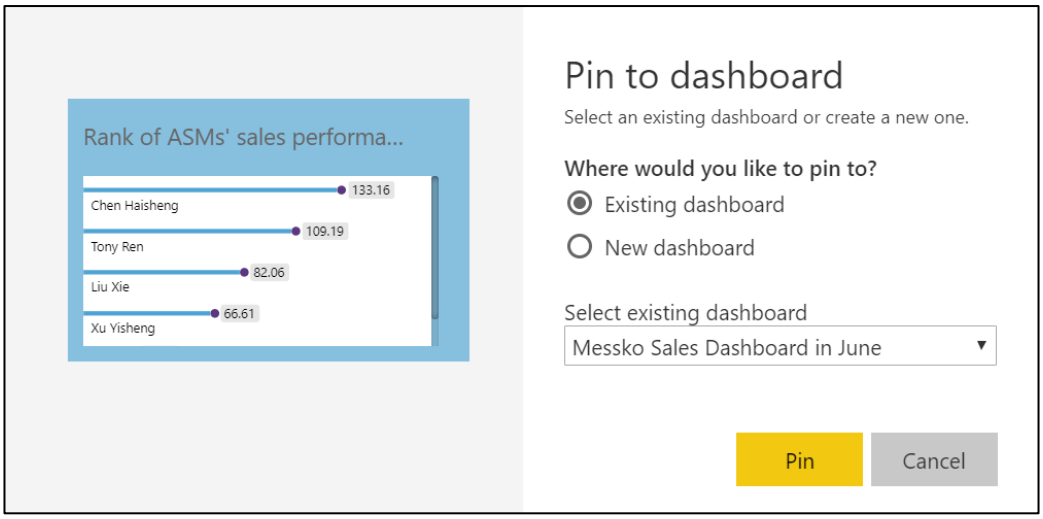

Figure 18 A Dialog Box of “Pin to dashboard”

Compared with report, dashboard has only one page with a limited space. Meanwhile, slicer is not supported in dashboard, which means that the slicers created in report cannot be pinned

to dashboard. Power BI dashboard still has advantages. It gathers the most important graphics on one page and users can monitor their business at a glance. The visualizations on dashboard can come from several different reports. When clicking one visualization, the dashboard will be redirected to the original report page. When dataset is refreshed, the tiles will be updated as well.

The following picture is an interface of Messko sales dashboard (see figure 19). This dashboard aims to provide a holistic view of Messko sales performance in June of 2018. Information of dashboard can be generally divided into four parts: sales net value, ASMs' performance, customers' performance and products performance.

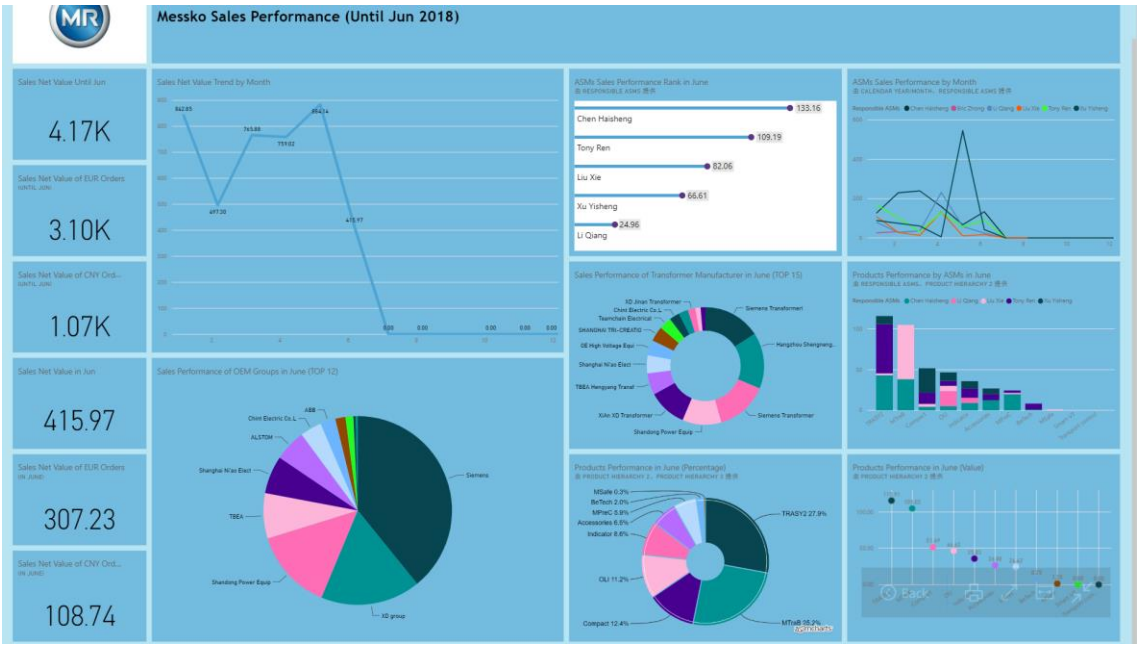

Figure 19 Messko Sales Dashboard

Firstly, there are six number cards displaying sales net value in the right side. They directly provide users with information of sales net value by currency. The first three cards are "sales net value until Jun", "sales net value of EUR orders until Jun" and "sales net value of CNY orders until Jun" respectively. The last three cards are "sales net value in Jun", "sales net value of EUR orders in Jun" and "sales net value of CNY orders in Jun". All of cards are pinned from report page "responsible ASMs" by customizing slicers. Take sales net value of EUR orders in Jun as example. In report page "responsible ASMs", check "Messko" in "product hierarchy 2" slicer, "EUR" in "currency" slicer, "2018" in "year" slicer and "6.18" in "calendar year/month". Then, pin "sales net value" card from report page to dashboard.

Then, the bigger tile in the upper middle position is "sales net value trend by month" pinned from report page "responsible ASMs". It shows a developing trend of sales net value from

January to June in 2018. Two smaller tiles next to it are “ASMs sales performance rank in June” and “ASMs sales performance by month” pinned from report page “responsible ASMs” as well. These three tiles provide a basic view of ASMs’ sales performance to users.

Next, there is another bigger tile in the bottom middle part called “sales performance of OEM Groups in June (TOP 12)”. The visualization besides it is “sales performance of transformer manufacturer in June (TOP 15)”. Both tiles come from the second report page – customer. According to these two visualizations, users can get a view of sales performance of customers in June.

The remaining three tiles are “products performance by ASMs in June”, “products performance in June (percentage)” and products performance in June (value)”. They are pinned from the final report page – product. From three tile of products, users can check sales performance of each product by ASMs, know the total of percent and specific sales net value of each product.

After designing the main contents of dashboard, company logo and theme color should be considered. To upload company logo, click “add tile” and select “image”. Company logo can be uploaded to dashboard. Designer need resize it and move to the top of dashboard. As for changing color, open “dashboard theme” in “more options”, tile background and background color can be customized to match with color of company logo, which is required by department.

Until now, the sales dashboard is achieved. It is automatically saved in power BI service. Users can go to “My Workspace” and this dashboard can be viewed. This version is a web view. Meanwhile, the phone view is also available to view report and dashboard on mobile phones.

5.3.6 Viewing Report and Dashboard on mobile Phones

One of the requirements gathered in interview is to make report and dashboard available on mobile phones, since majority of the users are not office-based. Power BI supports to view report and dashboard on mobile phones through power BI mobile app. Thus, designer creates phone views on power BI service. During the view design process, designer finds out that the phone view has a really limited space, which cannot display all of visualizations. What’s more, the final outcome of phone views cannot be smoothly running on power BI mobile app. Meanwhile, users reflect that the slicers on report page cannot work smoothly. As a result, designer decides to view reports and dashboards via landscape on power BI app. The interfaces on power BI app are the same as web views, so that users can view reports and dashboards on their phones.

5.4 Evaluation Phase

After completing designing phase, it comes to evaluate the power BI dashboard interface. In this phase, designer still chooses to interview 2 users for doing a systematic evaluation. Interview questions are generally classified into two categories: representation feature and content.

Before interviews, users view the dashboard on power BI service and power BI app by using designer's account. After they have first user experiences, interviews are conducted. Generally speaking, the outcome is the same as what department expect. Contents are all visualized and displayed on dashboard as required in the first interview. Compared with the power pivot, power BI dashboard more effectively makes users to easily understand what dashboard wants to tell. Besides, dashboard can be available on users' mobile phones, which reaches to their requirements as well.

In terms of content, what users are mentioned in the first interview are visualized in this dashboard. Although dashboard has limited space, required contents are visualized and concisely organized. Starting from viewing sales net value, each tile with a name is structured based on importance level, which help users to avoid wasting time to look for information. Meanwhile, visualizations facilitate users to efficiently understand information behind data.

As for representation feature, the dashboard is appealing when users firstly look at it. There is no remaining space, and each tile is well aligned with each other, so that users feel comfortable when viewing it. The layout is quite clear to view sales net value, ASMs' performance, customers' performance and products performance in order. Fragmented tiles containing similar content are organized closely, which makes the dashboard logic and users can easily understand. Additionally, color theme of dashboard is also matched with commissioning department.

The final outcome is what users expect at the beginning. When using power BI dashboard, the information delivery process becomes smoother and more effective between sales data and Messko department than before. Users prefer to check dashboard to view monthly sales performance in detailed rather than having a rough glance. This project helps Messko department in processing sales data and visualizing them. Therefore, they can follow the guide in thesis to update or improve dashboard by themselves in the future.

6 Conclusion

A dashboard is used for presenting a real-time status of business, monitoring business performance in organizations. An effective dashboard is able to facilitate decision-making process and to quickly trigger actions by delivering information to end users. In this project, a sales department, facing a large amount of data every day, requires a visual communication from

data to information. To achieve a better data visualization, Microsoft power BI is integrated to visualize and display sales data through dashboard. To design a useful dashboard, it is primarily necessary to get clear about the users of dashboard, what information is needed and what measures are critical. Besides that, choosing appropriate visualizations is equally important. It supports a more efficient information delivery process. The final dashboard is an interface to present visualized information. A well-designed dashboard interface is supposed to let users easily understand data and information. It is not messy, only containing important information. Meanwhile, dashboard should avoid overloading information. It is supposed to have focused points by properly organizing information blocks.

In fact, the whole empirical process is a work flow to transform raw data to information, aiming to provide valuable information for decision makers and others in management level. During the process, it is critical to have a well-understanding of dataset. Designer should focus on mining hidden information by reasonably organizing data and measures. By visualizing data, dashboard provides users intuitive visual effects and help them quickly understand indicators. However, dashboard cannot replace some work of business analyze, it still can facilitate team to spend less time on understanding data. So, they can have more time to review, make decisions based on visualized information.

Companies always face a rapidly changing external business environment. Business risks cannot be predicted without applying business intelligence. As a result, it is important for companies to emphasize the importance of business intelligence. What business intelligence can bring to them is to gather the large amount of data in daily business process, and transform them into information and knowledge. By combining with continuously innovative information technology, business intelligence becomes more practical and convenient to collect data, transform to generate information for companies. Based on valuable information, companies can quickly respond and seize business opportunities. It is imperative for companies to highlight the role of business intelligence in daily business activities. Meanwhile, choosing an appropriate business intelligence software is also critical for them.

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Figures

Tables

Appendix

Appendix 1: First appendix – First Interview Questions

First Interview Questions

- Could you describe your working environment and job responsibilities in department?
- How do you use “Messko Report” in your work? Give me some examples please.
- What are your thoughts on report in terms of following aspects?
  - Content
  - Representation Styles
  - Is it easy to understand?
  - Is it a facilitator to reflect business problems or not?
- (If answers to Q3 tend to be negative) Which part of the report do you think is problematic?
- What are your requirements for new sales dashboard?
- Based on your personal working environment and habits, how do you want to use the new dashboard?
- Any other suggestions?

Appendix 2: Second appendix – Second Interview Questions

Evaluation of Dashboard Interface

- Representation Feature
  - Is this interface appealing when you firstly look at it?
  - Is the colour theme suitable?
  - Is this layout clear to display information?
  - Any other comments for representation feature?
- Content
  - Does this dashboard provide contents you are concerned about?
  - Do visualizations easy for you to understand the information?
  - Is the structure of contents content and concise to you?
  - Any other comments for visualized content?
- Do you have suggestions for the dashboard?