LAB University of Applied Sciences

Developing a Dynamic KPI View for Customized Real Estate Reporting

Case: Assetti

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Abstract

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Title of the thesis

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Abstract

Measuring and visualizing data in order to assess the performance of a business is crucial for almost all industries. The usage of key performance indicators is an efficient way for companies to plan and control processes. Also, within the area of real estate, they form the basis for decisions and either show how well goals are met or serve as an alarm signal when something gets out of hand.

Digital solutions, like Assetti, provide companies with the right tools to capture and measure their performance. Against the background of property asset management, the thesis focuses on financial key performance indicators related to a company's cash flow.

The purpose of the thesis was the acknowledgement and design of key performance indicators in the environment of the existing Assetti software solution. The aim of the thesis was to create different prototypes which can be utilized later as a base for further product development. Those prototypes are focused on different visualization possibilities and on improving the usability of the software.

The research method was of a constructive nature and semi-structured interviews were used to gather primary research data. The interview results were analysed using qualitative content analysis The development process was supported by design thinking and the double diamond model.

Eighteen different user stories emerged from the research results. For each user story, prototypes were created and improvements and further developments are suggested.

Keywords

Key performance indicator, dashboard, real estate reporting, data visualization, design thinking, double diamond

Contents

1 Introduction

1.1 Background of the Study

The measurement of key performance indicators (KPIs) is crucial to assess the performance of a business. Regardless of the industry in which a company operates, almost all activities and processes can be monitored and evaluated using different types of business indicators. Controlling, in particular, works extensively with key figures. When it comes to accounting for a company and the transparent presentation of annual financial statements for stakeholders, key figures and key figure systems are indispensable.

Within real estate management, those KPIs can be utilized to get a better understanding of a portfolio's or property's performance, including metrics regarding return on investments, vacancies or yields. This information can be used to identify weaknesses in real estate management or help make better business decisions. The subject of my thesis is closely related to creating measurable key performance indicators for the real estate industry. The aim of this work is to acknowledge and visualize customized key performance indicators for property asset reporting. Those reporting KPIs will be utilized and implemented within a software platform called Assetti.

When investing in real estate, there are various factors that influence the success of your investment. For a real estate investment to be worthwhile, you need to know how to reduce various risks. In order to be able to measure the economic success of your portfolio, you need to have an eye on your key figures. Digital solutions can help industries visualize data in order to easily identify defined targets, changes, and key figures. Within real estate, these are part of the PropTech industry. In general, PropTech is the use of digital solutions to carry out individual procedures or entire processes such as renting out real estate. (Noelling 2019.) The real estate industry is currently changing existing traditional business models by taking new innovations into use. This digital approach makes processes more efficient and cost-effective. In addition, it enables more centralised operations and the analyses of data in real-time and with greater accuracy. That results in more efficient and user-friendly operations. Although the digital transformation within the real estate industry is nothing new, it is among the 8 key trends on innovations for the years 2022 and 2023 defined by KPMG. (Real Estate Innovations Overview 2022, 14.)

Companies have been seeking to achieve a digital transformation for years. Due to the COVID-19 pandemic, those efforts became more urgent and digitalization is changing corporate strategies. According to the Game Changer Report (2022, 5-7), executives state that they are keen on developing new digital products or finding new ways to digitise existing

processes. Enhancing performance by simplifying and optimizing processes and keeping inefficiencies low is crucial to achieving higher productivity and identifying potential ways to save costs. Reporting is central to achieving these performance enhancements and assures the documentation and tracking of goals.

Experience-centricity by design is another trend when it comes to using digital solutions within real estate. When using digital tools, customers tend to value user experience more than ever. There are certain ways to maximize the digital experiences for all kinds of users by:

- Automating processes, which means fewer clicks.
- Tailoring digital journeys according to the needs of the user.
- Enabling the tracking of data and showing the user just relevant information.

Keeping the user experience in mind is something Assetti is aiming to improve. By making KPIs customizable, a better user experience can be achieved because users can define themselves the data that is relevant to their decision-making.

When speaking of data, we refer frequently to the trends around big data as well. Since Assetti is a cloud-based solution, retrieving data not just via data imports but also through integrations and an open API, the amount of data needed for reporting is huge. The usage of private and public cloud services to store and analyse data is increasing rapidly. Managing huge data volumes can be supported by data science on the cloud. In addition, big data is closely related to predictive analytics and using KPIs for decision-making. Those analytics provide companies with valuable insights on which base the best course of action can be defined. (Utkarsh & Aulakh 2022.)

1.2 Target Organization

Assetti is a Lappeenranta based real estate technology company founded in 2013. Assetti works within the field of international B2B business. The company has developed a product called Assetti, which is an online property asset management solution for asset management professionals. Assetti is a single-product company, which is why the company has been branded under the product's name. In addition to Finland, Assetti has customers in seven other European countries.

The product Assetti itself is a SaaS solution, a software located in the cloud that is maintained by a service provider. It can be accessed from anywhere, at any time. Besides offering the possibility of managing general real estate data, Assetti visualizes key performance

indicators within a dashboard view. To meet different country-specific requirements, Assetti is available in eight different languages and supports twenty currencies.

To be able to manage all real estate related data in one application, it is possible to connect other systems via an open API and use data integration to avoid manual data imports or updates. Conversely, information stored in Assetti can be exported as sharable reports to support a holistic data overview.

1.3 Structure of the Study

The structure of the thesis was divided into three parts and is visualized in Figure 1. The first part, chapter 2, describes the research approach and research questions. It explains the development task and defines the purpose and aim of the study. The principle of constructive research is discussed in more detail and limitations are explained at the end of the chapter.

The second part of the study presents the theoretical framework relevant to this work. It covers the topic of reporting in chapter 3, the usage of key performance indicators in chapter 4 and explains the principles of data visualization in chapter 5.

The third part focuses on the empirical approach. Chapter 6 describes the research methods and explains the implementation with the help of design thinking and the double diamond model. The interviews and analysis of existing software features are included there as well. The prototypes and user stories are presented in chapter 7 and the summary with discussion and further developments in chapter 8.

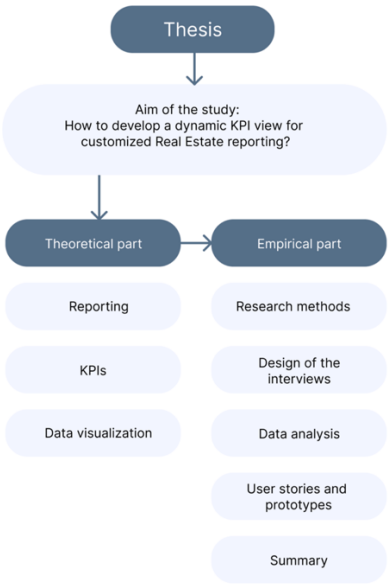

Figure 1. Structure of the Study

A more in-depth overview of this work, including the themes and methodologies of each chapter, is shown in Figure 2.

Themes and methodology	Chapter	Output
What is this thesis about? • Interview the case company	Chapter 1: Introduction	Providing background information on the topic and case company introduction
What is expected? • Interview the case company • Literature review	Chapter 2: Development task	Defining the objectives and the research approach, Agreeing on interview questions and restrictions
Why reporting is important? • Literature review • Discussions with case company	Chapter 3: Reporting	Defining the main benefits of reporting and their meaning for different departures within real estate
Why companies use key metrics? • Literature review	Chapter 4: KPIs	Defining different types of KPIs and their role in measuring performance
Why do we visualize data? • Literature review	Chapter 5: Data visualization	Defining when to use data visualization and explaining different ways of turning data into graphics
How to find answers to the research questions? • Interviews with 4 companies • Analysis of the software	Chapter 6: Research	Understanding and defining current challanges, finding missing KPIs, indicating solutions and improvements based on the interview results
How to turn the interview results into solutions? • Brainstorming	Chapter 7: Prototyping	Creating user stories based on the analysis and results of the interview, drawing prototypes to demonstrate possible solutions
What is the outcome? • Literature review • Observations of the autor	Chapter 8: Summary	Summarizing key findings and discussion on those, Further development suggestions

Figure 2. Themes and Methodologies of the Study

2 Development Task

2.1 Subject and Objectives

Assetti currently offers a dashboard view for portfolios, properties, units, leases and tenants. Within this view, Assetti visualizes different KPIs which can be displayed and adjusted via filtering the used data. However, the number of KPIs is fixed and exporting those visualized KPIs for e.g., reporting is not possible at the moment.

Through various customer feedback, Assetti acknowledged the need for a more dynamic KPI view. It was mentioned that customers would like to define by themselves which KPIs to have visualized. For example, one customer wanted to see the occupancy of a property, and another customer wanted to see the vacancies instead.

The main purpose of the study is to increase the knowledge of utilizing and visualizing financial KPIs efficiently from the perspective of a real estate company. Therefore, the purpose of the study is divided into two parts. The first purpose is about finding a way to extend the current functionality of a dashboard view with new KPIs and the possibility to choose those individually. The user defines which data they want to visualize. The second purpose is the development of a reporting template, including a library of key metrics and charts. Real estate financial reporting is used for many different purposes. In order to fulfil the changing requirements, the user would be able to create customized reports including visualized KPIs. There would also be the ability to export these reports in a PDF or PowerPoint format.

2.2 Research Questions

Based on the purpose of the study, the following research questions have been created:

- What financial KPIs in terms of cash flow are the most valuable ones in property asset management?
- How can visualizing cash flow related KPIs provide added value to a company's property asset management?
- How to create intuitive and visually rich customer-specific content out of structured financial data?

2.3 Research Approach

On a wider level, the frame of reference for this work is based on qualitative research. Qualitative research aims to describe, explain, interpret, or understand a specific phenomenon taking into account the experiences, thoughts, and feelings of the people involved in using

products or services. In order to bring solutions to the research problems, questions like "What?" “How?” or “Why?” can be asked. To conduct qualitative research, different methods can be used. (Puusa & Juuti 2020, 23.)

According to Kananen (2012, 29), this research approach is best suited for the following situations:

- When there is no existing information, theories, or research on the phenomenon; meaning the phenomenon is new as a research topic.
- To gain a more in-depth understanding of the phenomenon.
- To create new theories and hypotheses.
- When triangulation is used, i.e. the so-called mixed research strategy.
- When a detailed description of the phenomenon is desired.

Taking a closer look, the constructive research approach is implemented for this study. The constructive research method can be seen as a systematic approach enabling the meaningful creation of methods, modules, tools, and techniques. The main goal of constructive research is to solve a practical problem. This can be achieved by creating a new construct, meaning a concrete result. The outcome can be a product, an information system, a guide or manual, a model, a method, or a plan. (Ojasalo et al. 2015, 37.) According to Lukka (2021, 2), solving a real-life problem with the help of a new construct is the ideal outcome of constructive research. This kind of problem-solving process is widely used in computer science as well and since my research is related to software development, it can be categorised as constructive research.

2.3.1 Constructive Research Supported by Interviews

Interviews are, in addition to questionnaires, the most commonly used method of data collection in qualitative research. They provide the interviewer with the opportunity to gather qualified answers from a representative population sample covering different shades of opinions (Chowdhury 2013, 43). There are many research interview methods and the differences arise mainly based on the degree of structuring, i.e. how firmly the questions are formulated and how strongly the interviewer controls the situation. Interviews can be divided into two different categories: structured or standardized form interviews, and all other interviews, such as theme interviews, in-depth interviews, and semi-structured interviews (Hirsijärvi & Hurme 2008, 41-43.)

A structured interview gathers responses with the help of precisely defined questions and typically those responses are easy to analyze and consolidate (Hirsijärvi et al. 1997, 203).

A semi-structured interview leaves more room for discussions about the respondent's opinions and views (Chowdhury 2013, 43).

In a semi-structured interview, the format of the questions is basically the same for all interviewees, but the order, formatting, and wording of the questions can be varied as needed (Hirsijärvi & Hurme 2008, 47). Some of the questions can also be eliminated in the interview situation or, alternatively, necessary questions can be added. Since the interviewees can answer in their own words, the dialogue between the researcher and the interviewee is essential for the success of the interview. A semi-structured interview can also be called a theme interview. (Ojasalo et al. 2015, 108.)

In the data collection phase, many ethnographic methods can be used, such as observation of the environment, interviews, articles or sources of theoretical literature, with the help of which the author of the study familiarizes himself with the subject area under investigation with the aim of achieving a comprehensive overview of the initial situation. The researcher needs to identify the previous theories of the subject area so that new research results can be applied in accordance with the old theory, but also to develop and analyse previous results. (Lukka 2021, 16.)

In a theme interview, the focus is usually on an identified problem. People are selected for the interview who have worked on a subject related to the theme and who possibly also have first-hand knowledge of the problem that the research is dealing with. In the interviews, you should first focus on the management level, in this case, the steering group and the project owner, so that you get the best possible overall understanding of the problem. The lower level, in this case, the experts of the project team, are able to supplement the problem description in more detail, for example from the side of a certain business area. Interviews and interviewees generally provide genuine information that makes it easier to understand the overall picture. However, it is worth remembering that viewpoints and opinions vary greatly, and a unified truth may not be found based on interviews alone. (Kananen 2017, 81.)

Qualitative research focuses on a small number of cases but aims for as deep an understanding as possible. The objects to be studied are carefully selected as those who are known to have knowledge of the subject under discussion. Qualitative research can also be well applied to the development of operations or, for example, to researching different alternatives. Qualitative research is less structured than quantitative research and the collected material is text-based and more challenging to evaluate with statistical methods. In interviews related to qualitative research, it is common to have a conversation between the interviewer and interviewee in which both parties influence the other. It is also possible for

the researcher to collect material by observing the environment where activities related to the researched area take place. (Heikkilä, T. 2014.)

In my research, I utilized the semi-structured interview method because of its flexibility. A structured interview method would have not been able to carry out ideation or topic development in the same way. I had discussions with four selected core customers of Assetti located in Germany, Austria, Sweden, and Finland. I asked all the interviewees the same questions, but I changed the order and formatting according to the interviewee's role and expertise. In some cases, I added further questions. When acknowledging an important fact in a previous interview, I discussed the issue in subsequent interviews to evaluate its relevance for other cases. The interviews were held in English, German, and Finnish.

2.4 Restrictions

Although the research is made for KPIs to be displayed on mobile devices, this project is fully focused on developing and designing a prototype for desktop. One main use case of this study is the task of creating a report. The data sets used to create reports are usually huge and additional data is contributed by service providers into Assetti. At the same time, Assetti shows a large amount of KPIs on one page. Most users of mobile devices don’t see the need for in-depth visualizations because the device's small screen size is not suitable for such detailed analysis. The lack of screen space on mobile devices affects the user’s ability to get the answers they need at a glance. If a mobile dashboard has too many elements like KPIs or text, it is likely not focused enough. (ArcGis, 2022.) Creating, overseeing and sharing reports is more convenient on a desktop and assures a better quality of the final report.

For defining the problems and developing the solutions, I will follow the Double Diamond working process. Although this process covers the phases discover, define, develop and deliver, I will not be able to test prototypes small-scale. The final results are user stories on which base further testing can be done by the target organization.

3 The Importance of Reporting

3.1 Reporting in Real Estate

We can see that the topics of reporting and dashboarding are becoming more and more relevant in the real estate industry. Discussions with customers have confirmed that good data visualization is essential. Demand is increasing for solutions able to display important KPIs in reports and dashboards in the best possible fashion. Significant changes and deviations must be recognized more quickly so that various stakeholders can get an overview of the current performance at a glance. Nowadays, huge amounts of data produced by a company come from all possible directions, from which it is often difficult to filter important and business-critical information. Therefore, financial reporting is developing into the backbone of every successful company, enabling corporations to quickly react in a changing business environment. A good company is able to produce real-time financial management reporting for the company's management and employees, as well as informative and easy-to-read information for external stakeholders. (Rantanen, 2022.)

The main challenge of reporting is combining and structuring all data into relevant and actionable information and delivering those to the right recipients. That often requires the collation, processing and reporting of three types of information: measures of performance, reporting of events, and provision of context or analysis. (Axson 2010, 141.)

It's no surprise that small companies in particular find financial management reporting difficult and often outsource it to an external entity. The reporting and sending of reports often requires continuous manual work. Manual work has its risks because in these cases the numbers can easily be mistyped and one can't necessarily trust them. Nowadays, companies often operate globally, which makes it very difficult to manually produce real-time and reliable information for international teams. Because above all, the quality of information is the most important characteristic of external and internal reporting. (Lahti & Salminen 2008, 33; Axson 2010, 143.)

Digital solutions and new technologies allow companies to utilize integrated performance measurement systems. Therefore, data must be translated into useful management information. Axson (2010, 142) divides that process into five steps of collecting, structuring, storing, transforming, and using data (Figure 1).

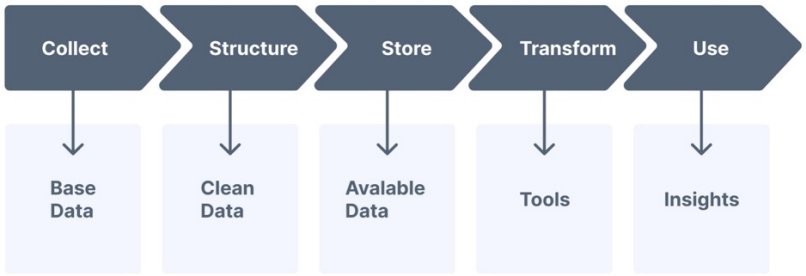

Figure 3. Translating Data Into Useful Management Information

3.2 Financial Reporting

Financial management is a system with which an organization monitors its financial events. It reports information about these events and their activities to different stakeholders. The concept of financial management itself is a much broader entity than just accounting. The tasks of financial management can be divided into general accounting, reporting, and archiving. Since general accounting contains several sub-processes, it is an important source of information in the reporting process. (Lahti & Salminen 2014, 16-19.)

Reporting is one of the main tasks in financial management and its purpose is to give an overall picture of the financial and operational status of the company's operations. Reporting is much more than profit and loss information, as its task is to provide information on how the company has fared, why it has gone this way, and what the company is aiming for. Reporting should communicate a versatile picture of the company's operations in order to be able to analyse the history, see the present, and anticipate the future. (Alhola & Lauslahti 2006, 173.)

In general, we can say that reporting is aimed at the company's stakeholders. A company's stakeholders are all of the entities that are closely involved in the company's business. The most significant of these are customers, owners, creditors, subcontractors, public authorities, and personnel. (Tomperi 2004, 7.)

External reporting produces information for stakeholders outside the organization, such as authorities, creditors, suppliers, and owners. In external accounting, it is very important to comply with the law and meet the minimum requirements set by, for example, the Bookkeeping Act. Internal reporting, on the other hand, is not in any way regulated on the basis of laws or policies but it must meet the financial information needs of the organization's management. Its task is to support decision-making, direct people, and secure resources. (Jormakka et al. 2011, 10-11.)

Financial reporting is part of the financial reporting supply chain (Figure 4) and gives an overview of the stakeholders involved.

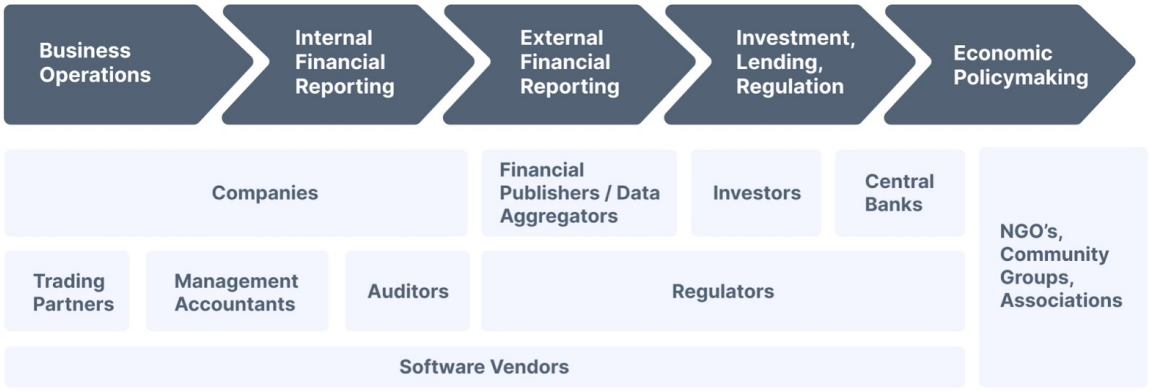

Figure 4. Financial Reporting Supply Chain per Müller-Wickop (2012, 3)

To assure high-quality reporting, financial information should be relevant and faithfully presented. Relevant financial information can make a difference in stakeholder decision-making. Faithful presentation of financial information means data that is complete, neutral, and free from error. Other qualitative characteristics for improving financial information are comparability, verifiability, timeliness, and understandability. (IFRS Foundation 2018, 25-30.)

3.3 User Groups Involved in Reporting

3.3.1 Asset Management

Asset management is a financial service related to the strategic management of a real estate or a real estate portfolio in order to increase its value. Asset management includes all value-influencing measures of a property during the management phase. The aim of asset management is to achieve the highest possible return over a specified period of time at a specified risk level or to minimize the risk as far as possible with a specified return. Therefore, financial and economic actions are taken in order to optimize and secure the invested capital. (Colliers a.)

Asset management takes care of investors' real estate investments and is their first point of contact. Asset management not only just advises its clients, but also makes investment decisions. Therefore, it has to keep a close eye on the real estate market and think long-term. Gathering, processing, and distributing information on all real estate matters supports this process. According to Mascher & Zink (2022), the range of tasks and services of property management mainly includes the following areas:

- Planning: Defining together with the investor the goals that need to be achieved, the budget, and all important information regarding the financial situation and risk tolerance.
- Control & organization: Controlling all contracts and processes relating to a property in the interest of the investors as well as the active planning, implementation, and control of all value-influencing actions in the management phase.
- Monitoring: Overseeing real estate and tenant-specific issues, such as real estate valuations or legal disputes. Additionally, monitoring the returns on investments and deciding on rent adjustments or refurbishments.
- Communication with owners/investors: Providing regular reporting and financial information about, for example, current rental income or budget compliance as well as decision memos.

Colliers (2022) defines the most important performance indicators in real estate property management as vacancy development, internal rate of return (IRR), net operating income (NOI) and weighted average lease term (WALT).

3.3.2 Property Management

Property management together with facility management focuses on the day-to-day operations of a rental property. In contrast to asset management, it does not refer to the investment and portfolio level, but to the concrete object or property level. That is to say, management on an operational level. A property manager, like an asset manager, acts in the interest of the investor and tries to implement the object strategies specified by asset management as efficiently as possible to ensure return-optimizing management.

According to Mascher and Zink (2022), the range of tasks and services of property management mainly includes the following areas:

- Planning: Conducting inventory, analysis, and monitoring of the managed properties keeping in mind the property goals specified by asset management. The targets often relate to the condition of the property, the quality and turnover of tenants, the maintenance effort, or the efficiency of management.
- Control & organization: Carrying out the targets specified by asset management by monitoring an ongoing analysis of income and expenses or by identifying and using new potentials to increase efficiency.

- Controlling and reporting: Responsible for complying with the budget set by asset management and therefore monitoring, analyzing, and evaluating tenants and service providers regarding deviations from contractually agreed services and costs. Property management creates reports for asset management that provide information about the development at a property level.
- Risk management: Complying with the strategies set for avoiding risk, controlling risk, and transferring risk.

Other key tasks of a property manager are finding and keeping major tenants, executing leases with the given terms and conditions, making sure that rents are paid on time, and maintaining the property. Additionally, asset management provides monthly and year-end financial reports to the property owners. Tenant retention, rental income, occupancy, vacancy rates, and tenant turnover are some of the most valuable KPIs measured. (Rohde, 2021; Colliers 2022)

3.3.3 Controlling

Controlling can be seen as the comprehensive business process of setting goals, planning, implementation, measurement, and improvement to ensure the sustainable economic development of the company. The determination of key figures, the implementation of analysis, and the derivation of recommendations for actions are central contributions to controlling the operational process. Therefore, controlling can be seen as a comprehensive, proactive companion to management at eye level. In fact, surveys show that controllers see themselves more as providers of numbers and less as consultants. Planning is often the dominant task as well as budgeting, reporting, and variance analysis. (Schädlich 2019, 18-20)

Controlling is essentially divided into two areas: operational and strategic. Both areas form a so-called control loop, meaning that operative planning heavily depends on strategic planning. Conversely, operational data provides helpful considerations for strategic planning. Operational and strategic controlling are interdependent.

4 Measurements and Key Metrics

All management, not only just within real estate, requires measurement. With the help of indicators, information about causalities, meaning cause-and-effect relationships, can be gained. With the help of the information obtained from the measurements, conclusions are made about whether the causalities work as planned and in the intended direction. With the help of metrics, the matters relevant to the organization and the areas considered important in the respective strategy period are indicated. (Saarijärvi & Puustinen 2020, 231-232.)

Metrics or key figures are result variables that characterize facts and relationships in a simplified and condensed form and reflect a quantitatively measurable situation. Key Performance Indicators will help companies define their strategy with a clear focus. Metrics, on the other hand, are good to follow on a general level since they bring additional knowledge, but are not business-critical measurements a company is striving to achieve. (Gladen 2011, 11.)

4.1 Types of Measurements

Antikainen et al. (2018, 6) define the most important concepts related to measurements as follows:

- A metric produces information about an issue or phenomenon that is a directly measurable factor or a combination of such factors. The metric is often made up of a calculation formula where figures from, for example, measurement or statistical results are entered. An indicator can be calculated with the metric.
- An indicator describes the state and development of the measured issue. The indicator can measure issues statistically or qualitatively. Indicators condense large amounts of data into an easily usable form. The indicators should not be open to interpretation but should give the most unambiguous final result.
- A dashboard or scoreboard is a whole that consists of several indicators. The scoreboard is used in decision making, defining cause-and-effect relationships and setting and monitoring goals. A dashboard shows a wide variety of indicators and metrics based on real-time data. Many organizations use both models as business intelligence reporting tools.

Steffansson et al. (2019, 139) urge that when choosing metrics, one must pay attention to the fact that the chosen metric describes a change in line with the goal. Impact assessment is a process in which goal assessment, goal definition, and goal achievement evaluation form a continuum. A functioning metric always describes the change in the same way and

systematically, regardless of the evaluator. Niemelä et al. (2008, 101) stress that good and functional metrics must be connected to the company's strategic goals and focus on measuring key processes at all levels of the organization. High-quality and comparable information is obtained when it is known what or who is measured, why, how, and with what it is measured. The metric is used according to the agreed instructions and the results are systematically recorded. The metric must be sufficiently simple and easy to use if the information is to be collected as part of everyday work. It is important that the metric's purpose, area of use and validity, repeatability, and reliability are carefully evaluated. (Steffansson et al. 2019, 140.)

Pellinen (2017, 44–45) divides the definition of metrics into three stages. In the first stage, the performance area is defined, which can be, for example, costs or quality. In the second stage, the target level is set for the metric. Depending on the metric, the target level may concern, for example, product-specific costs or the target number of defective products in the defined total quantity. The third stage defines how the achievement of the set goal is measured. At this stage, the challenge is often that not all things can be measured directly, such as quality.

In general, we can say that a good metric provides the following benefits:

- It supports decision making.
- It points out failure and success with high accuracy.
- It improves future performance.
- It helps identify and mitigate risks.
- It helps improve customer satisfaction (Kerzner, 2017. 122-123).

4.2 Types and Structures of Key Figures

There are different types of key figures and the significance of the respective key figures defines their information content. According to Gladen (2014, 15-16), key figures can be divided into absolute and relative key figures.

Absolute key figures are key figures that result from sums, differences, or average values. They can be variables related to a point in time (stock variables) and also variables related to a period of time (flow variables). Stock variables only reflect instantaneous situations, whereas changes over time can be described with flow variables (e.g. turnover). If absolute key figures are not compared with others, they have very little significance.

Relative key figures, also known as ratio indicators, are determined from the ratio of at least two mostly absolute key figures. These are divided into:

- Relationship key figures, which determine the ratio of two different quantities (for example sales per employee).
- Index key figures, which set two similar quantities in a mostly temporal ratio to each other. One quantity forms the index base (usually 100) at the base time. Another quantity recorded at a later date represents their development as a relative comparative value (for example indexing of personnel costs for the long-term analysis of development).
- Outline ratios, which put a subset to the total quantity, meaning numbers in which a part size is related to total size. They are often visualized in pie charts and displayed as percentages (for example, the share of equity in the total capital is the equity ratio).

4.3 Role of Measurements for Companies

The meaning and importance of key figures is fully recognized when taking a look at their role within an organization. They can show the strengths and weaknesses of companies and are therefore important decision-makers in a company. They are also used as an important tool for various processes. According to Schreyer (2007, 78), there are five roles and functions that key figures support (Figure 5). These are operationalization, excitation, specification, allocative, and control functions.

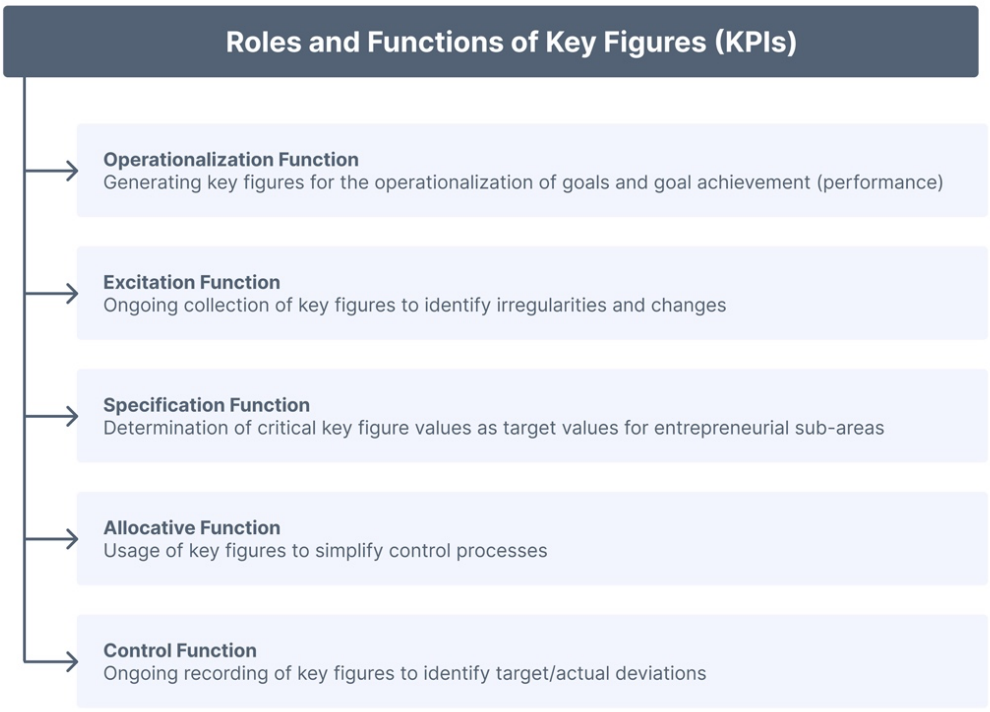

Figure 5. Roles and Functions of Key Figures

In order for KPIs to be able to fulfil their decision-making function, they must be prepared clearly. However, when aggregating the data, it must be taken into account that detailed information can get lost. For a correct perception and interpretation of the key figures, the correct visualization is important. KPIs not only support pattern and problem recognition, but they also fulfil control functions. The planned and the achieved result can be compared with the help of KPIs. For real estate companies that can mean following actual numbers to compare them to a set budget and control if the set targets are met.

Since KPIs help with the implementation of decisions and with the coordination of different areas in the company, they have a coordination function. In order to avoid mismanagement, the key figures must be carefully selected. After all, key figures also allow an outlook and therefore have a visionary and strategic function. Key figures allow conclusions to be drawn about the success or failure of a company, ensuring any impending insolvency can be recognized in good time. (Sevdesk 2022.)

There are different priorities and requirements for key figures in various areas of a company. Most common KPIs are related to the areas of finance, customers, and processes, as summarized in Figures 6, 7 & 8 (Reimus et al. 2021).

Finance

Earnings Indicators	Profitability Indicators	Liquidity Indicators	Cash Flow Indicators
Revenue	Net Profit Ratio	Cash Ratio	Cash Flow
Net Operating Income	Return on Equity	Quick Ratio	Gross / Net Cash Flow
Earnings before Taxes	Return on Assets	Current Ratio	Free Cash Flow
Earning before Interests & Taxes	Return on Investments	Working Capital	Operating Flow

Figure 6. Breakdown of the Most Important KPIs Related to Finance

Customers

Customer Relationship Indicators	Marketing / Communication Indicators	Price Management Indicators
Customer Growth Rate	Media Reach	Profit Margin
Customer Retention Rate	Click Through Rate	Trade Margin
Duration of Customer Relationship	Cost per Thousand	Marginal Return
Rate of Complaint	Brand Awareness	Price Elasticity of Demand

Figure 7. Breakdown of the Most Important KPIs Related to Customers

Processes

Project Indicators	Quality Indicators	Supply Chain Management Indicators
Schedule Performance Index	Quality Rate	Procurement Efficiency
Cost Performance Index	Scrap Rate	Misdelivery Rate
Time Estimate at Completion	Failure Costs	Error Delivery Rate
Process Acceleration Costs	Compliance Cost Share	Level of Readiness for Delivery

Figure 8. Breakdown of the Most Important KPIs Related to Processes

All of these indicators regulate and influence organizations and are often the main driving force behind practices. Designing a system of performance measurements is not an easy task. Therefore it is important to gain and integrate knowledge from different process areas as well as make use of different people, information technologies and the right scientific methods. In general, we can say that indicators must be reliable, representative, and easy to draw a conclusion on. Furthermore, they should be able to indicate time trends and to adapt if changes inside or outside the organization occur. The ability to process, collect, and update data easily and quickly is another requirement. (Franceschini et al. 2019, 8.)

If we split the term key performance indicator into its individual parts, we can define its meaning. Key can be seen as the major contributor to success or failure. Performance is something that can be measured, adjusted and controlled and the indicator is showing how that performance is achieved at the moment and how it will develop in the future. (Kerzner 2017, 128.)

The SMART (specific, measurable, attainable, realistic, time-based) rule is a common practice to identify certain characteristics a KPI should have. Kerzner criticizes those characteristics and points out that when selecting KPIs, the user must be able to control the outcome and therefore one main characteristic of a KPI should be its actionability. Further, he is referring to 12 characteristics for KPIs developed by Wayne Eckerson shown in Figure 9.

1. Strategic	Performance metrics focuses on the outcome you want to achieve.
2. Simple	KPIs should be straightforward and easy to understand, not based on complex indexes that users do not know how to influence directly.
3. Owned	Every KPI is "owned" by an individual or group on the business side who is accountable for its outcome.
4. Actionable	KPIs are populated with timely, actionable data so users can intervene to improve performance before it is too late.
5. Timely	The KPI can be updated frequently so performance can be improved if intervention is needed.
6. Referenceable	The user can relate back to the origins of the use of the metric.
7. Accurate	The performance metric data can be measured and reported with reasonable accuracy.
8. Correlated	The KPI can be used to drive the desired business outcome.
9. Game-proof	Frequent testing and analysing on the KPI can be conducted so that the data is realistic and not fudged or circumvented due to laziness.
10. Aligned	KPIs are always aligned with corporate strategy and objectives.
11. Standardized	Everyone agrees on the definition and meaning of the KPI. KPIs are based on standard definitions, rules, and calculations so they can be integrated across dashboards throughout the organization.
12. Relevant	KPIs gradually lose their impact over time and must be periodically refreshed, revised, or discarded.

Figure 9. 12 Wayne Eckerson's Characteristics of Effective KPIs

4.4 Selected Key Performance Indicators

The key figures used later in this work are briefly explained in this chapter.

Yield

Yield defines the future income of an investment and is a crucial number when buying or selling an investment property. On a general level, it is calculated annually as a percentage, based on the real estate's market value or cost. (Cossar 2021.)

IRR

The internal rate of return is an annual rate of growth that is often used for financial analysis. IRR predicts the growth that an investment is expected to generate and helps therefore to forecast the profitability of a potential investment (Fernando 2022a).

NOI

Net Operating Income equals the sum of all income from renting and leasing a property, minus all reasonably necessary operating expenses like inventory costs or insurance. NOI is a very important parameter for the valuation of objects according to the international DCF procedure. Debtors such as banks determine NOI to assess the economic viability of the capital service for an investment. NOI is an internationally established indicator for assessing the profitability of a property and is therefore of great importance in the real estate industry. (Colliers b.)

OPEX

Operating expenses include all expenses incurred by the owner in owning or using land, buildings, or outbuildings. Not all operating costs can be passed on to the tenant. Allocable costs are ongoing consumption costs such as expenses for water supply and disposal, heating costs, garbage disposal, street cleaning as well as gardeners and caretakers, sewage and others. Usually, one-off costs such as repair and maintenance costs as well as administration costs or account fees cannot be passed on. (Kenton 2022.)

ROI

Return on investment is a profitability metric that helps to evaluate the performance or profitability of an investment. ROI aims to measure the amount of return on a particular investment, in relation to the cost of that investment. Because of the versatile and simple calculation behind ROI, it is a very popular metric within investment management. (Fernando 2022b.)

Vacancy & Vacancy Rate

Vacancy includes all properties that can be obtained within three months. The vacancy rate shows the current vacancy of a unit (building, city, region, etc.) in relation to the total floor space of this unit. (Colliers c.)

WAULT / WALT / WALE

WAULT (weighted average unexpected lease term), WALT (weighted average lease term) and WALE (weighted average lease expiry) are basically referring to the same concept of measuring a property portfolio's risk of becoming vacant. It refers to the average remaining rental period of a commercial real estate portfolio (Rahmat 2013.)

5 Information Design and Data Visualization

5.1 Data

Data is everywhere and the amount of data we generate and use is increasing rapidly. In 2020, the data volume generated worldwide was over 64 trillion gigabytes and is predicted to rise up to 181 trillion gigabytes by 2025 (Statistika 2022). Data can take many forms but in general we can say that all written, digital, visual and audiovisual material is classified as data.

In everyday language, many consider the words data and information to be synonymous with each other. However, this is not the case with a precise definition. Data refers to the raw material from which information is formed. From information, on the other hand, knowledge is created, which is then refined into wisdom. Wisdom and knowledge, according to their definitions, are essentially related to humans and human understanding. Those four layers are referred to as the DIKW pyramid. The model can be widely applied in the field of information science and knowledge management. The relationships between data, information, knowledge and wisdom is visualized in Figure 10. (Frické 2018.)

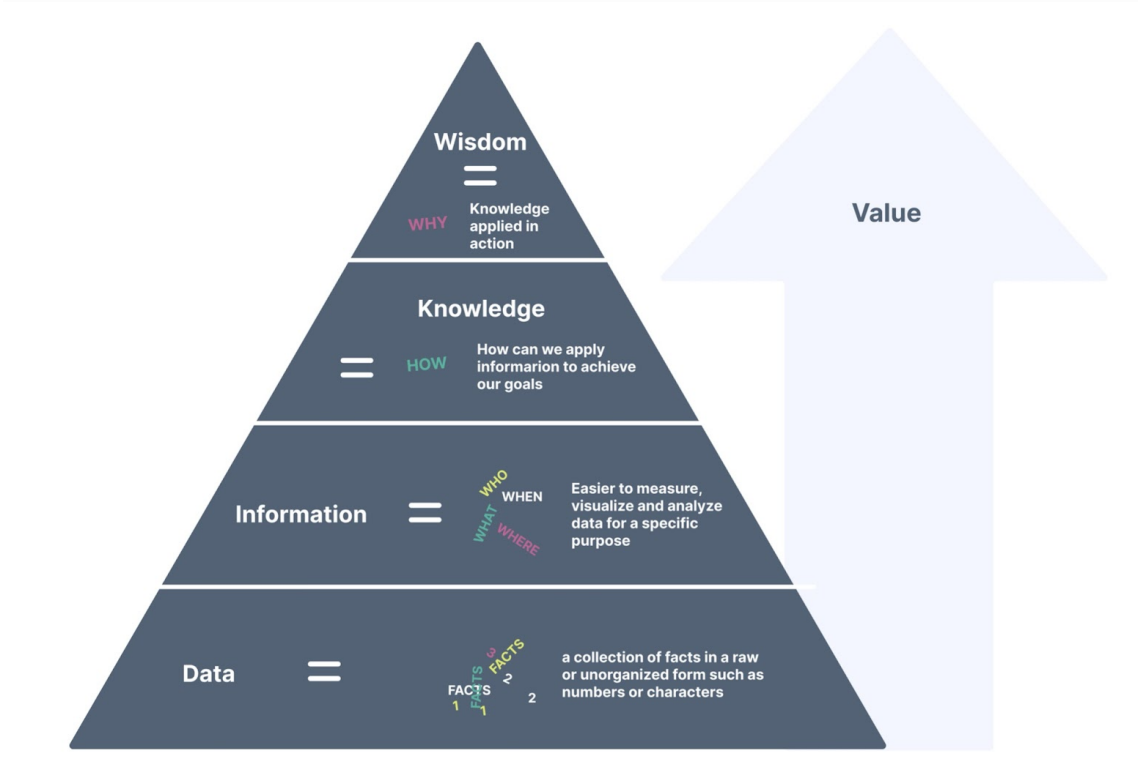

Figure 10. Data, Information, Knowledge, Wisdom (DIKW) Pyramid

Data itself is not useful, but the knowledge refined from this data can be very valuable for a company's operations. Each layer of the pyramid is answering questions regarding the initial

data and therefore adds value to it. This means that the value of data develops the further the information obtained from the data is refined with relevance and context. More knowledge means more insights. Once we reach the wisdom stage, we have turned those insights into a meaningful learning experience that can now guide our further actions. (Salo 2013, 26-27.)

Nowadays technology enables the safe storage of huge amounts of data. Although humans have caused this massive growth of data, we ourselves are not producing all the data that is formed. New technological solutions like the internet of things (IoT), also produce data at an accelerating pace. IoT is the name for a network of physical objects equipped with sensors, software, and other technologies to connect them to other devices and systems over the internet. (Salo 2013, 12–13.)

One term related to data is data science. Data science can be seen as the extraction of actionable insights from raw data. Aust describes data science as solving problems with the help of computers. It is about understanding and analysing human problems and finding a solution by translating them into computer-solvable problems. (Aust 2021, 3.)

5.2 Why Visualize Data?

Data visualization is the process of using visual elements such as charts, graphs, tables and maps to represent data. Converting data into visual content helps the user understand relations, trends or patterns more quickly. Visualized data can often reveal statistical calculations or analyses and describe facts more clearly and understandably than pure text or tables. Since it is proven that almost 90 percent of all sensations are transmitted to our brain through the eyes, it is natural that visual communication takes on an increasingly central role in our lives. (Koponen et al. 2016, 11; Götz & Rogamonti 2015, 14.)

The assumption that it is already sufficient to simply collect or generate information and then convert it into visually appealing graphics is not entirely correct. Data visualization also means the ability to read and understand an ever-increasing amount of data and facts. When creating graphs or visualizing information, one should always keep the audience in mind. The needs of the people who will use the information are the most important factor to consider during data visualization. The way data is presented is equally important as the data itself. (Schwabisch 2021, 1.)

Dashboards and infographics are two of the most common ways of visualizing data. Both types use a combination of charts, text and images to tell the message of the data. But no matter the size or shape of data visualization, all of them should have certain characteristics. According to Yuk (2014, 8-9), they must be useful, desirable and usable (Figure 11).

Characteristic	Description
Useful	People use it in a regular basis and can make relevant decisions by viewing all the information they need in one place.
Desirable	It's not only easy to use but also pleasurable to use.
Usable	People who use it can accomplish their goals quickly and easily.

Figure 11. Characteristics of Good Data Visualization

Additionally, there is one golden rule determining when data visualization is useful. If something can be described at least as clearly with words as it can be in a picture, visualization is not necessary. The purpose of visualization is to make it easier for the reader to understand the data and analyse it. Visualization is clear when the reader understands the content shown and with the help of the content gets an answer to a question or creates new perspectives on the matter being visualized. (Koponen et al. 2016, 29-30.)

It is also evident that information graphics cannot be objective, since they always consist of elements that have already been processed or interpreted. The graphic evaluates its message simply by the way the content is translated visually. The world is made up of signs and codes that must be recognized in order to be understood and interpreted. Since not all people think in the same way, a visual element is not only related to its content but above all to the person who interprets it. (Götz & Rogamonti 2015, 16.)

A very good example of data visualization is isotype. Isotype (international system of typographic picture education) was developed in the 1920s by Viennese sociologist and philosopher Otto Neurath as a method for visualizing data and relationships. The educational goal was to use representational images and symbols to transform complex issues into an intelligent and condensed form that was both clear and interesting and accurate. (Cat 2019.)

5.3 Types of Data Visualization

On a general level, data visualization can either be exploratory or explanatory. Exploration is best used when one has a lot of data, but the content is not clear. It is often used in data analysis and helps to find the story the data has to tell. Explanation on the other hand, is best to use when the content of the data is already clear. It is often used in the presentation phase and to tell the story of the data to somebody else.

Explanatory visualization can be divided into three categories which are based on the relationship between the designer, the reader and the data. The three-legged diagram introduced by Iliinsky and Steele and shown in Figure 12 is based on three paradigms: informative, persuasive, and visually appealing. When visualizing data, the nature of the visualization depends on which relationship between two of the three components is dominant.

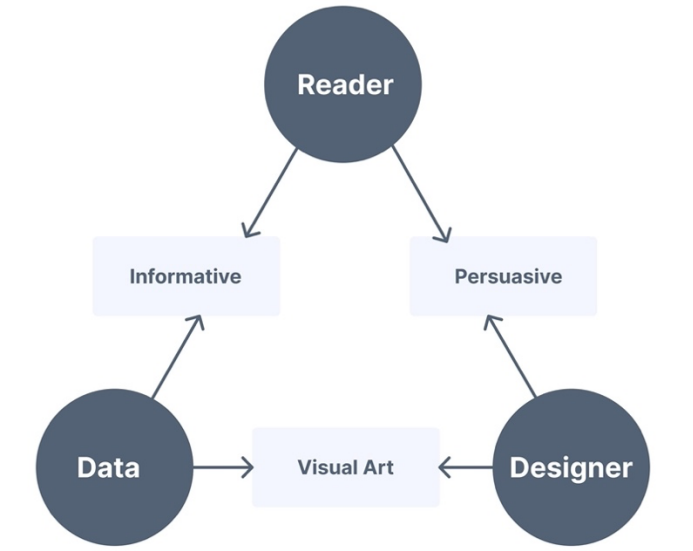

Figure 12. The Designer-Reader-Data Trinity

The relationship between the reader and data is often supported by informative visualization. This means that facts are presented in a way that educates the reader and puts the data into a manageable consumable form so it is easy for the reader to understand.

A persuasive visualization mainly serves the relationship between the designer and the reader and is useful when the designer intends to change the reader's mind about something. It mainly represents a very specific point of view and therefore aims to change the readers opinion or actions on some specific topic.

Visual art primarily serves the relationship between the designer and data and merely translates the data into a visual form. It often entails the unidirectional encoding of information. This means that the reader might not be able to decode the information and the designer intends only to condense it, translate it into a new medium, or make it beautiful. (Iliinsky & Steele.)

5.4 Aesthetics

When visualizing data, we take data values and systematically and logically transform them into visual elements. All data visualizations map data values into quantifiable characteristics that are represented in the resulting graphic.

According to Wilke (2020, 7-8), aesthetics describes every aspect of a graphic element. Naturally, a critical component of any graphical element is its position, which describes where the element is located. Furthermore, all graphic elements have a shape, size, and colour. When we use lines to visualize data, those can have different widths or can be shown as dotted or dashed lines. Commonly used aesthetics are visualized in Figure 13, but one needs to keep in mind that text and other aesthetics play an important role in data visualization as well.

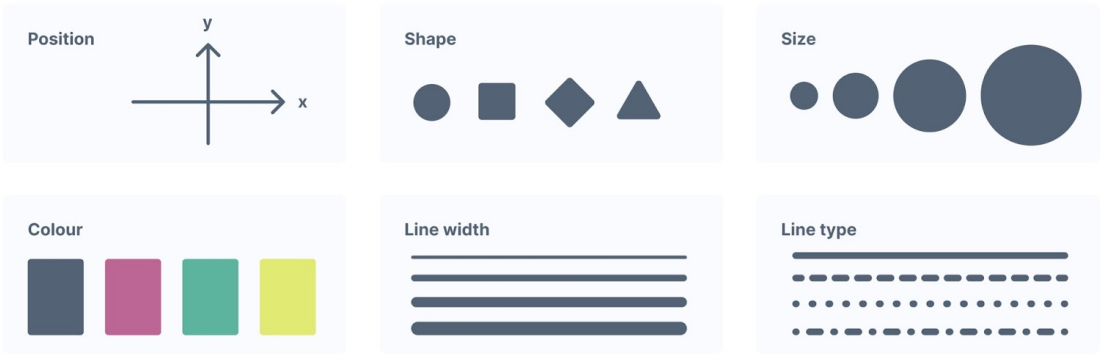

Figure 13. Commonly Used Aesthetics in Data Visualization

Two groups of aesthetics can be defined: those that can show continuous data and those that cannot. A time duration for example can have many values between two points and can therefore be seen as continuous data. In contrast is the discrete value of, for example, the number of kids in a classroom. There can be 20 kids, but not 20,5.

These numerical values, also called quantitative data, are only two types of data used in data visualization. But other data can also have the form of discrete categories, such as dates, times and text. Those can be seen as qualitative data. Figure 14 describes the types of data usually used in data visualization according to Wilke.

Type of variable	Examples	Appropriate scale	Description
quantitative/numerical continuous	1.3, 5.7, 83, $1.5x10^{-2}$	continuous	Arbitrary numerical values. These can be integers, rational numbers, or real numbers.
quantitative/numerical discrete	1, 2, 3, 4	discrete	Numbers in discrete units. These are most commonly but not necessarily integers. For example, the numbers 0.5, 1.0, 1.5 could also be treated as discrete if intermediate values cannot exist in the given dataset.
qualitative/categorical unordered	dog, cat, fish	discrete	Categories without order. These are discrete and unique categories that have no inherent order. These variables are also called *factors*.
qualitative/categorical ordered	good, fair, poor	discrete	Categories with order. These are discrete and unique categories with an order. For example, “fair” always lies between “good” and “poor”. These variables are also called *ordered factors*.
date or time	Jan. 5 2018, 8:03am	continuous or discrete	Specific days and/or times. Also generic dates, such as July 4 or Dec. 25 (without year).
text	The quick brown fox jumps over the lazy dog.	none, or discrete	Free-form text. Can be treated as categorical if needed.

Figure 14. Types of Data Typically Used in Data Visualization

Adobe devides data into dimensions and metrics. Dimension consists of qualitative values like names, types or places and is discrete. They can be used to categorize or segment data since dimensions are discrete or put values in specific orders.

Metrics on the other hand consist of quantitative values that can be measured and are continuous. Ratio scale is an example where values are plotted at specific points to show their exact measure. Visualization usually starts at zero as the most meaningful reference point. Ratio is similar to the interval scale but lacks a meaningful zero or origin point. Relations and scales are visualized in Figure 15. (Adobe 2022a.)

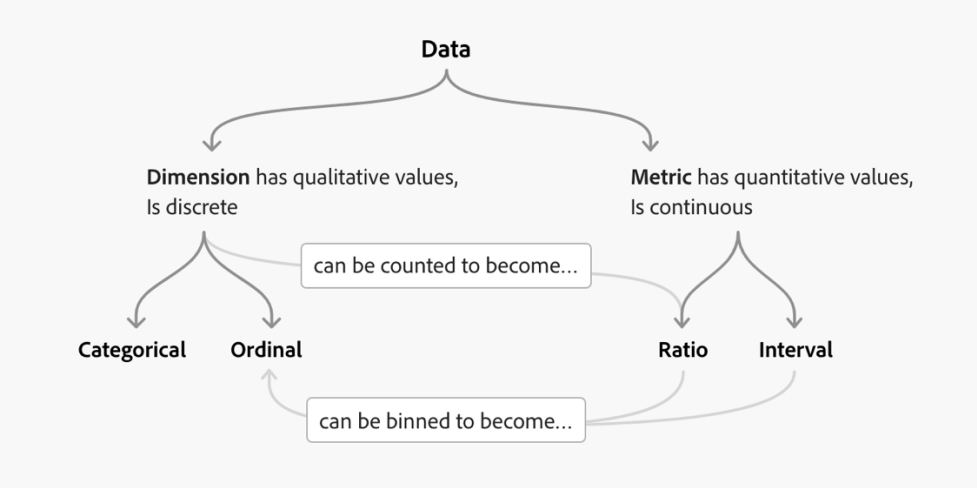

Figure 15. Differentiating Data in Data Visualization

5.5 Meaning of Colour

Colour is a common way to distinguish groups of data from each other. But we also use it to represent data values or to highlight certain data points. Colour in general is a good element to improve the quality of a chart's aesthetic. It can as well increase its ability to effectively communicate the data it presents. (Muth 2021.)

According to Koponen et al. (2016, 29-30), colours have two different roles in information design. They are directly related to the coding and structuring of information, meaning that colour itself can contain information. Colours also have aesthetic and cultural meanings and have an unconscious effect on humans. That means, that we associate certain attributes with colours (Designer in action 2020).

Three essential data visualization colour palette types to consider are displayed in Figure 16: categorical, sequential, and diverging (Muth 2021).

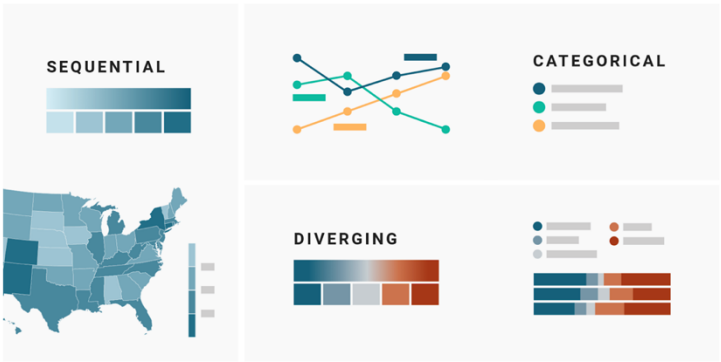

Figure 16. Data Visualization Colour Palette Types (Muth 2021)

5.5.1 Categorical Colours

We can use a qualitative colour palette as shown in Figure 17 to differentiate one item from another by defining a specific set of distinct but similar colours where no colour stands out relative to the others. Also, the palette should not create the impression that colours present a specific order. There are widely used, predefined qualitative colour scales available like the Okabe Ito scale, ColorBrewer scale, or the ggplot2 hue scale. These categorical colours help users map non-numeric meanings to objects in a data visualization. (Muth 2021; Adobe 2022b.)

Figure 17. Examples of Qualitative Colour Scales

A use case where categorical colours are of great benefit is when values are industries or countries as in Figure 18.

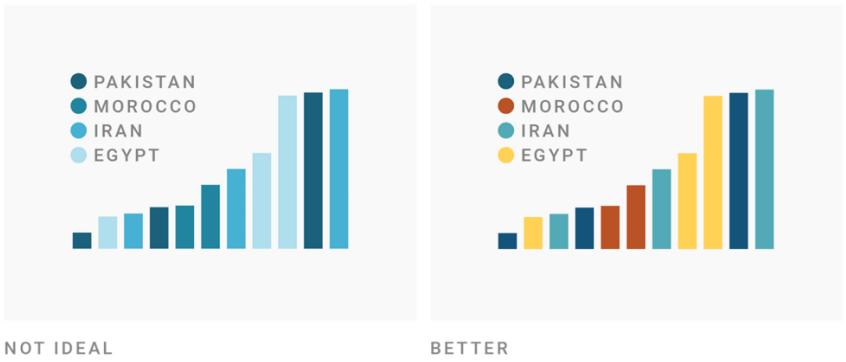

Figure 18. Example of Qualitative Colour Use (Muth 2021)

5.5.2 Sequential Colours

When colour is used to represent data values, we speak of sequential colour scales like in Figure 19. Those are gradients that go from a brighter to a darker colour or the other way around. They can therefore indicate for example increasing numbers, like age, temperature, or income. They can be also used to emphasize an underlying order or show how distant two specific values are from each other. (Adobe 2022b.)

Figure 19. Sequential Colours Used by Adobe (2022b)

Use cases where sequential colour is a good choice include visualizing, for example, income or unemployment rates like in Figure 20.

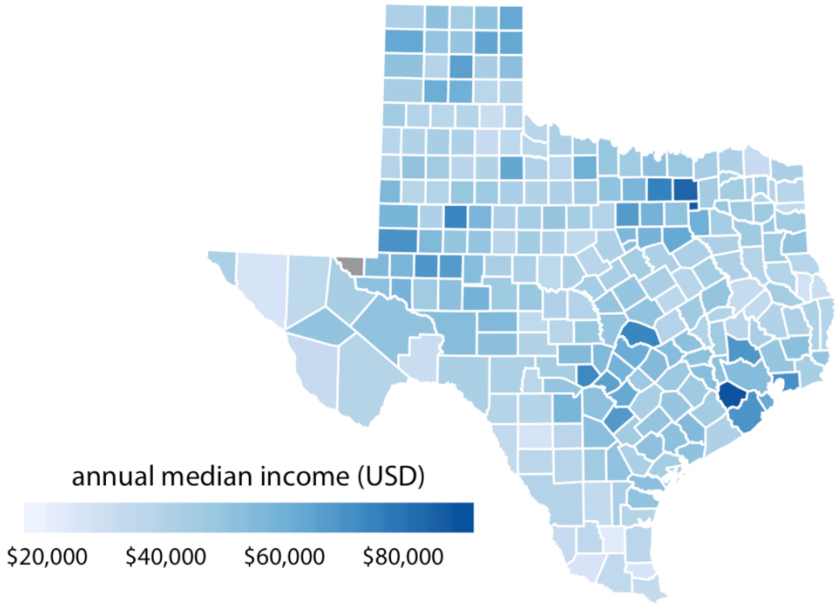

Figure 20. Example of Sequential Colour Use (Muth 2021)

5.5.3 Diverging Colours

Diverging colours, like in Figure 21, are often used when highlighting a specific element in the data. To emphasize that particular element, we can assign a colour that stands out against the other colours used in a visualization. Therefore, it is important that the baseline colour does not compete for attention. In some ways, accent colours are similar to sequential colour scales. The difference is that in addition to showing a scale going from low to high, they have a bright middle value and go darker on both sides of the scale.

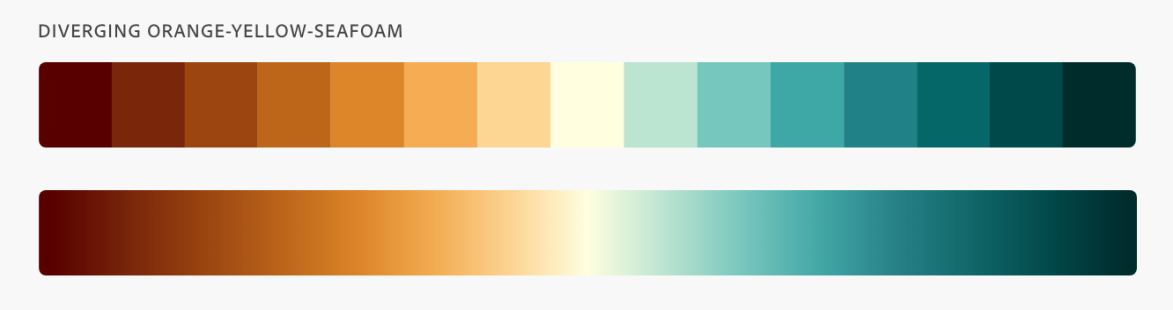

Figure 21. Example of Diverging Colours (Adobe 2022b)

When visualizing data containing negative and positive values or Likert scales, the application of a diverging colour scale is a good choice. (Muth 2022.)

5.6 Outline of the Most Common Visualizations

When visualizing data, we often ask what we would like to show. There are different kinds of graphs suitable for different kinds of datasets visualisation, for example, comparisons, amounts, or distributions (Wilke 2020, 44).

5.6.1 Amounts

To visualize amounts we commonly use bars. They can be vertically or horizontally oriented. Alternatively, dots can be used to indicate where a certain bar would end (Figure 22). In the case of two or more sets of categories with amounts, grouped or stacked bars can be utilized. When mapping categories on the x and y axis and showing amounts by colour, a heatmap like that shown in Figure 23 can be used.

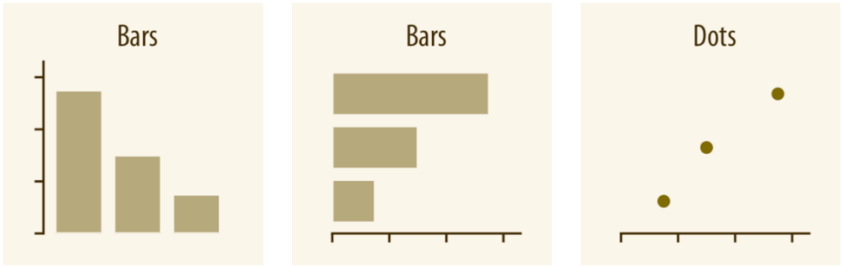

Figure 22. Amounts Visualized in Bars and Dots

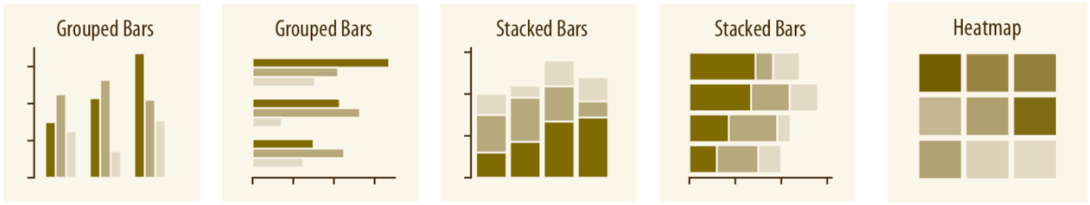

Figure 23. Amounts Visualize in Grouped and Stacked Bars and with a Heatmap

5.6.2 Distributions

Distributions can be best visualized in the form of a histogram or density plots. A faithful data presentation can be achieved by using cumulative densities and quantile-quantile plots, but they might be more difficult to interpret for the reader (Figure 24).

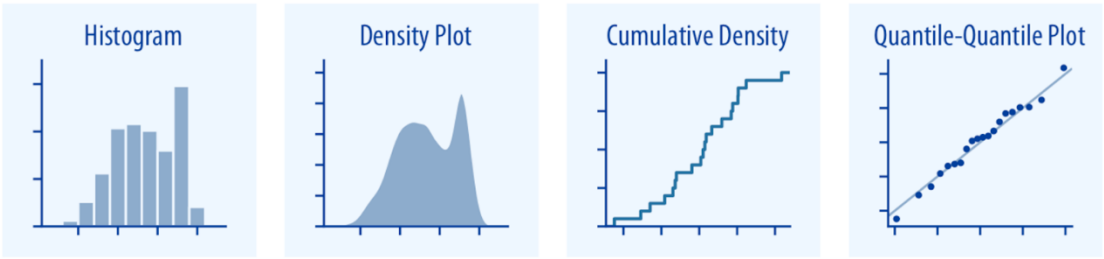

Figure 24. Distributions Visualized

Boxplots, violins (or alternatively ridgeline plots), strip charts, and sina plots are useful when visualizing many distributions at once. A more in-depth comparison of a smaller number of distributions can be reached by using stacked histograms and overlapping densities (Figure 25).

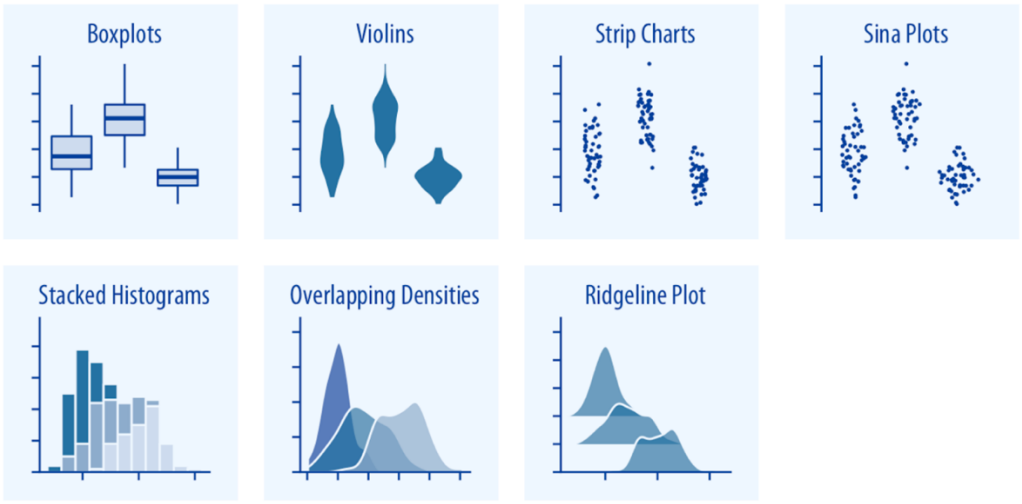

Figure 25. Methods of Visualizing Distributions by Distributions Arears

5.6.3 Proportions

The best ways to visualize proportions are via pie charts, side-by-side bars, or stacked bars Figure 26). Pie charts visualize clearly that the individual parts are added together to form a whole. On the other hand, individual values can be more easily compared in side-by-side bars. Stacked bars can be used when comparing multiple sets of proportions. (Wilke 2020, 45)

Figure 26. Visualized Proportions

6 Implementation of the Research

The research of this final thesis heavily relies on the concept of design thinking. The idea of design thinking is to produce visually concrete, even touchable alternatives, from which it is possible to evaluate solutions, choose the best ones and make final concepts. In this concept, problems are solved with the help of thinking that looks for different alternatives and matching different requirements, so that, for example, the values of user desirability, technological feasibility and economic profitability are made to work together. Design thinking is a reference framework for problem solving, which is about long-term and purposeful action to identify and solve problems and business opportunities. (Miettinen 2014, 29; Kosonen, 2018.)

At its best, design thinking is a great agent of change, and it can be used to solve challenges on many levels, from designing user experiences and services to creating strategy, designing business practices, and organizing companies. Since the process of design thinking is exploratory in nature, it first aims to find the most important problem or opportunity to be solved. The perspective is always broadened first, and only then are decisions focused on the most relevant topics.

A successful business, product, or service is created by finding a balance between customer needs, feasibility, and business potential. Finding this balance is one of the most central tasks of design thinking. The central questions of design thinking are:

- What does the customer really need?
- What kind of opportunities could there be for us in the current environment?
- With what products and services do we respond to a need or take advantage of an opportunity?
- What role do our products play in our customers' lives?
- How should we organize ourselves so that we can manage now and tomorrow?
- How does the solution affect the surrounding world? (Kosonen, 2018.)

It is crucial to have a fundamental understanding of what users actually need and what their goals are. That requires that many designers step away from their desks and enter another world - the world of the users for whom they design a product or service. Verschoor sees the primary goal of research as understanding people. In order to reach this goal, the selection of methods used for research must be responsive to the context. Research done

responsively follows the steps of observation, triangulation, analysis, and interpretation. (Verschoor 2016, 46.)

Key ways to ensure the appropriateness of the solution are e.g. human-oriented research, making prototypes and testing them together with future users. In this way, you ensure that design decisions are based on real information, or at least as accurate an assumption as possible about the needs of the customer. (Kosonen, 2018.)

Understanding the user's needs, context, behaviour, and motives also brings certainty to development choices. In the long run, it is much more cost-efficient to define at an early stage a solution that solves the user's problem best from the user's point of view and most efficiently from the service provider's point of view. Therefore, it is helpful to have a team of several professionals who can examine a problem from as many angles as possible. In this case, more solutions can be found, faster, and the final solution has a greater chance of being realized in accordance with the goals. (Miettinen 2014, 44.,111.)

According to the Interaction Design Foundation (2022.), the design thinking process covers 5 basic pillars:

1. Empathize and strive to understand users.

2. Define customer needs, challenges, and your own discoveries.

3. Challenge ideas, hypotheses, assumptions and create new solutions.

4. Prototype and create concrete visual solutions.

5. Test the prototype on users and develop according to feedback.

In many organizations, Design methods are now used at the strategic level - no longer just as part of product development - and many organizations have clearly become more design driven. The challenge of implementing design thinking is due to three different factors that differ from previous thinking:

- Customers and their role: In traditional organizations, the customer has been seen as a passive consumer who does not participate in the value creation process. Design thinking, on the other hand, relies on consumer insights and also uses them as a starting point for identifying new ideas. Consumers are seen as active partners from product development to release and beyond.

- Abductive knowledge: Traditionally, development work has sought to utilize existing data, reduce risks and build future solutions as a continuation of previous operations. Abductive logic goes the other way - instead of looking at one's own past

performance, one tries to understand what is happening in the environment and what the consequences might be. These consequences will be addressed in the best possible way. This method directs the most significant uncertainty factor directly to the middle of the innovation process. A new phenomenon is an opportunity and not only a risk. It inspires new alternative scenarios and reflections on what might be, instead of looking for what is already known.

- External perspective: Utilizing an outside perspective reduces the risk of investing in something that people may not even want to embrace. It is frustratingly common within organizations that status quo rules structure and operation, even though from an outsider's point of view these practices are not necessary or even useful. Thus, design thinking is much more than what a toolkit offers: it requires a new organizational culture and the internalization of new values. (Valtonen & Nikkinen 2022, 112-115.)

Design thinking is often mentioned in relation to the Double Diamond design process model introduced by the British Design Council back in 2005. The Double Diamond model presents a framework that makes it possible for companies to apply design characteristics to find creative solutions and innovative ideas. It helps us to understand the type and shape of a project that is going to be undertaken. The Double Diamond model can be seen as the heart of the Framework for Innovation, Design Councils' framework for setting design thinking in a strategic context. It can be divided into four phases: discover, define, develop and deliver. (Ball 2019.)

These phases can be roughly adopted not just for design thinking, but also for service design, co-design and transition design as visualized in Figure 27. The four phases are defined differently, but go hand in hand with the idea of discovering and defining a problem as well as developing and delivering a solution to solve that initial problem. (Verschoor 2016, 81.)

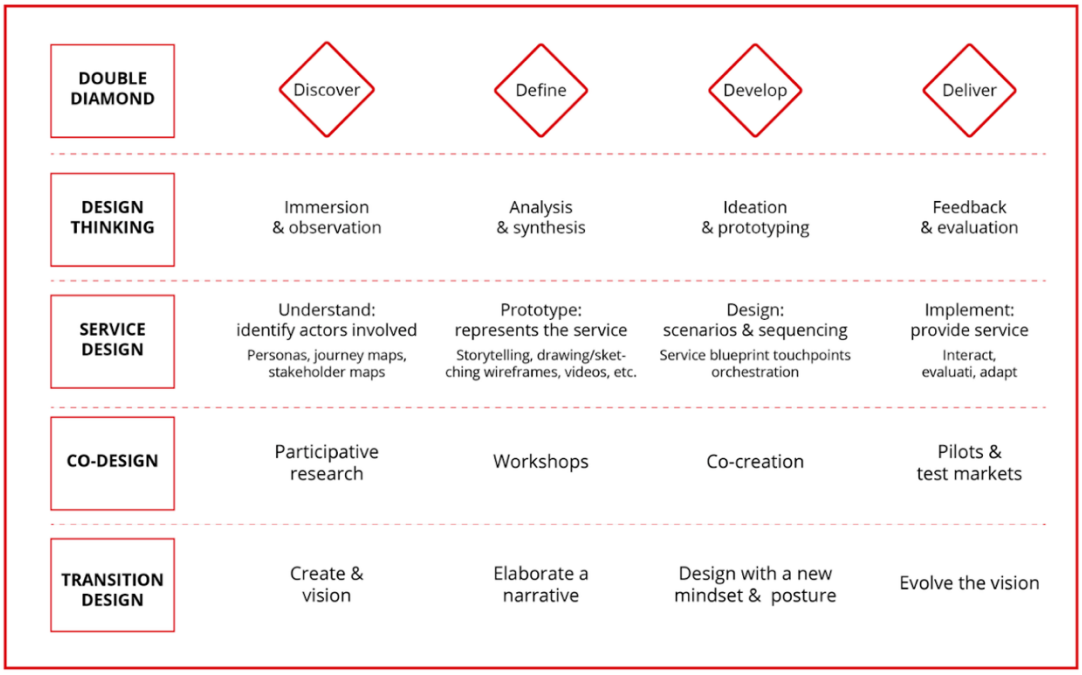

Figure 27. Double Diamond Model in Relation to Design Thinking, Service Design, Co-Design & Transition Design

When beginning the research for this project I assumed that design thinking and the Double Diamond model are competing concepts and cannot be united into one framework. I was overwhelmed by the many guidelines for designing good solutions that users love. Figure 28 shows how the Double Diamond and the design thinking can be united and helped me to get a clearer path for my research and development work.

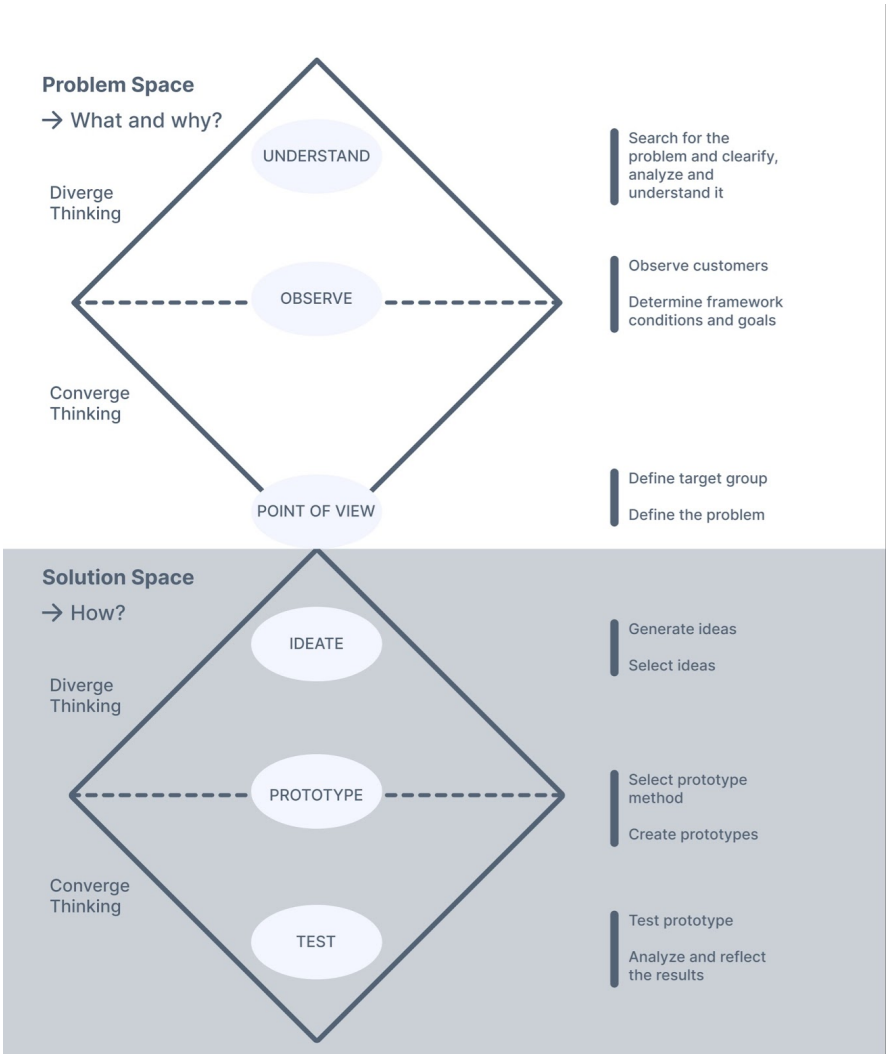

Figure 28. Design Thinking Approach Supplemented With the Double Diamond Model (Müller-Roterberg 2018, 6.)

6.1 The Problem Space

The Double Diamond process consists of two connected areas having the shape of diamonds with each area divided further into two phases. Diamond number one, or the so-called Problem Space, seeks to gather information and is dedicated to user research.

6.1.1 Understanding the Problem

Every new design project usually starts with a trigger. In the case of Assetti it was their customers' wish for a more flexible reporting solution. That means that the improvement of the existing product was our initial starting point. This user research and wider market research was the main driver for me in the beginning of this project. I had little knowledge about our customers' needs for reporting, was not aware of the data used, and was unsure about various country-specific requirements for real estate reporting.

Because this first phase is focused on the user, I wanted to collect as much information as possible. My aim was to understand in the best possible way their working routines, their motivations, and their problems. In order to gain that knowledge and to properly understand and design for them, I selected user interviews as my user research method.

Ideally, a user interview involves two user experience researchers and one user. In my case, I conducted interviews alone and had two or more users in one interview. For that reason, I recorded my interviews to ensure no information gets lost or forgotten and transcribed them as soon as possible after the interviews. There are certain topics that are usually covered within a user interview. These consist of background information of the user and their use of related technologies, but also questions about how the user employs a product or service. Additionally, the user's main objectives, motivations, and pain points with the product or service are discussed. My goal for the interviews was to find concrete use cases upon which I could build my future development work.

6.1.2 Finding the Right Participants

To find suitable participants and to ensure recruiting a representative sample of users, I started evaluating Assetti's user personas. During a meeting with the project team, we agreed on recruiting users who are already familiar with or working with the reporting possibility within Assetti. In order to get a wide understanding of how international customers use the Assetti software, I selected customers from different countries for my user interviews. Those countries were: Austria, Germany, Sweden, and Finland. A total of four semi-structured themed interviews were conducted for this study. Due to the different locations of the interviewer and interviewees, the meetings were held remotely via Google Hangouts and Microsoft Teams.

The themes of the interviews are mainly structured according to the current usage and requirements regarding a customizable reporting process and needed KPIs. In addition, I was trying to find out the users' thoughts and needs regarding the usability and visualization of the reporting possibilities. The names and organizations of the interviewees are not mentioned, but they are referred to as interviewee A, interviewee B, and so on. In the interviews, the aim is to maintain perspective on the needs of a small to medium-sized organization that manages its data within the Assetti platform and wants to expand its usage of data to support better reporting.

6.1.3 Introduction of the Interviewed Organizations

Company A is a real estate developer located in Austria but operating in a total of 14 countries within Central and Eastern Europe. The company originally specialized in office buildings, but now has a large portfolio in the residential sector as well. It holds a comprehensive portfolio and has so far developed around 560,000 m² of hotel, commercial, and residential space. They develop and manage real estate both for their clients in the specific sector and for third parties. In addition, Company A is a 100% owned subsidiary of an international bank. Having a bank as a shareholder is somewhat atypical for a real estate company. This brings certain advantages, but also disadvantages since standards and internal regulations are very bank-heavy.

- Interviewee A: Head of Asset & Country Management. Responsible for matters related to rentals and operation of the buildings in their portfolios. Also responsible for marketing and PR agents in the team.
- Interviewee B: Responsible for controlling, finance and key figure analysis as well as reporting.

Company B is a German real estate company that offers all services relating to commercial real estate and at the same time assumes the group's holding function. Services include asset management, leasing management, project development, and institutional advisory. The range of services covers the entire life cycle of a property.

- Interviewee A: IT Project Manager who has worked for company B for four years.
- Interviewee B: Team Lead Real Estate and Investment Management solutions who has worked for company B for five years.
- Interviewee C: Business Analyst with more than 20 years working experience in various European countries and in different businesses (asset management, banking, industrial and commercial). Has worked for company B for more than three years.

Company C is a Nordic real estate company that was founded in 2016 and focuses on societal real estate. In Sweden, the company also owns rent-regulated residential properties. The company is listed on the Stockholm Stock Exchange and has grown into the largest owner of societal real estate in the Nordic countries, with real estate holdings worth around 15 billion euros at the beginning of 2022. The business model includes project and property development, renovations, extensions and remodeling, as well as property transactions. Company C is a long-term partner of the Nordic public sector.

- Interviewee A: Controller who has worked for company C for two years.
- Interviewee B: Head of Property Management who has worked for company C for four years.

Company D specializes in investments, offering versatile and high-quality saving possibilities and asset management services for private investors, institutions, and professional investors. The company has 13 different offices around Finland and employs over 100 investment professionals. The services of company D are trusted by more than 10,000 clients, on whose behalf they manage assets of almost 4 billion Euros. The group's parent company is listed on the Nasdaq Helsinki Stock Exchange and their operations are supervised by the Financial Supervisory Authority of Finland.

- Interviewee A: CFO, Real Estate Asset Manager, experienced finance professional with expertise within reporting (financial, client profitability, sales), business controlling, and forecasting. Has been involved in several IT implementations, both finance and project management, and shared her knowledge later on as a trainer for those as well.
- Interviewee B: Director, Real Estate Asset Management, Almost 6 years working for the company. Is a commercial property professional with wide experience in all areas of the business, in particular shopping centres, retail, and business park properties. Prior employers include e.g. investment managers and a listed property company. Senior manager with 20+ years of experience in property asset management.

6.1.4 Interview Questions

As presented in chapter 2.3.1, I selected a semi-structured interview method for my research. Naturally, in the beginning of every interview, I asked the interviewees' permission to record the interview. Furthermore, I told the purpose of the interview and where its content and analysis will be published. A good way to start an interview is to begin with broader descriptive questions and then refine them with more detailed clarifications. As a starting question, I asked the interviewees to shortly introduce themselves and to tell me a bit about the company they are working for. Since all of them were Assetti customers, I was, to some extent, already familiar with the individual use cases and the way the companies utilize the Assetti software. But for me, the interviewees were unknown. I was familiar with their work title but unfamiliar with their work tasks.

The rest of each interview I divided into six parts. The first part was about the role of reporting within the specific company to get a holistic overview of the topic's importance. Furthermore, I wanted to gain knowledge about the content of reports and about the stakeholders involved. In the second part, I gained knowledge about the data and whether there are enough data points within the Assetti software to support effective reporting. The third part was taking general KPIs under investigation. The target of those questions was to find out what current KPIs are important, and if applicable, which are missing. The fourth part was similar, but there I focused on questions regarding financial performance KPIs. The fifth part was about visualization and requirements regarding different views and customization of charts. In the last part, I wanted to find out how users would like to utilize custom reporting to share insights. The interview path is visualized in Appendix 1.

6.1.5 Analysis of the Interview Material

When conducting a content analysis of the interview material, it is important to think about the following points. The interview material needs to be examined in detail, including the search for similarities and differences. Content analysis, like discourse analysis, is examining the material in text form and can be as well the analysis of materials that have been converted into such. The aim of the content analysis is to present a condensed description of the phenomenon under investigation and to link the results with other research results on the topic under discussion. (Tuomi & Sarajärvi 2002, 105.)

After collecting the data, I started to sort the feedback. Being able to define the problem required the identification and creation of common patterns and initial hypotheses. To make the findings visually recognizable, I used a Miro board (Appendix 2 and 3). A Miro board is an online whiteboard that can be used to visualize ideas or work on projects as a team or individually. On that board, I started adding sticky notes divided into the following categories:

- Use case
- KPI Examples
- Targets
- Reporting type
- Content (besides KPIs)
- Challenges
- Must haves

- Nice to haves
- Not relevant

Overall, it can be acknowledged that reporting plays a significant role within the real estate industry. The way companies carry out their reporting or best practices varies. One reason for this are the different backgrounds of the companies interviewed.

> ***Company A:*** *"Reporting plays a very important role because a bank acts as a shareholder. Banks are very digit-oriented, i.e. mainly in the financial sector."*
>
> ***Company B:*** *"Reporting is one of the very critical factors for corporate success. Because we try to differentiate ourselves from other competitors through reporting and the flexibility that we have in reporting. We often had the case that we were able to provide such reports that others could not provide."*
>
> ***Company C:*** *"Our holding company is registered in the Swedish Stock Exchange - reporting plays a big role and is required regularly."*
>
> ***Company D:*** *"Our first and primary role is to report to the investors and the funds. That means making investor reports and reports for our advisory boards on a regular basis."*

When it comes to the stakeholders involved in the reporting process and the question to whom the reports are sent, the answers were very similar. Mainly the financial departments or controlling, the asset- and property management and external service providers are involved. Reports can be divided into internal and external reports. Internal reporting is used to report to the companies' management or to control and oversee specific targets which have been set for different areas.

> ***Company A:*** *"We need to know if we reach the goals set. It could be that on a headline level the goal is achieved, but not at net effective level."*

External reporting, on the other hand, is used to communicate development and as-is situations to shareholders, advisory boards, investors, banks, and customers. We can also see that for internal reporting, a dynamic view in the form of a dashboard is preferred, while for external reporting, a static report is seen as a better approach.

> ***Company B.*** *"Such (external) reports show the result of the work and are binding and must therefore have no dynamics at all."*

Internal reporting is also much more flexible when it comes to the content. External reporting is often influenced by regulations set by banks or institutions and therefore the content is

much more clearly defined. Similarities for both reporting needs can be acknowledged for the reporting intervals. In general, those are monthly, quarterly, and annual. In some cases, for example, when it comes to returns over a specific period, a custom interval might be needed. Periods shorter than one month are not seen as useful.

> ***Company A:*** *"Shorter reporting periods than 1 month makes no sense, for that the real estate business is too static. You don't sign new leases daily, and leases don't expire every day."*

In question 5, I asked the interviewees how valuable insights are regarding rental income (GRI), costs (OPEX), NOI 1/yield (sum level), other income and costs, NOI 2, amortizations, and free cash flow. Rental income is one of the most important KPIs needed for real estate reporting and is particularly connected to cash flow. But rental income is defined and often calculated differently within the companies. In some cases, gross rental income is the most needed KPI, in other cases, it might be the net effective rent. Furthermore, I asked which KPIs are the most valuable as related to cash flow reporting.

We can summarize those as:

- Rental level or the price for m2
- Gross rental income (GRI), meaning the gross income received from all properties in a portfolio before any expense is deducted
- Headline rent, meaning the rent agreed upon in the contract
- Net effective rent, meaning the agreed rent minus the agreed deduction
- Occupancy / occupancy rate
- Vacancy / vacancy rate
- Number and area of parking lots
- Biggest tenants (numerous and %) + (per segment)
- Duration of lease agreements
- Number of rental contracts (and those with a break option)
- Tenant turnover
- Remaining term + expiring lease (rental contracts ending within next X month)
- Arrears (numerous and %)
- Wault (average remaining contract time)
- Share of the largest tenants on an annual rent level
- Rentable area by unit type
- Maturity
- Development of the rental level for head rent and net effective rent

- Development of KPI X over last years & month
- Utility costs and operating expenses
- Breakdown of expenses
- NOI (from gross to net)
- Amortizations and loans
- Cash and cash flow
- Cash flow growth / revenue growth
- Yield

The research shows that the level of detail on which KPIs need to be shown varies. Therefore, there is a need to not just simply show the KPI as it is, it must additionally be possible to break them down into segments. Those might be a portfolio or property, an industry, a unit type, a unit, or a tenant itself.

6.2 Defining the Problem

6.2.1 As-Is Situation

Assetti already has a KPI section as well as a separate reporting section within their software. This research has shown that when it comes to reporting needs, both features have a right to exist and are needed. The dashboard view gives the user dynamic insights which can be used for individual reporting and for following targets in combination with daily work practices. The reporting section itself is seen as valuable for static reporting where big data is shown but where it is possible as well to create static reports needed on a periodic basis.

For the KPI section, the user can choose between separate tabs for portfolio, properties, units, leases, tenants, operational expenses, and repairs. Additionally, the user is able to select the time period for which the data should be shown. Filters give the possibility to limit the content seen. The user can as well select between a list view (Figure 29), a dashboard view (Figure 30) and a trend view (Figure 31).

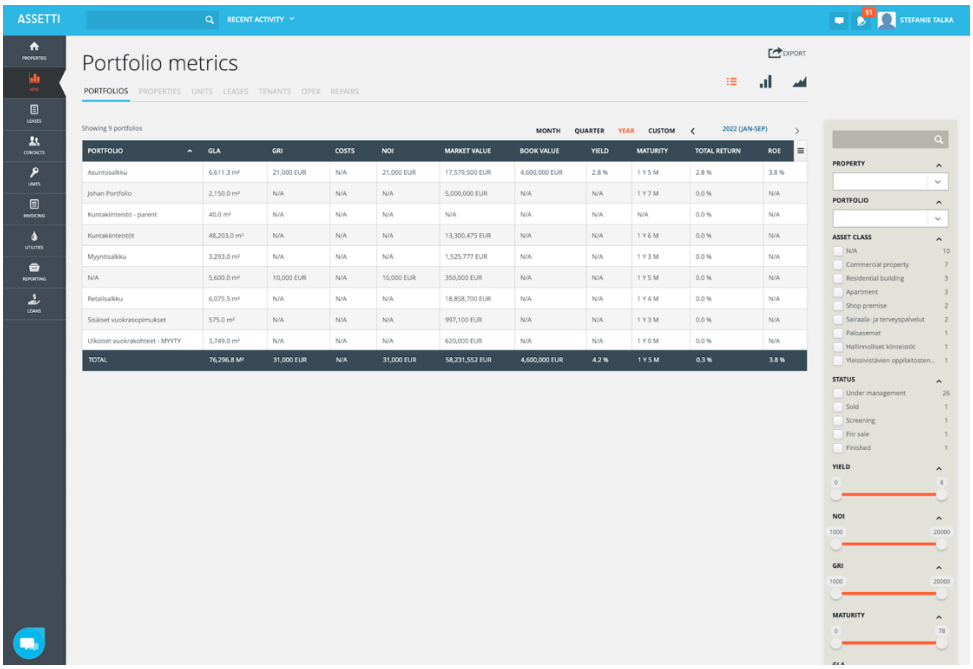

Figure 29. KPI Section with List View

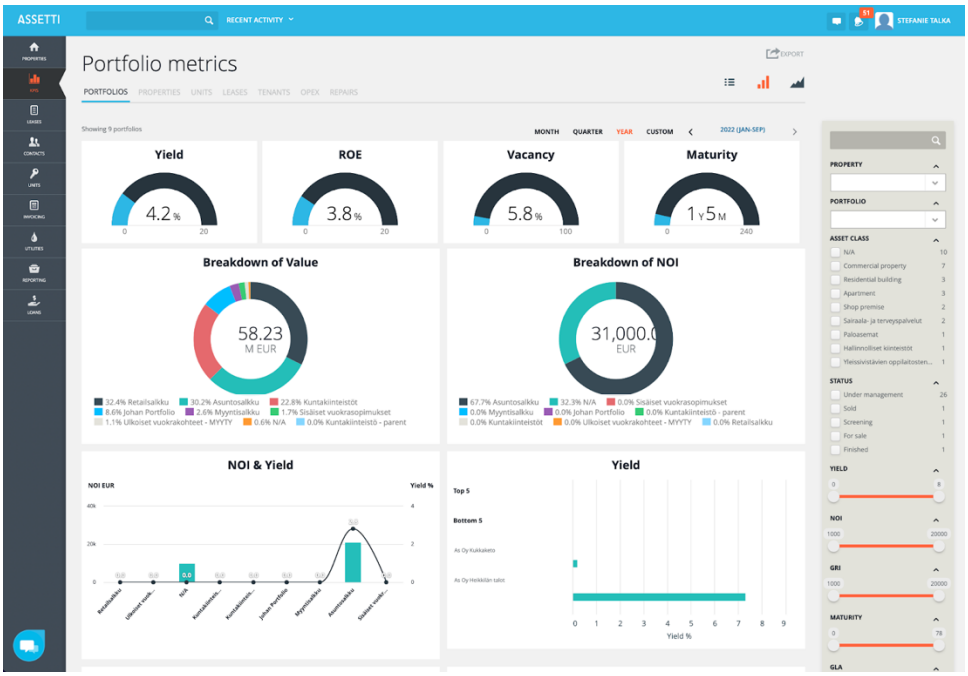

Figure 30. KPI Section with Dashboard View

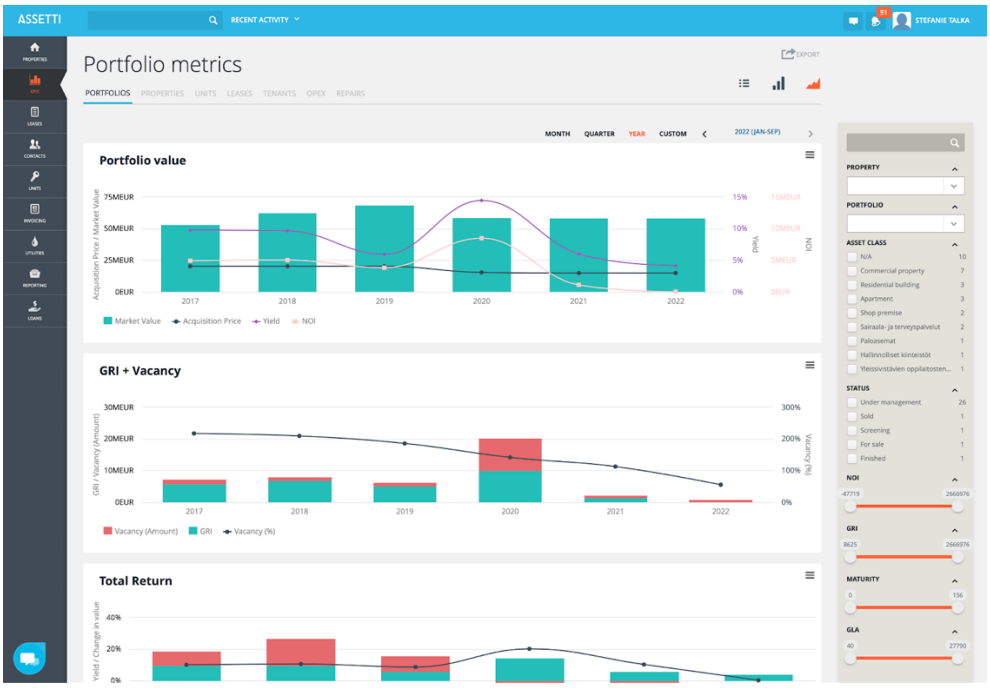

Figure 31. KPI Section with Trend View

The reporting section itself provides the user with a list view of reports already created in a draft or published mode (Figure 32). Draft means in this case, that the report can still be edited. Once the report is published, no changes can be done anymore. In addition to the reports listed, there is a tab for templates. That means that the user is able to set up a predefined layout for a report that is saved as a template. The layout can be designed within a raster of 4 times 4, with a maximum of 16 widget fields. For each widget the user can choose the visualization type, the dataset, the size and the widget title (Figure 33). When creating a report, the user must choose one of the before created templates to start a new report (Figure 34).

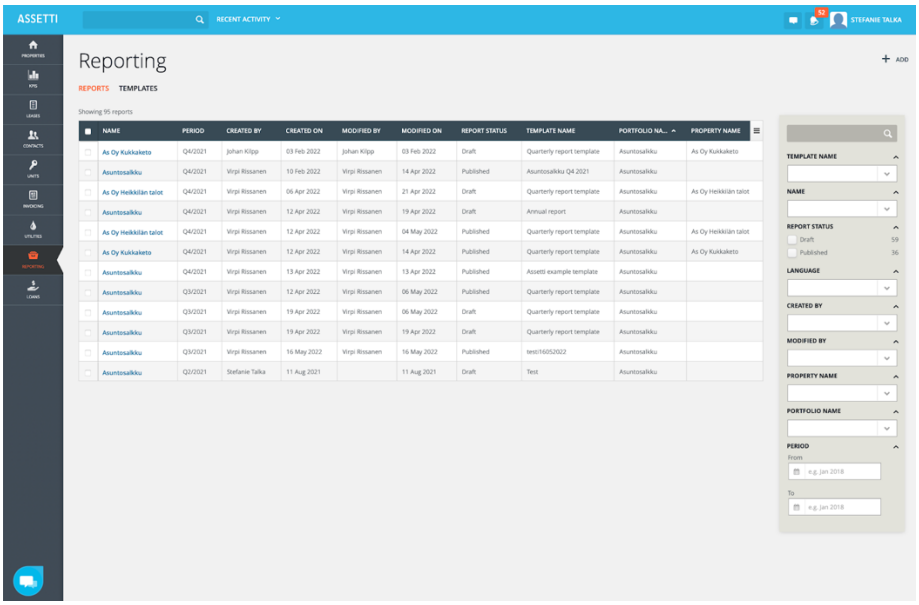

Figure 32. List View of the Reporting Section Within Assetti

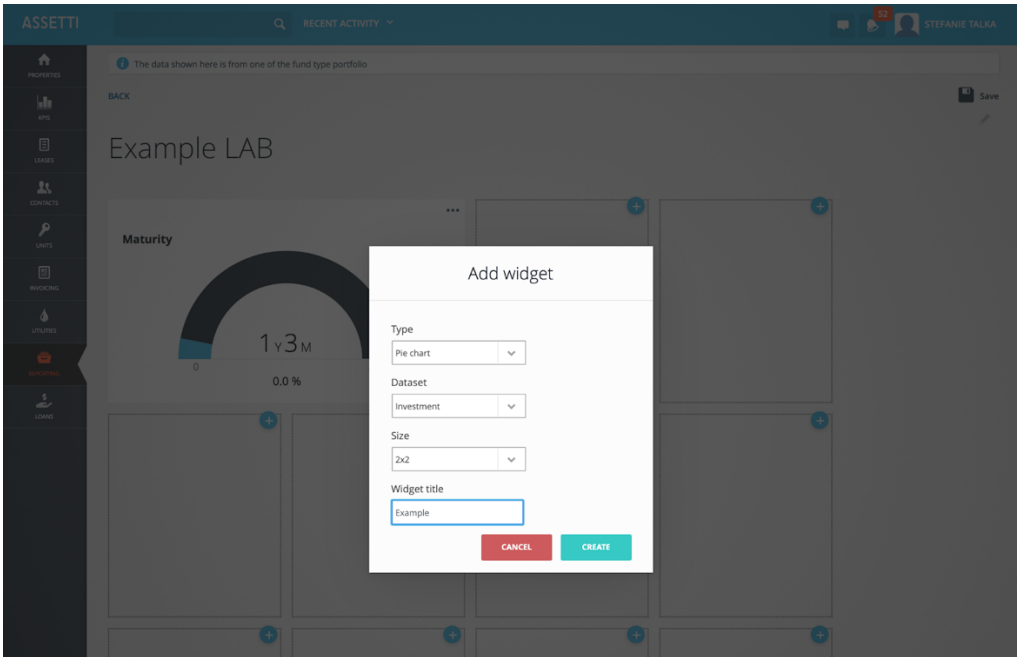

Figure 33. Adding a Widget to the Reporting Template

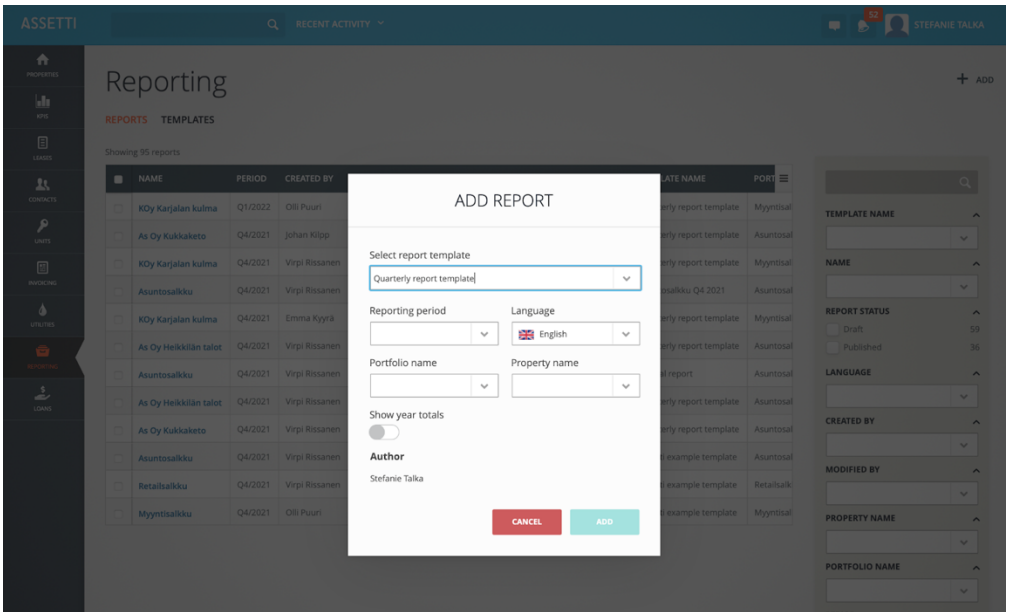

Figure 34. Selecting a Reporting Template in Order to Create a Report

6.2.2 Missing Key Performance Indicators

To answer the initial research question asking which financial KPIs in terms of cash flow are most valuable in property asset management, I made an inventory list of the KPIs discussed with the interviewees and collected in Table 1. By making this kind of overview, it was easier to identify existing and missing KPIs and the need for improvement. For already existing KPIs, I evaluated the visualization further and made notes for the ones that needed to be added and visualized.

KPI	List view	Dashboard view	Trend view	Widget
Rental level (EUR/m2)	x	x	x	
Rentable area	GLA	GLA		In rent roll table
GRI	x	Rental income	x	In rent roll table
Headline rent				

Net effective rent	Monthly rent			
Occupancy / occupancy rate		x	x	
Vacancy / vacancy rate		x	x	In rent roll table
Number of parking lots				
Area of parking lots				
Biggest tenants numerous		Rental income by tenant		x (Pie chart)
Biggest tenants in %				x (Pie chart)
Number of rental contracts	x	x	x	
Tenant turnover		x	x	
Remaining term				
Arrears numerous				
Arrears in %				
Maturity / Wault	x	x	x	In rent roll table, Gauge
Utility costs	x	x	x	
Breakdown of expenses	x	x	x	

NOI	x	x		
Amortization / Loans				
Cash and cash				
Yield	x	x	x	x (Trend)
Cashflow growth/ comparison			x	
VAT breakdown		x		

Table 1. KPI Inventory

6.2.3 Analysis of the KPI Section

As previously mentioned, the KPI section within Assetti consists of three different views. Adding headline rent and net effective rent to all KPI views seems like a necessary step. That would give the user the option to choose whether they want to see the monthly rent (which is available already), the headline, or the net effective rent. Within the list view, the user has the option to deselect certain numbers or KPIs (Figure 35). Within the dashboard and trend view that is not possible.

Figure 35. Option of Replacing Existing KPIs Within the List View

As long as the rent amount is displayed as a numerical value, it is fairly easy to embed it into the current KPI and trend view. If there is the need to visualize rental income for example by building or tenant, further filtering of the data is needed. One reason is the big amount of data. In order to bring value for the user, the KPI must be concrete, which is not the case when adding 120 different rents into one pie chart. If it is possible to narrow down those 120 rents to one building or unit consisting of just 10 rents, then a chart approach could be useful for seeing patterns or irregularities. Selecting to replace the monthly rent with e.g. headline rent would most likely affect further KPI calculations. The calculation for a rental level is the lease's monthly rent divided by leased by the leased area. If a user selects the headline rent as a base to work on, the calculation would change to the lease's headline rent divided by leased by the leased area. In that same content, another issue reported by the interviewees arises. In all interviews, it was mentioned that it is hard to tell what underlying data a KPI consists of. In that case, I would have the KPI of a rental level which is, for example, 23 €/m2. But I can't tell how exactly it was calculated. The same problem applies to the other variable in this calculation. The leased area is not always defined the same, they might vary or might be named differently.

A missing KPI is not necessarily negative. If we take the GLA, for example, we can see that displaying this KPI as numerical values makes sense in the list and dashboard view. In the trend view, it most likely won't bring value to the user since the GLA often stays the same and is not changing constantly.

Parking lots are handled as unit types within Assetti. Unit types are for example retail, offices, apartments or storage spaces. The number and area of parking lots can be maintained within Assetti, but they are not directly shown as KPIs. The dashboard contains a graph visualizing the Breakdown of m2 by unit type as well as rental income by unit type (Figure 36). When hovering over the graph, details are shown. But I cannot extract or filter a single unit type and show that specific data. Only filtering the Asset Class is possible.

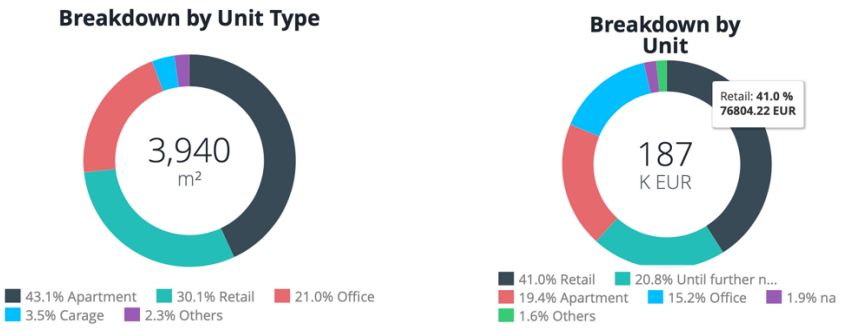

Figure 36. Breakdown of m^2 by Unit Type and Rental Income by Unit Type

The biggest tenants are currently shown by leased area and by rental income (Figure 37). In addition, there is a pie chart displaying the biggest tenants as percentages of the total (Figure 38). The graph within the dashboard view always shows the 5 tenants occupying the biggest lease areas and providing the biggest rental income. The view cannot be changed to “Top 10” or “Top 3”. That flexibility was seen as beneficial by three out of four interviewees.

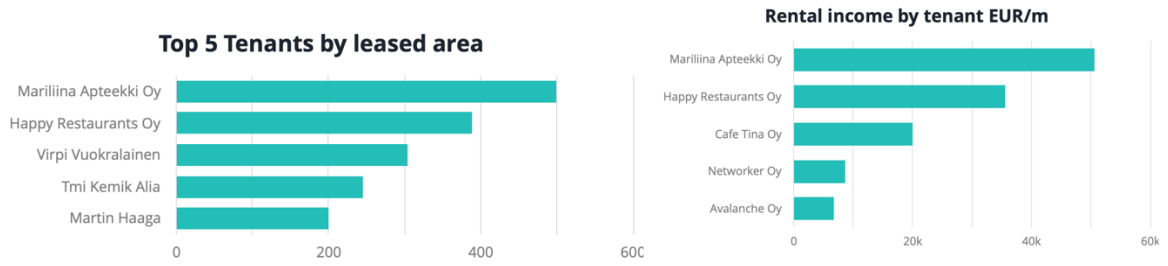

Figure 37. Tenants by Leased Area and by Rental Income

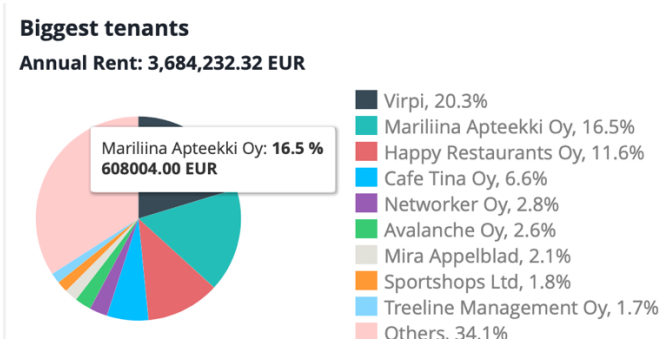

Figure 38. Biggest Tenants as Percentages of a Total

The number of rental contracts is currently shown within all views, but is not displayed as a KPI. It is more a mark in the corner of the page, and is therefore easily overseen (Figure 39). Even if it would follow the same visualization as the other KPIs, rent contracts or leases would need a further breakdown into for example the previously mentioned unit types.

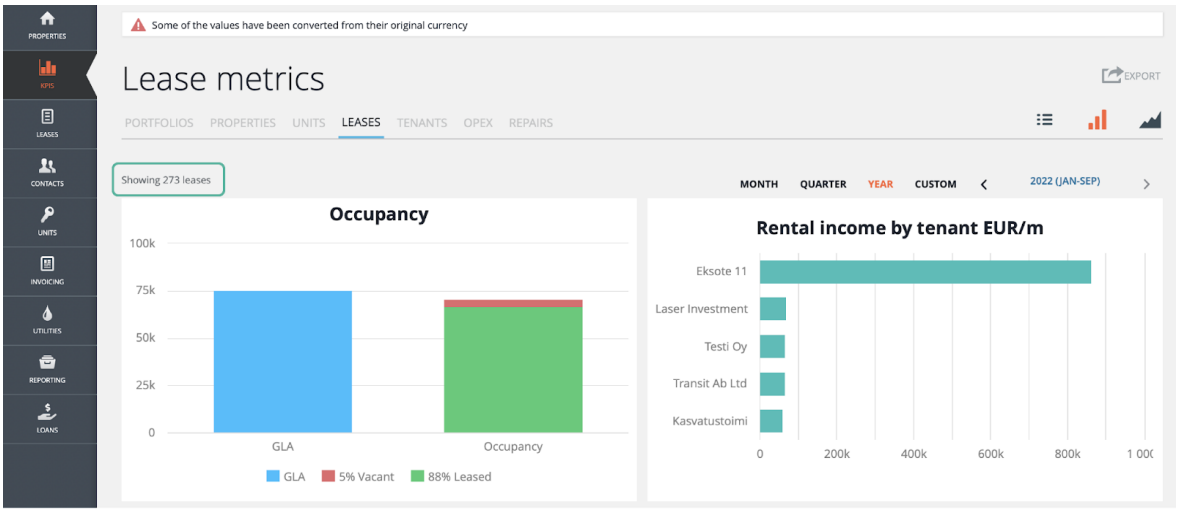

Figure 39. Active Leases or Amount of Rental Contracts

The research also shows that there is not only the need to break down the number of leases itself, but also to see how many leases are going to expire within a certain amount of time. The time frame for that can be 1, 3, 6 or 12 months. Since all of the interviewees stated that forecasting is one important aspect of reporting, a best case/worst case scenario based on the ending leases could be taken into account. One piece of feedback given by the interviewee was related to how likely it is that a building will be fully occupied. This kind of scenario with a possibility of 100% occupancy could be possible to display in that way.

Arrears is a KPI that is lacking in Assetti. It is closely related to leases and rental income since it has a negative impact on the cash flow when payments are delayed. Gross rent arrears (all tenants) could be shown as a percentage of rent due for the reporting year. But also here, a KPI shown as numerous values is needed.

Amortization and loans are an important topic since they show cash flow from financing activities or net flows of cash that are used to fund the e.g. property. The amount of loans, their value, or KPIs related to the amortization schedule can be visualized. The same applies for the actual cash flow growth and comparisons of income and expenses. This is a beneficial indicator and a KPI missing at the moment within Assetti.

6.2.4 Analysis of the Reporting Section

From the KPI inventory, we can see that this is the place where most of the KPIs are missing. Since it can be seen that the KPI section already offers quite an extensive amount of KPIs, the research question of creating intuitive visually rich customer-specific content out of structured financial data can be more aptly applied to the reporting section.

Taking the feedback from the interviewees into account, and the amount of data needed for reporting, we can say that the current view of 4 x 4, or a total of 16 widget fields, is not enough. Additionally, some of the widgets take more space by default than just one of those fields. During my research, I found myself thinking many times that I am talking about two different styles of reporting within one software that behave very differently. The KPI view is predefined for the report - I need to first build a template before I can even start to create a report. That is somehow contrary to how many other solutions operate. Frequently, I can save a ready report as a template to be used later on. In our case, I can use the template to create a report, but when I want to add some extra content, it is not possible. Therefore, I would need to edit the template first and then start over again. This process causes confusion, usability suffers, and the user gets frustrated.

The approach of viewing visualized data in the KPI section and then, for example, adding a graph I need to my reporting template from there would sound more reasonable. Another challenge is that not all KPIs visible in the KPI section are available in the reporting section. At the moment the user can add a graph or KPI by selecting the type first (Figure 40). For the type a trend view, pie chart, table, free text, or gauge can be added. Then the user selects the data and size and gives the widget a name. Two things are very irritating for me at that point. First, I would want to select my data first and then subsequently select my chosen visualization type. And second, I cannot simply rebuild a graph I might have seen in the KPI section, because the number of widgets is very limited.

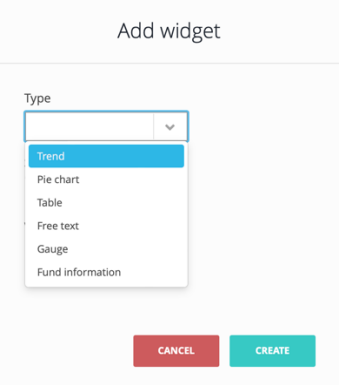

Figure 40. Add Widget Pop-Up

6.2.5 Challenges

I think the biggest challenge for the user is to identify and find the KPIs they really need. The list view is great for overseeing a big amount of data and working with exact numbers. The dashboard brings the biggest value for the user since it was often mentioned that irregularities need to be spotted and the overall situation must be seen with just a couple of

clicks. Real-time data is important for decision making. The trend view is something that adds value for the customer because they can follow developments over years and months. Forecasting could be combined with this kind of view. In order to make forecasts, there is often a budget that sets the base for calculating forecasts.

In addition to visualized numbers and KPIs, there is also the need to show numerical values or counts. It is necessary to see the number of parking lots, units, properties or lease agreements. Since trends are an important topic, the user would need the possibility to see the development of a KPI. In a trend view where several months or years are displayed, that is fairly easy. On a numerical level, arrows showing an increase or decrease towards the previous period can be useful.

If there are more than two or three items in one category, we can see the need for not just reviewing numerical values, but also for filtering and/or sorting those further. The ability to break them down into smaller entities and go into details is also seen as useful. An example are arrears telling which payments are overdue by tenant. On a fund or portfolio overview, the total amount of arrears is of interest as a key figure. This might be the total number of overdue payments (10 payments), or the value those have (500,000 €). But those who are working with the numbers daily must of course look into the details. Is there one tenant who is responsible for €400,000 in arrears or do I have 10 tenants whom each has €50,000 in arrears?

Data quality is a problem that was mentioned many times. If there are values missing within a KPI calculation the whole calculation is not working and the result is wrong. Therefore, the user must need a way to check on the calculation so as to be assured that the result is correct.

> ***Company C:*** *"We make all decisions based on data and if the data is wrong, the decisions are as well."*

We can see as well that there are different levels of detail needed for reporting within the companies and for the stakeholders involved. The perspectives on how one looks at a property are different. For example, a property manager is not interested in the yield. He or she wants to know which rental contracts are expiring within the next X months. The asset manager has a different way of looking at the data. He wants to know what the monthly rental income is, and what building measures are planned for the current and following year. Financial metrics are also important to him.

Since it is fairly difficult to combine all of these different metrics and measurements into one format or dashboard, it is clear that customized views are the best approach. To accomplish

this and to build a strong foundation for individual reporting needs, a widget gallery is the best approach. There can be predefined views, like the ones Assetti offers already. But in addition, there must be the possibility to add, replace, or even delete KPIs.

6.3 The Solution Space

The second diamond space and its two phases are focusing on processing gathered information and the gradual design process including the creation, testing and designing of initial concepts. Once a problem is clearly defined, different solutions to solve that problem must be found. Usually, getting inspiration from different sources can help to find possible solutions. That includes as well co-designing together with other people who might not necessarily be designers themselves. (Lankmilier 2022.)

Naturally, knowing the user's needs should automatically have an impact on the flexibility of a design. Needs can be defined more clearly once the user gets a better understanding of the possible needs that can be satisfied. As a conclusion, the designs also need to become more specialized.

In the previous section, I analyzed the current situation as well as the results of the user interviews. The common challenge is to develop a customizable reporting view with KPIs important for the end user. The challenge itself is combining these various requirements into one solution. Making more KPIs available will have an impact on the product's complexity. Offering the user more functions and actions to take will increase flexibility. But it is proven that at the same time, usability decreases as options increase, as shown in Figure 41. Offering a flexible design will add complexity to a product or service, which often means that it will be more difficult to use. A flexible design will satisfy a larger set of design requirements, which always goes hand in hand with compromises and complexity. (Lidwell et al. 2010, 102.)

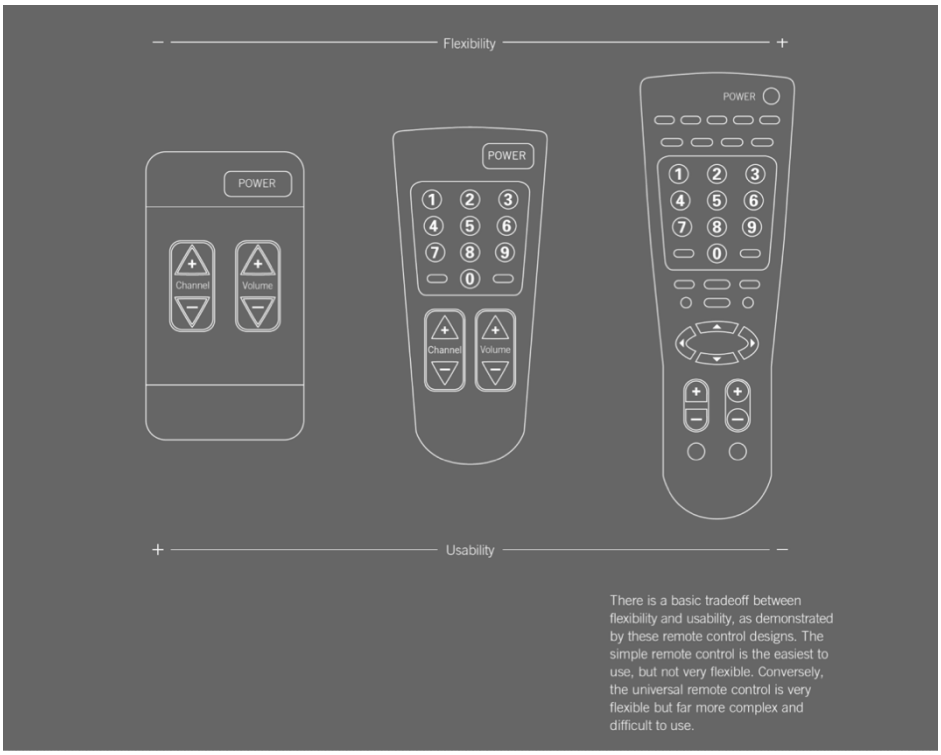

Figure 41. How Flexibility Affects Usability

When selecting KPIs, we can see a similar trade-off as in the figure below. The more KPIs I choose and the more information involved, the more simplicity is lost (Figure 42).

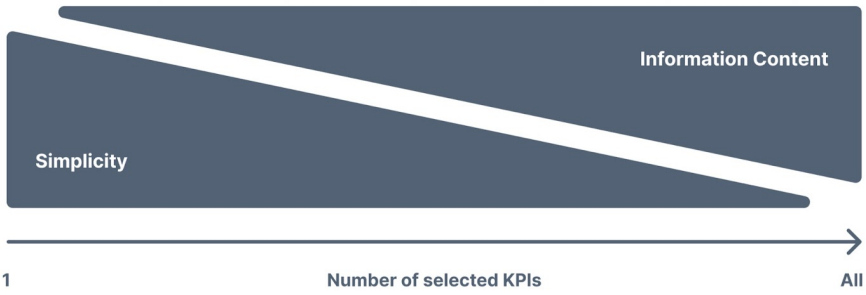

Figure 42. Relation Between Information Content and Simplicity

6.3.1 Developing Phase

As mentioned earlier, information design is about designing a visual presentation for information. The work phases of an information design project progress from selecting the information to be presented, to organizing it, to choosing the presentation method. The starting point of the process can be either communicative goals or some specific material. The collected material should be studied using different tools, and information that is not interesting

or relevant to the goals can be filtered out. Sufficient time should be reserved for the next phase of the process, i.e. sketching and experimentation. At this stage, the need often arises to return to the exploration of the material and its structuring. Next, after the sketching phase, the desired presentation method is selected and the presentation method and graphics are finalized. At the end of the process, it is time to evaluate the realization of the goals and collect feedback. If the graphics have been made for online use, they may also need to be updated and possibly expanded in the future. (Koponen et al. 2017, 315.)

The process of developing the KPIs and visualizing different prototypes is based on steps 1 - 4 as presented in Figure 43. In this development work, the starting point of the information design project were the interviews conducted with current customers who use Assetti software. The data obtained from the interviews made it possible for me to limit the content and to support the goal-oriented work of creating prototypes and solutions.

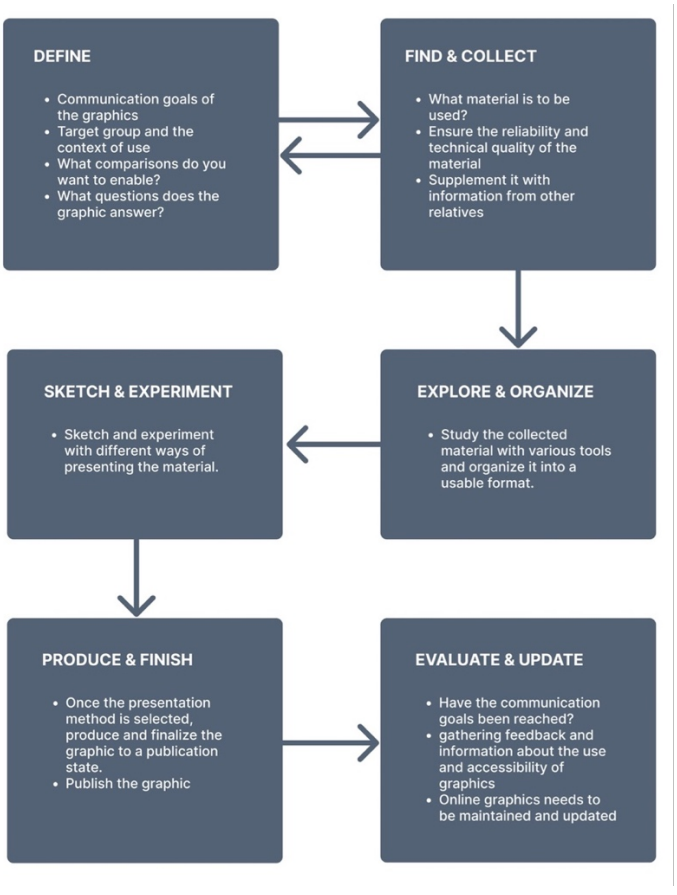

Figure 43. Information Design Work Process

Furthermore, during the entire sketching and experimenting phase, I aimed to work towards the ten principles of good design by Dieter Rams (DDC 2011). In particular, I kept in mind that good design needs to be innovative, as it makes a product useful, understandable, and aesthetic. Rams started formulating those principles in 1975 and finalized them in 1985.

Even though products and technology have changed since then, those principles remain valuable and valid guidelines for any design work (Klemp 2022). Durability, user-friendliness, genuine utility and environmental friendliness of products are characteristics that Rams defines. Although Assetti is a complex product, and real estate reporting often comes with big data sets, I still aimed to make the solutions as simple as possible.

Another way of thinking that helped me get the right mindset about what to design and how to design it was Tom Moog's order, contrast, and reduction method (Figure 44). The method follows the approach of content schematization. The first "sieve", order, excludes what is not structured. The middle "sieve" only lets through what is exciting and interesting because it is rich in contrast. The conceptually most important thing, because it gets to the heart of the content, is the reduction. As the lowest "sieve", it only lets through what has been reduced in terms of content and form. (Moog 2013.)

Figure 44. Order, Contrast and Reduction Method

6.3.2 Improvements

I would recommend utilizing parts of the visualized content from the KPI view in the reporting view as well. Selecting a widget based on plain descriptions might be difficult for the customer. If a user sees visualized data he needs for reporting within the KPI view, it would be useful to simply add the widget from there to a report or report template. Another approach could be to make the widget visible when selecting the setup with the pop-up and show a kind of preview for the user. That would not only avoid mistakes in selecting a wrong visualization, it would also go hand in hand with usability heuristics set by Jakob Nielsen.

The match between the system and the real world is, in this case, selecting the right KPIs important for a specific need and making them appear in a natural and logical order. Recognition rather than recall refers to adding already visualized KPIs from the dashboard view to the report itself. In this way, the user does not need to remember how the KPI looked or was visualized. The user does not need to rebuild it because it exists already within the user interface. (Nielsen 2020.)

7 User Stories and Prototypes

User stories are employed in the development of products or software within agile frameworks, including Scrum. Because Assetti is a software solution and the development of new features is done within the Scrum framework, I decided to utilize user stories as a base on which to build my prototypes. A user story can be seen as a short description (story) of what a user wants. A user story consists of a few sentences that describe what the user of the product wants or needs to do. A user story is usually not very detailed and should fit on a sticky note. Through the user story, the user influences the development of a software or product and above all, its functionality. (Kooijman et al. 2017.)

In that way, user stories enable user-centred and productive discussions about how to create a good product. They also help improve visibility for the backlog and make it easier for teams to understand the bigger picture behind product development. That methodology reveals constructive and releasable slices of product add-ons which will meet the users' needs. That knowledge helps teams to decide where to focus their time in order to maximize usability, value, and feasibility in upcoming iterations. User stories also play a significant role when there is a need to react to changes. (t2informatic.)

7.1 Custom Dashboard

Building a personal dashboard that only shows the data valuable for a specific user was a wish made by all interviewees. Developing this kind of additional feature will give the user the flexibility to select their own set of properties (e.g. properties under his management) and select the desired graphs and figures from a predefined set of numbers, figures, and KPIs. The predefined set of KPIs is taken from all figures available throughout the KPI section (including portfolio, properties, units, lease, tenants, and OPEX). This dashboard view (Figure 45) could be linked directly to the reporting section, where, under the same concept, users could choose a custom time period and figures to design their own report and export those as a printable format. The goal of this feature is to offer customizability and quick access to a unified dashboard with values from all categories (property, tenant, and leases). That is not possible at the moment.

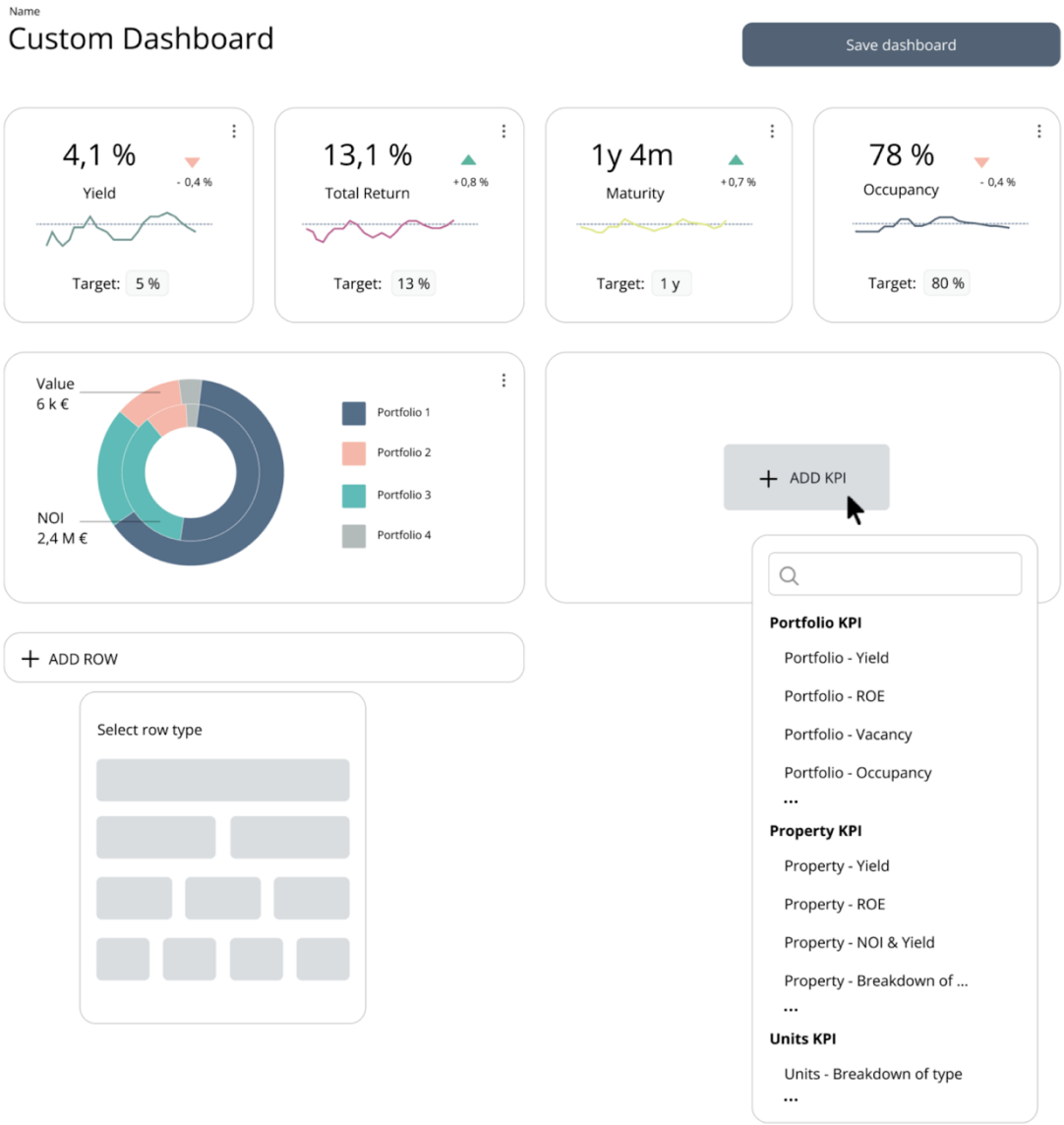

Figure 45. Prototype of a Possible Dashboard View

7.2 New KPIs

User Story 1:

As an Asset Manager, I need to see the breakdown of my rental income by lease, contract, and unit type (Figure 46).

> ***Company A:*** *"When your rental income is 8 Mio €, of which 7.2 Mio € comes from renting out offices, then you know what to concentrate on. Then you see the biggest tenants in that unit type, and you know which ones to focus on and nurture customer relationships in particular."*

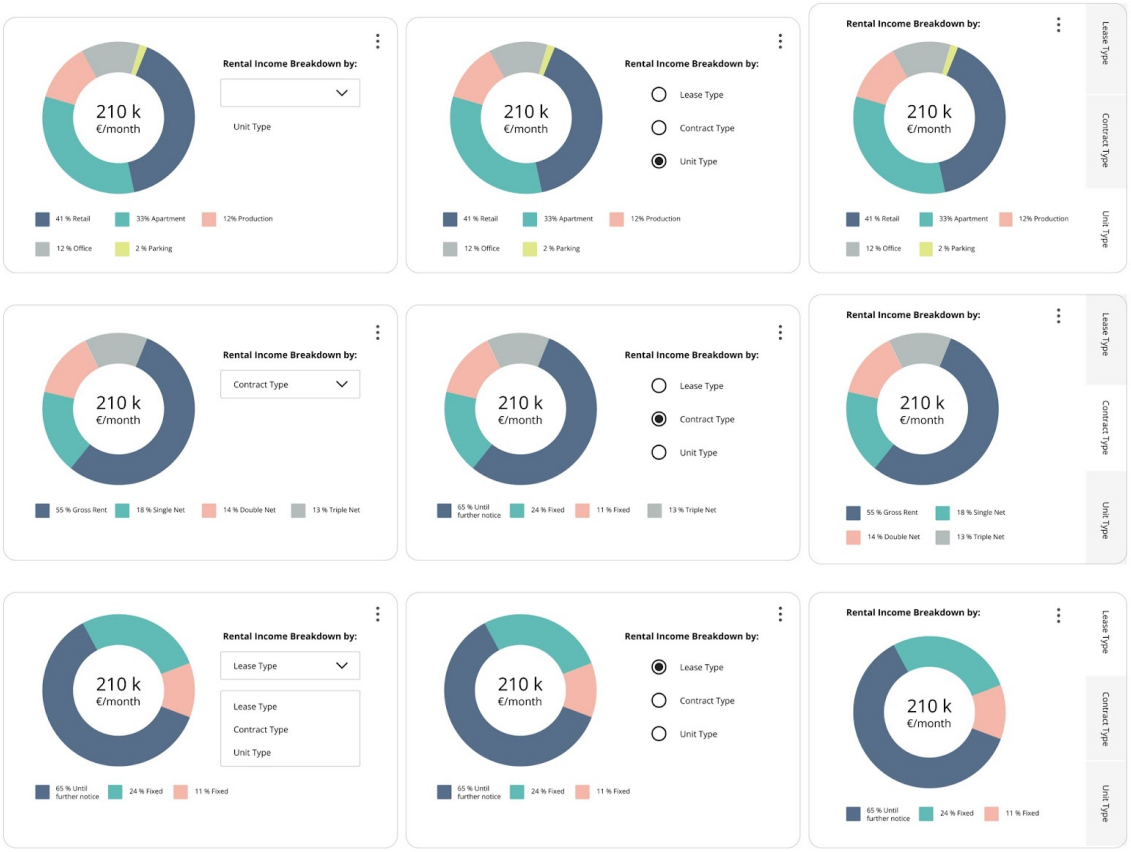

Figure 46. Prototype of Possibilities to Visualize Rental Income

User Story 2 and 3:

As a Property Manager I need to know how many leases expire within the next 1,3,6, or 12 months so I can take actions to prolong those in time or search for a new tenant well ahead.

As a Property Manager, I want to forecast my rental income based on expiring leases so I can estimate my cash flow for the next year(s). The combination of both use cases is visualized in Figure 47.

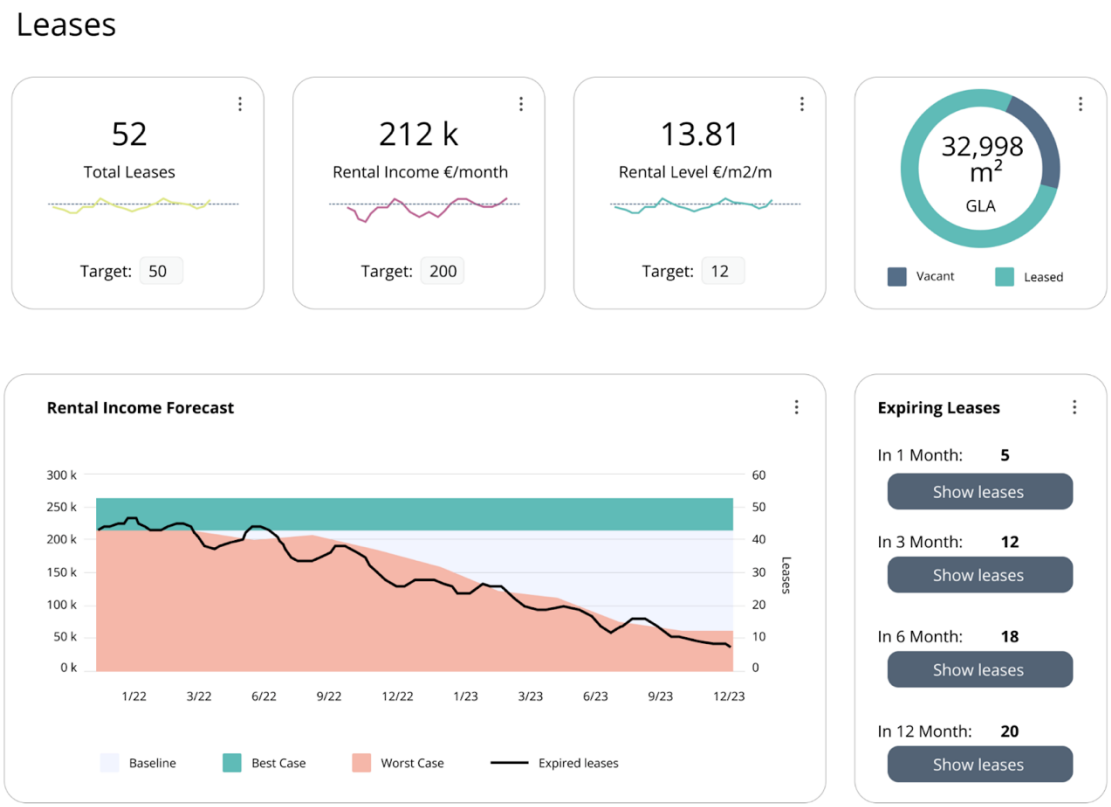

Figure 47. Prototype of Possibilities to Visualize Lease Income and Forecast

User Story 4:

As a Property Manager, I would like to view KPIs based on unit types or add a unit-specific KPI to the dashboard view (Figure 48).

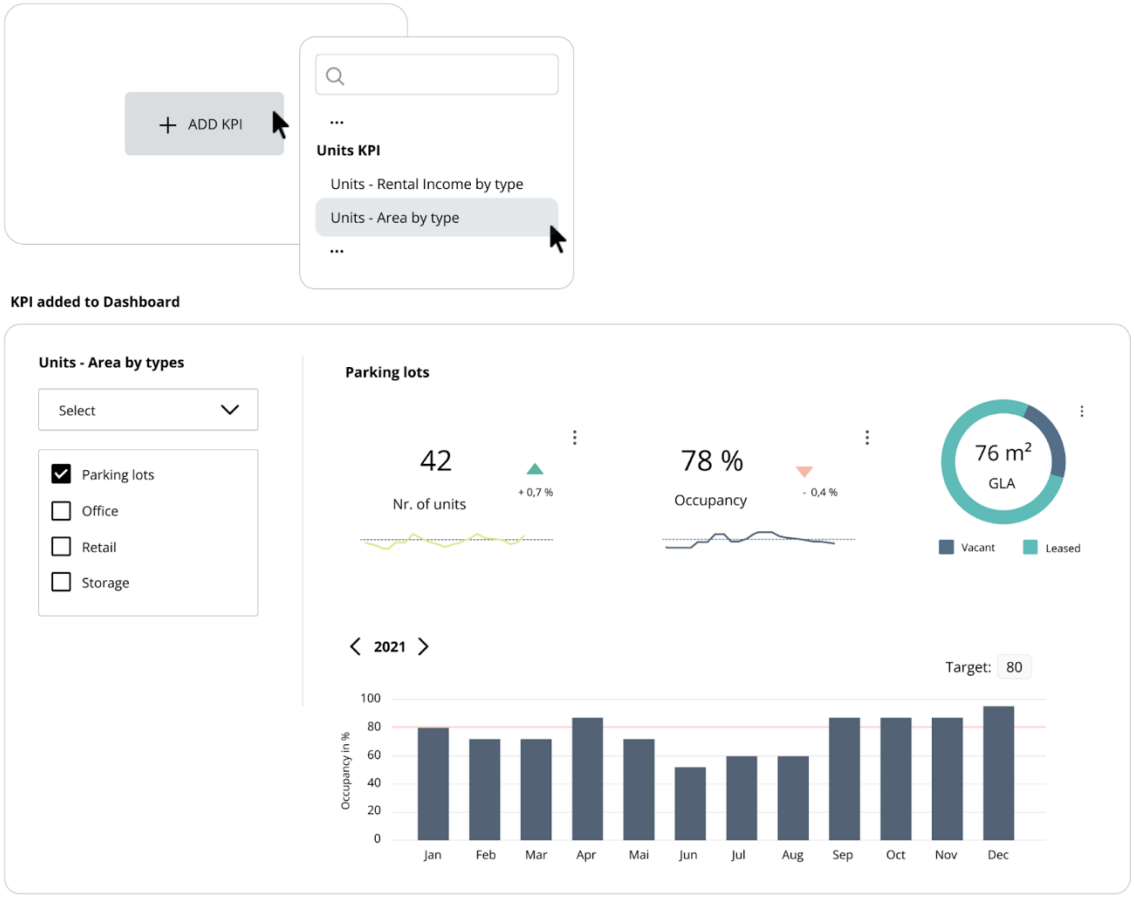

Figure 48. Prototype for Adding Unit Related KPIs to a Dashboard

User story 5:

As an Asset Manager, I want to know which properties are supported by loans and what amortization schedules are set to repay those (Figure 49).

Figure 49. Prototypes of an Amortization Schedule

User Story 6:

As an Asset Manager, I need a breakdown of revenue and expenses as a waterfall graph so I can see what affects my NOI most (Figure 50).

Figure 50. Prototypes of Waterfall Graphs

User Story 7:

As an Asset Manager, I need to have an overview of arrears so I know if the cash flow is secured (Figure 51).

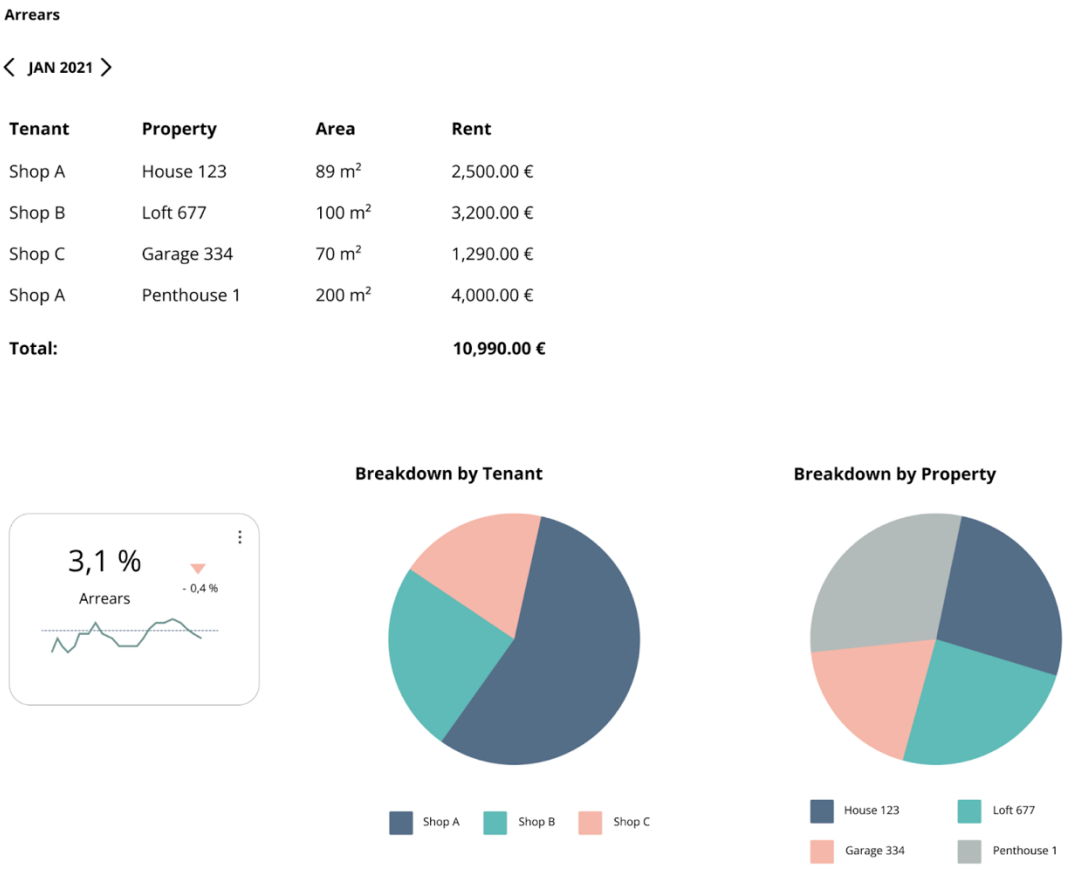

Figure 51. Arrears Visualized

User Story 8:

As an Assetti user, I want to limit or expand the content I want to see in my KPIs so I can focus on indicators with big impact (Figure 52).

> ***Company D**: "When presenting our data, we follow the 20/80 rule. 20% of the customers bring 80% of your turnover, that is what we want to say with this chart."*

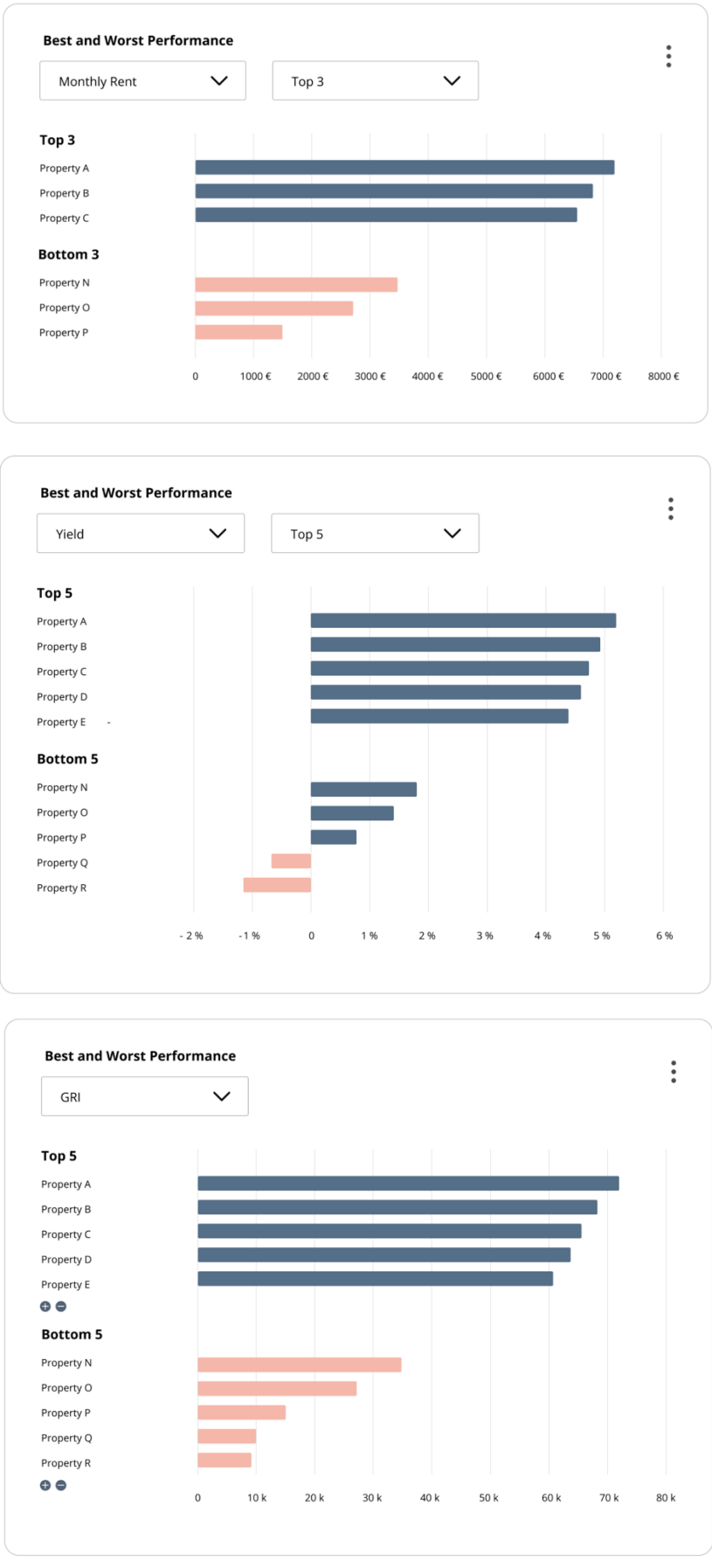

Figure 52. Prototypes of Expanding or Limiting Content

User Story 9:

As a Property Manager, I need to see how KPIs are calculated in order to know that my data quality is good and I can trust the data (Figure 53).

> *Company D: "Some KPIs have been based on the purchase price, some others on market value. Sometimes it is hard to know what the underlying data consists of."*

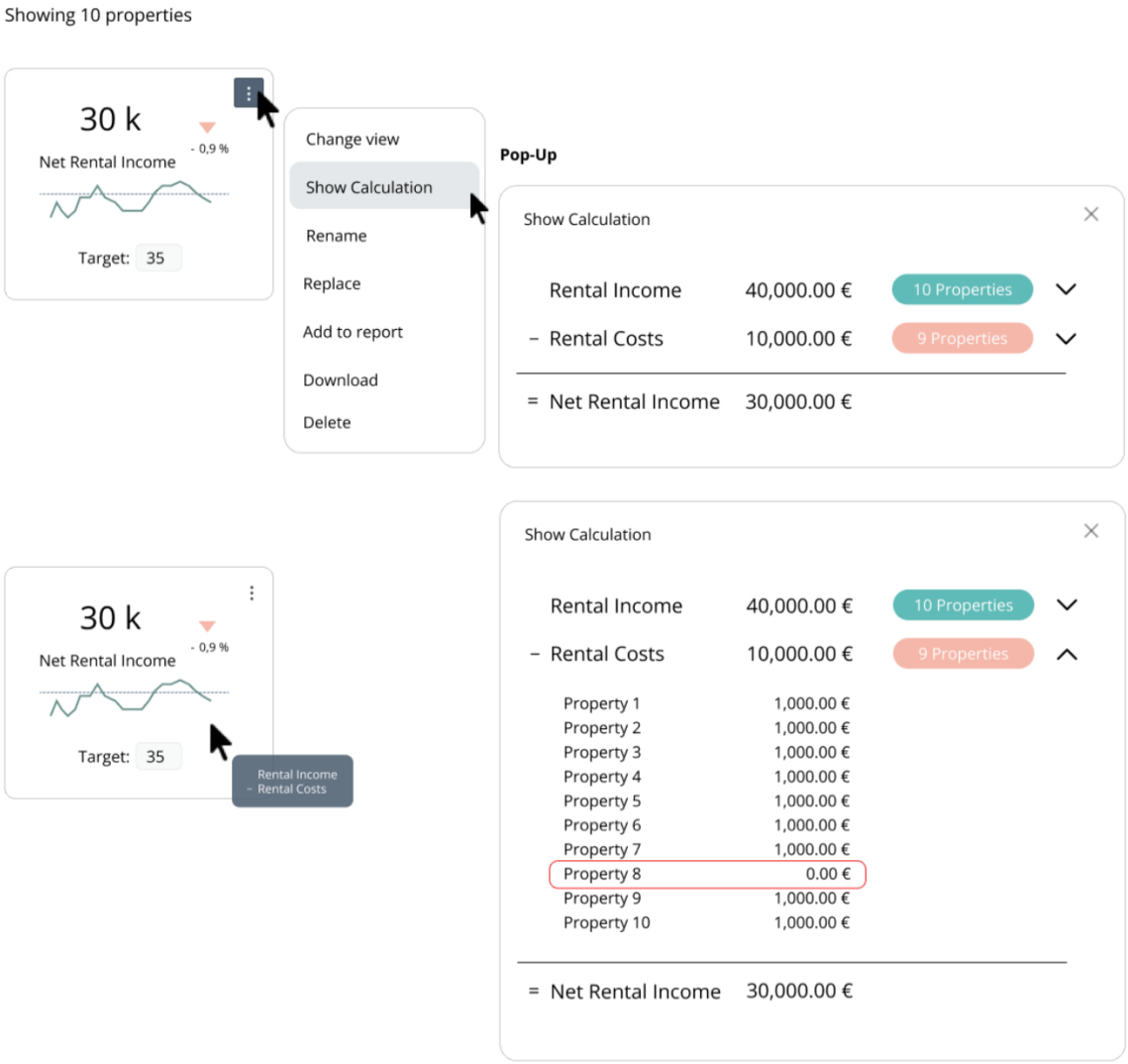

Figure 53. Prototype of Visualizing Calculations

User Story 10 and 11:

As an Assetti user, I need to be able to adjust the calculations of KPIs so they match internal calculations a company uses outside Assetti.

> ***Company B:*** *"There are data sets that are defined differently in Germany and which are based on different calculations, e.g. Net cold rent. We would need a way to drill down into the data"*

As a Property Manager, I would like to choose which rental income I want to use for my KPI calculation so they match internal calculations a company uses outside Assetti. Both use cases are visualized in Figure 54.

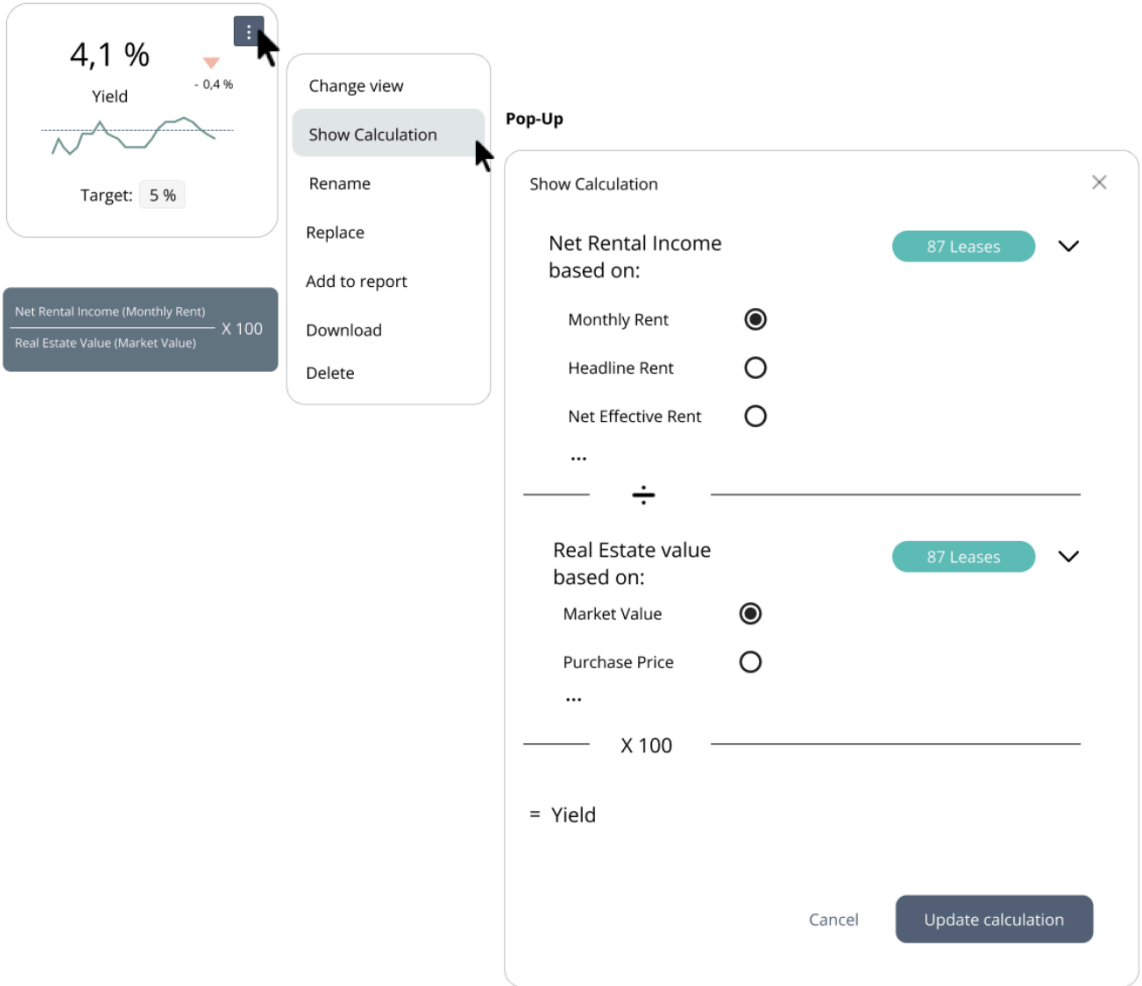

Figure 54. Show Calculations and Underlaying Data

User Story 12:

As an Asset Manager, I need to be able to see a forecast on KPIs based on a budget so I am able to plan better (Figure 55).

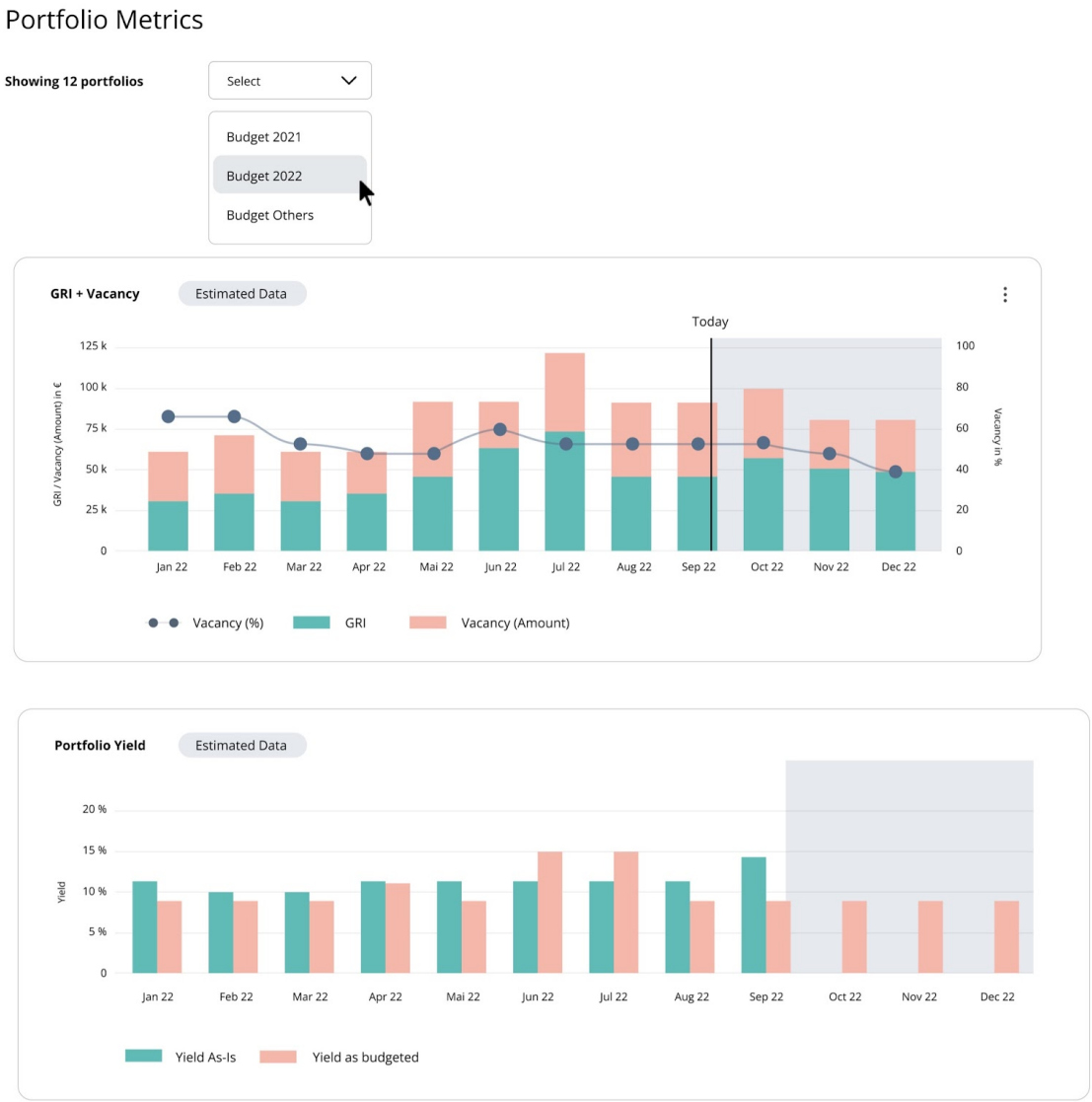

Figure 55. Forecasting KPIs Based on a Budget

User Story 13:

As a Property or Asset Manager, I need to be able to set targets or limits for certain KPIs so I know which property or portfolio is performing well and which is not (Figure 56).

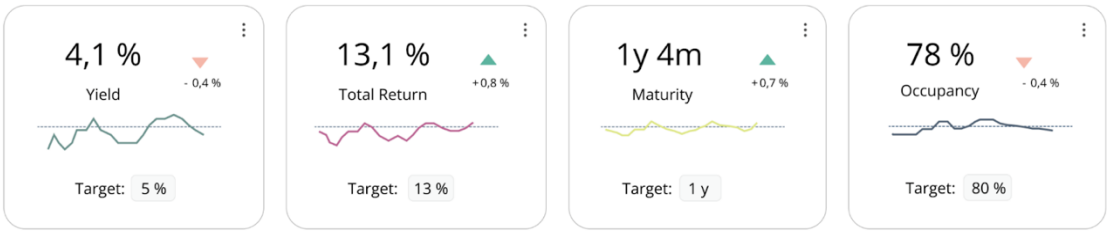

Figure 56. Setting Targets for Certain KPIs

User Story 14:

As an Asset Manager, I would still need a rent roll so I can view details related to leases (Figure 57).

> ***Company A:*** *"A list of tenants is essential. There I can see when the lease in which area expires or when the lease was extended - that makes the history of the tenant visible."*

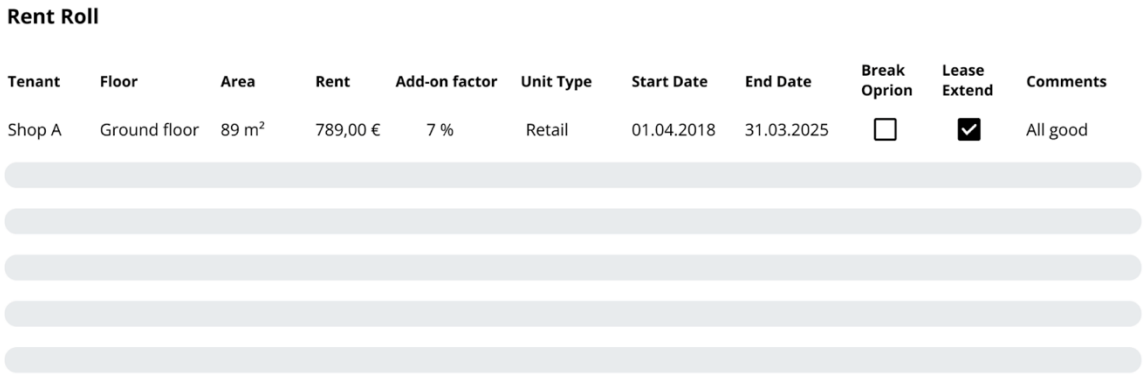

Figure 57. Visualization of a Rent Roll

User Story 15:

As a user, I need to be able to give access rights or custom links with limited content in order to support reporting needs (Figure 58).

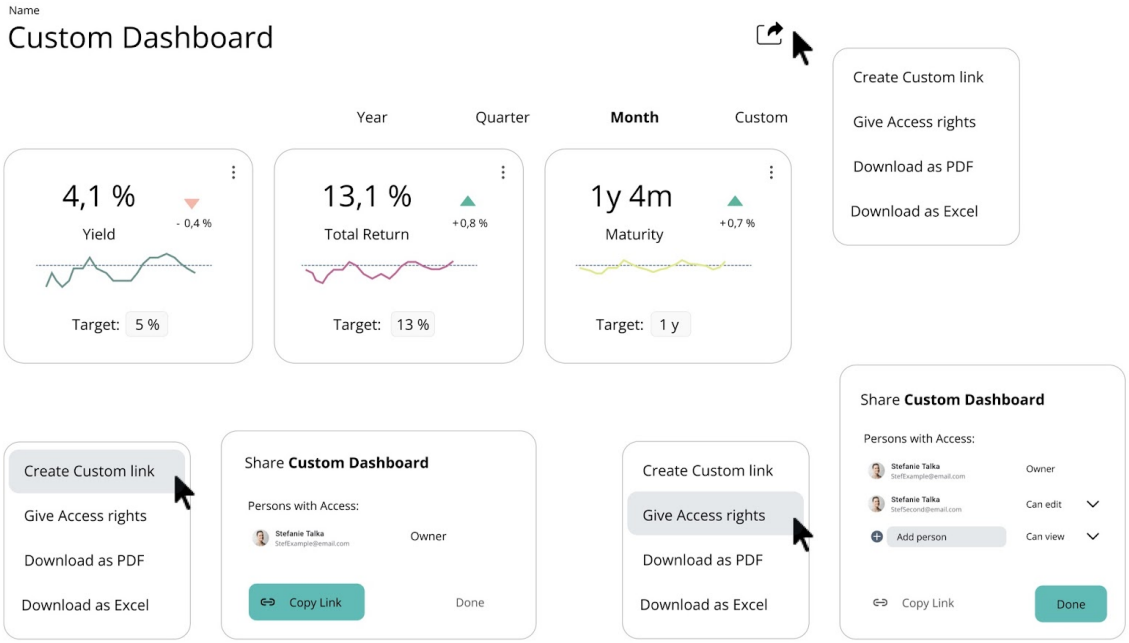

Figure 58. Giving Access Rights

7.3 Reporting Section

User Story 16:

As an Assetti user, I need to be able to add or delete widgets from a report I am working on (Figure 59).

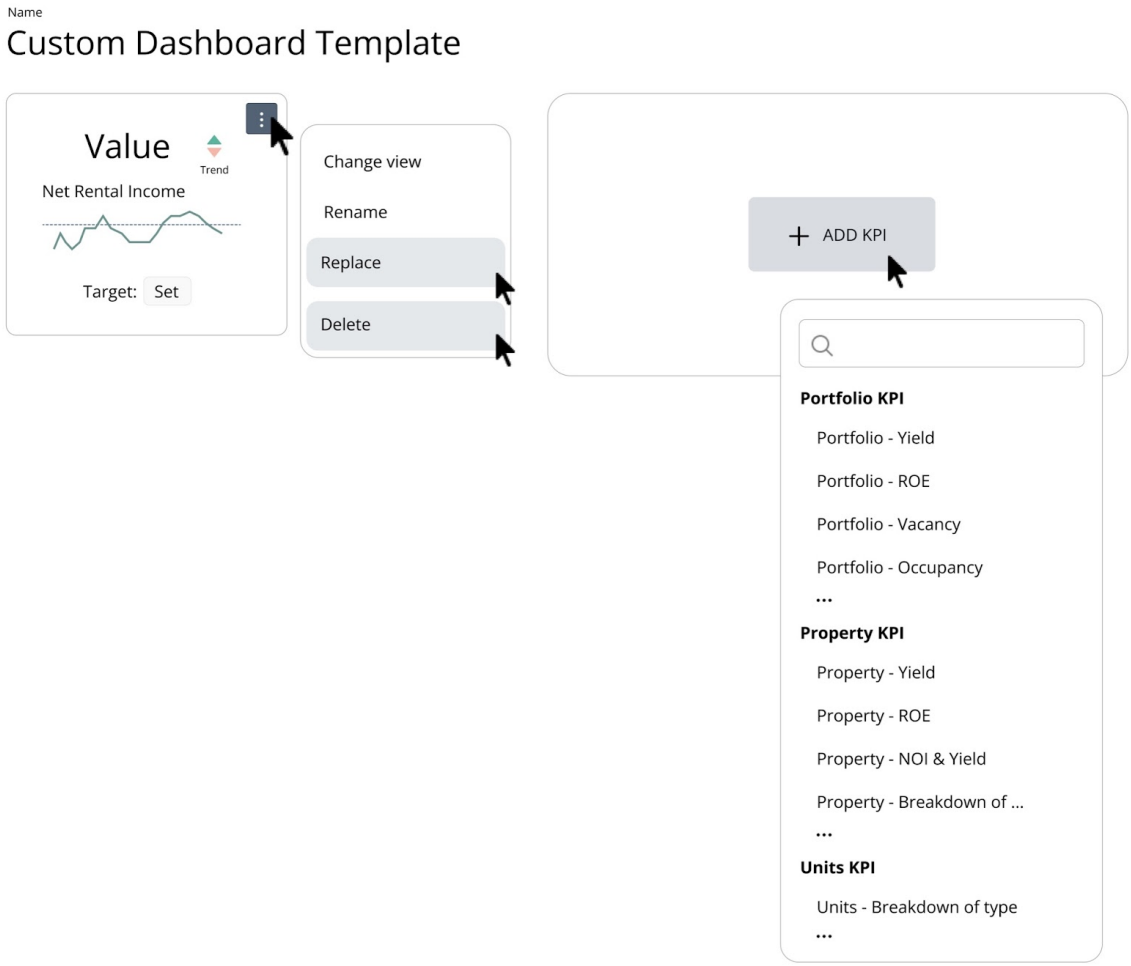

Figure 59. Adding or Deleting Widgets

User Story 17:

As a user I need to be able to create report templates so they match our own requirements (Figure 60).

This will as well reduce the amount of confusion that empty or irrelevant data fields cause to the user. When I have the freedom to decide myself which data I show, I will only select those I know I have enough underlying data to support the KPI calculations.

> ***Company D:*** *"The level of details shown in a report varies depending on the recipients and groups."*
>
> ***Company B:*** *"No matter which tool you usel, it is difficult to bridge the gap between the data found in ERP systems and how it ultimately appears in the report."*

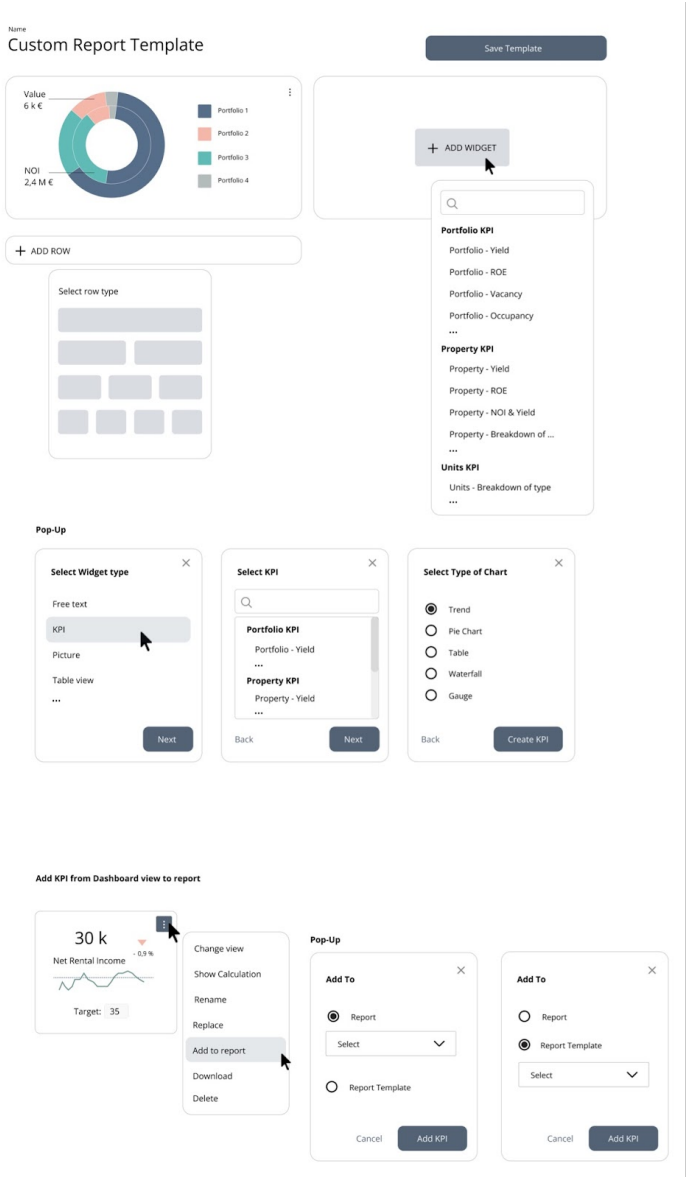

Figure 60. Creating Report Templates

User Story 18:

As a user, I need to be able to export reports in the form of a PDF, Excel or PPT presentation so it is accessible to customers (Figure 61).

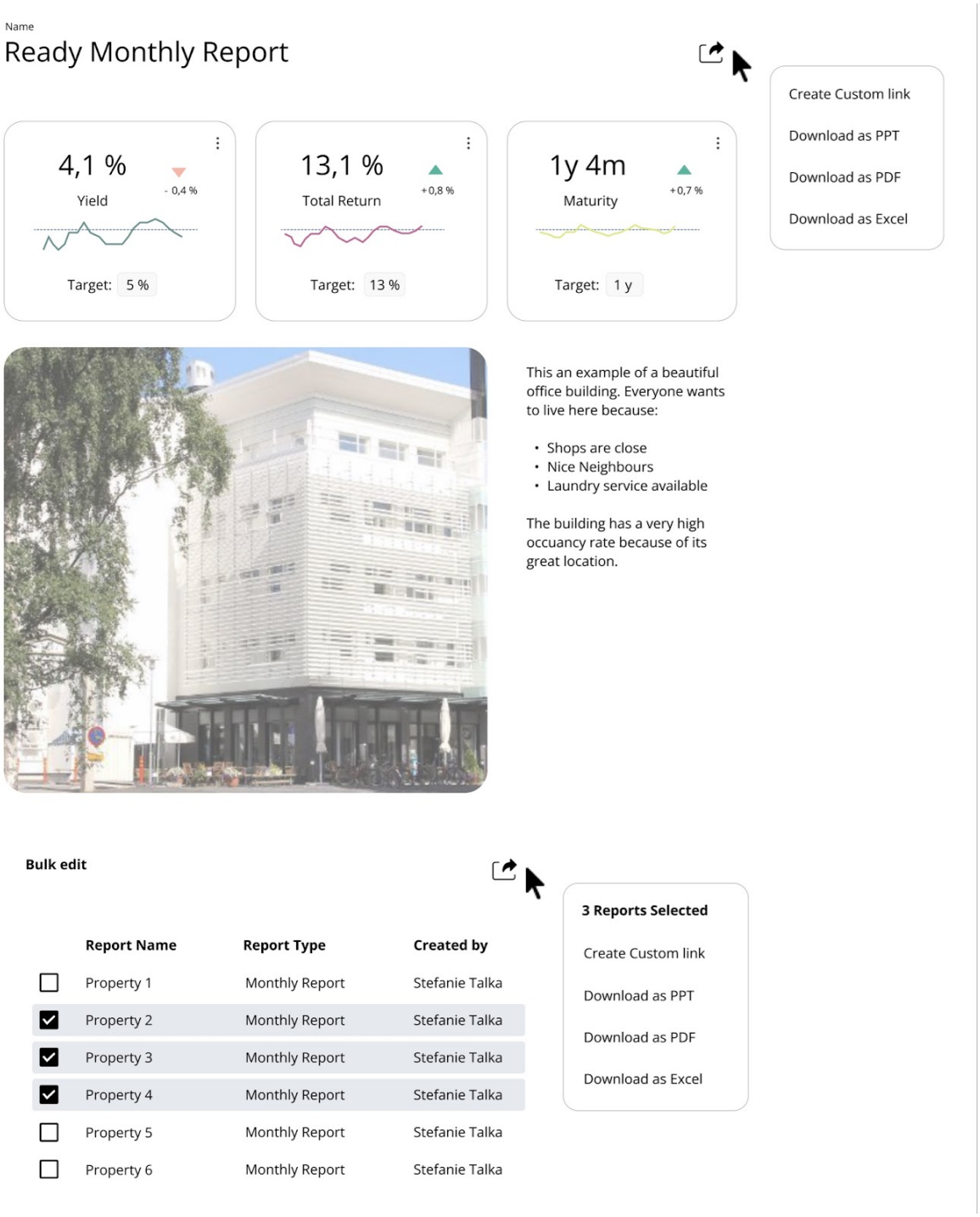

Figure 61. Different Ways of Exporting Reports

8 Summary

The development task given by Assetti was to find out which financial KPIs in terms of cash flow are the most valuable in property asset management, how visualizing related KPIs adds value and how to create intuitive, visually rich customer-specific content out of structured financial data.

The research revealed a few concrete improvement suggestions for the product. Those were related to usability, the user interface, data quality and data management. Furthermore, missing KPIs were acknowledged.

The development work resulted in a set of ready-designed and visualized key performance indicators as well as examples and recommendations for the future development of KPIs important to the real estate industry. In addition, different solutions for an intuitive user interface for creating, adjusting and working with KPIs were proposed. The development work was built upon existing functionalities within the Assetti application. With the help of the acknowledged indicators and customizable metrics, it is possible for Assetti to advance the process of continuous development after the completion of the development work as a thesis.

8.1 Discussion

Key performance indicators are an important management tool and working with KPIs is a central task for many institutions. KPIs are not only about forecasting accurately but about being able to transform data into knowledge. Analysing the interviews and building the prototypes resulted in certain requirements important for developing and visualizing KPIs for the Assetti software. These are:

- Comparing actual data to a given goal
- Diving into the data - getting a better understanding of the data behind a KPI
- Being able to see how KPIs are calculated
- Adopting underlying calculations to match given business rules
- Sharing KPIs and dashboard views
- Sharing reports with adjustable content internally and externally

The research has shown that key figures must be tailored to the individual needs and requirements of different target groups (differentiation). While in property management a large number of influencing variables for precise adjustment are needed, fewer, but condensed and meaningful figures are sufficient in asset management. If required, asset management users can access more key figures by drilling down to detail levels. Drill-down means in this case layer-specific, selective, and gradually stepping down in a hierarchical tree structure. Differentiation shows the difficulty in defining strategic key figures as well as operational key figures. The wider the range of possibilities, the more difficult it is to define valuable key figures.

Implementing a valuable measurement system will improve customer satisfaction with Assetti users. The more users enjoy working with a product, and recognize the value it brings to their daily work, the more frequent usage will be. But offering a solution that serves a wide variety of customers will come with challenges. The biggest threat is the complexity of the user interface. A complex user interface can disorient the user or even alienate them. The option to choose and visualize as many KPIs as needed will make it harder for users to set up the important measurements.

It is likely that users will not be aware of all possibilities they have for adopting their dashboard or reporting to their needs. It is proven that the Pareto principle is applicable for software development in the same way it is to many other industries. The 80:20 rule states that 80% of effect comes from 20% of causes. IBM realized already back in the 1960s that a person working with a computer spends 80% of their time using just 20% of the available software on that computer (Sobaca 2010, 8-9). For this Assetti case, it could mean that 80% of software users use only 20% of the available features. To guarantee a lean application, the usage of pre-defined templates for certain customer groups is recommended. It is easier to adopt a view by adding and deleting certain KPIs, than it is to build a KPI view from scratch. After all, Assetti was designed to be easily understood and used.

When comparing the dashboard and reporting functionalities, it is obvious that although they display similar content, the functionalities behave very differently. I believe that leveraging mental models can help sync these two functionalities. A mental model is one of the most important concepts in human-computer interaction and is based on belief, not facts (Nielsen 2010). If a user is familiar with using the dashboard view and how to adjust KPIs, they will based on their prediction, expect the reporting section to behave the same way. Therefore, I would recommend utilizing parts of the visualized content from the KPI view in the reporting view as well. Selecting a widget or a KPI based on plain descriptions might be difficult for the customer.

The match between the system and the real world is, in this case, selecting the right KPIs important for a specific need and making them appear in a natural and logical order. Recognition rather than recall refers to adding already visualized KPIs from the dashboard view to the reports. In this way, the user does not need to remember how the KPI needed looks or was visualized. The user must not rebuild it because it exists already within the user interface. (Nielsen 2020.)

A waterfall model, a completely new method of data visualisation to Assetti was suggested by the customer and presented in user story 6. A waterfall chart compares a final value with an original value taking into account operational parameters having positive or genitive influences. When creating this kind of chart, values and categories are presented. It can be applied to several KPIs including calculations around Net Operating Income and Free Cash Flow.

One of the main findings of this work is not so much related to data visualization but to data quality**.** All of the interviewees mentioned early on, that all data can be visualized but if the data is incorrect, the decisions based on that data will also be incorrect. It is therefore crucial to provide the user with an easy way to verify that the data used is correct. In a complex software solution, that is a challenging undertaking. I therefore suggest indicating more clearly those parameters that are used to calculate a KPI to the user, or from which data point the information for displaying the KPI is retrieved. Another threat is that if the user realizes that the KPI is not showing the right results, he would likely lose trust in the software. Quite often it is not even the software's "fault". Many cloud-based solutions work with integrations and an open API (application programming interface) which feed the data into software solutions like Assetti. If that data is already incorrect, the data shown in Assetti will be wrong as well. It might be that the data error can be spotted easily, as in the case a KPI is totally out of scale. Smaller irregularities would be much harder to detect. Therefore, it is important that the user has the possibility to see the underlying data or even open the calculation of a KPI. That will make it easier to find the root cause of incorrect KPIs and at the same time assure better data quality.

The meaning of colour plays a significant role when visualizing KPIs. A couple of the KPIs I visualized were related to comparing results to a certain target. Traffic light colours helped me to create a more intuitive user experience with those KPIs because they are actionable for the user. Traffic lights are so integrated into our lives, that we react instantly to them. We will stop if we see a red light, and we will go when we see a green one. In performance measurements, those traffic light colours can be equated to specific meanings. A red colour intends that targets are not met and immediate actions need to be taken. A yellow colour is

applied if targets are not met but they are still within a tolerance interval and therefore need to be analysed and monitored. A green colour stands for targets that are met. (Brudan 2010.)

The colours red and green have also been used when visualising trends. A positive change in a certain time period compared to the actual time period was shown as a green arrow, a negative change was displayed as a red one. The same colour relation was applied to as well to user stories 5 and 6. Within the amortization schedule, the already paid amount is displayed in green, and the amount unpaid in red. The waterfall chart shows incomes in green bars, expenses are shown in red colour.

8.2 Further development

The research revealed that there is a regularity in the reporting intervals. Those intervals vary from one month to one year. Especially for those reports whose content is consistent, the possibility of automated reporting should be considered. Automated reports can be generated at fixed intervals or they may also be triggered by certain events, like for example bigger change in a critical KPI. For that case, it would be possible to set different alerts so the user would get notifications in case numbers are dropping or rising above or below a certain limit set. Sending reports on a scheduled base will decrease manual work. Once a report is created, it can be generated at fixed intervals, such as every first day of a month. It will then be automatically sent or shared in the desired format to the recipients.

Assetti is offering within the solution also a functionality called Notes. With the help of notes, it is possible for the user to create tasks or record short notices. That enables tracking strategic documentation related to a portfolio and assigning tasks for team members concerning a specific property, lease or unit. That functionality could be embedded in the KPI- and reporting section and would deliver added value to medium and larger companies. According to the interview results, smaller companies don’t see a need in applying this kind of feature, since internal communication and task management are easier by phone, email or via direct conversation.

The usage of IoT (Internet of Things) and connecting Assetti with smart buildings can bring a further future advantage. Integrating a comprehensive set of different sensors into the Assetti software can help to show real-time data more precisely. Taking into account the importance of environmental aspects, sensors and IoT can help to for example decrease energy consumption. Also, other non-financial factors like Social and Governance can be taken into consideration.

Giving the user the possibility to start again where he took off last time is another improvement which should be taken into consideration. Saving a certain view or making the software remember the search I applied the last time will make it easier for the user to continue work without interruptions.

To understand the customer needs better and to know what data needs to be displayed in which format, further user testing is needed. Exploring which of the existing KPIs would need to be visualized in a different way is just a task that needs to be tackled. Connecting the right data points and having all data available to enable valuable visualisation is another one.

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Appendices

Appendix 1. Interview Questions and Structure

1. Intro

- Can you please briefly introduce yourself and the role within your company?

2. The role of reporting within your company

- What are your business objectives or how would you like to use Assetti for reporting?
- Who are the stakeholders involved in the reporting process?
- What kind of reporting do you need to support? (Internal/External/Multi-Nation)
- For whom the reports are made?
- What is the content you need to cover in your reports?
- Are there any reporting standards you are following?
- On what base or how often do you have the need for reporting?
- Which use case suits better for your business operations?
    - A real-time dynamic analysis through the current KPI views
    - A static and regulatory reporting

3. Data

- What are the requirements from the data point of view?
  What data do you need for successful reporting?
- Do we have enough detailed information for your reporting needs?

  If **NO**: How would you improve the data structure?
- Do you feel that you have efficient data sets in order to display reliable KPIs?

4. General Key Performance Indicators

- Are the key performance indicators currently shown in Assetti providing you with enough information for your business?

  If **YES**:
    - What are the most valuable KPIs for you in Assetti?

  If **NO**:
    - What KPIs or charts do you feel are missing?
    - If you could structure the content differently, how would you do it?
- Do you feel there is too much information which is not relevant to your business?

  If **YES**:
    - Which ones are those?
- Do you need to take action when KPIs seem incorrect? For example add a note or create a task so your team can act on it?

5. Financial Key Performance Indicators

- What are the main KPIs you require for financial performance related reporting?
- How valuable for you are insights regarding:
    1. Rental Income (GRI)
    2. Costs (OPEX)
    3. NOI 1/Yield (Sum Level)
    4. Other income
    5. Other costs (CAPEX, etc)
    6. NOI 2 (Sum level)
    7. Amortizations
    8. Free cashflow

6. Visualization

- Do you prefer visual reporting and dashboards (KPIs for decision making) over raw and structured data (Big data with exact numbers for analytics)?
- Is the historical data the most important for your reporting or do you need to keep an eye on trends as well (predict future)?
- Do you need to spot irregularities to identify critical cases or are comparisons more valuable for you? For example comparing an actual KPIs against a budgeted target?
- At the moment we are supporting Bar, Pie, Column and Line charts. Is there any format you are missing?
- How important is it for you to:
    - customize KPIs e.g. in terms of coloring, font, white labeling to be in sync with your company's brand identity?
    - limit or extend data shown e.g. “Top 5 tenants” instead of “Top 3 tenants”?
    - show numbers in different currencies?

7. Utilization

- How would you like to utilize the custom reporting?
    - I want to generate turnkey reports.
    - I want to integrate pre-calculated KPIs to other tools or reporting solutions.
    - I want to share or export visualized charts / dashboard from Assetti?
    - I want to provide access rights for different stakeholders (with limited data shown).

Appendix 2: Visualized Findings from the Interviews with Company A and B

Appendix 3: Visualized Findings from the Interviews with Company C and D