**BBM475 Management Information Systems**
**2022 Fall, BI Project**

# BUSINESS INTELLIGENCE (BI) PROJECT

Delivery Date: Jan 8, 2023

**Team Members:**
**21827555 – Meltem Kaya**

**21727039 – Muhammet Ali Çaki**

**21827349 – Beyza Erdoğan**

## 1. PROJECT OVERVIEW

BI Project Purpose : Business intelligence is used to make wiser decisions for the company. Businesses also utilize business intelligence to find new business prospects, reduce expenses, and find ineffective company procedures. Our purpose is improving and measuring software quality using the given software metrics via GQM approach on given ISBSG D&E Repository Data . A technique for implementing goal-oriented metrics across an entire software business is the "Goal-Question-Metric" (GQM) methodology. With GQM, we first define the objectives we hope to accomplish before outlining the queries we hope to address with the information we gather.

BI Tool Used : Power BI

**Table 1.** Goal(s), questions, and metrics used in BI Project

| Goal | Question | BI Feature Used |
|---|---|---|
| 1. Improving the performance of deliveries | (MIS) 1.1. What is the quality of deliveries?<br>Metrics:<br>- Minor Defects<br>- Major Defects<br>- Extreme Defects<br>- Defect Density<br>- Total Defects Delivered<br>- Meet stated objectives | - Clustered Bar Chart<br>- Stacked Bar Chart<br>- Pie Chart |
| 1. Improving the performance of deliveries | (MIS) 1.2. How efficiently do we deliver?<br>Metrics:<br>- Delivery rate<br>- Speed of delivery<br>- Ratio of Project Work Effort to Non-Project Activity | - Clustered Bar Chart<br>- Pie Chart |
| 1. Improving the performance of deliveries | (DSS) 1.3. What would happen if we reduce the defects?<br>Metrics:<br>- Minor Defects<br>- Major Defects<br>- Extreme Defects<br>- Defect Density<br>- Speed of Delivery | - Line and Stacked Column Chart |
| 2. Decreasing the total project cost | (MIS) 2.1. What is the cost of people related aspects?<br><br>Metrics:<br>- Team size of group<br>- Experience of teams<br>- Working hours per role | - Clustered Bar Chart |
| 2. Decreasing the total project cost | (MIS) 2.2. What is the time cost of the project?<br><br>Metrics:<br>- Speed of delivery | - Clustered Bar Chart<br>- Line Chart<br>- Summarize |

| | | |
|---|---|---|
| | - Average Team Size<br>- Recording Method<br>-Functional Size<br>- Speed of defining solution<br>- Speed of providing solution | |
| 2. Decreasing the total project cost | (DSS) 2.3. What would happen to the total project cost if project size attributes are decreased<br>Metrics:<br>- Functional Size<br>- Relative Size<br>- Average Team Size<br>- Lines Of Code<br>- Total Project Cost<br>- İmplementation Cost | - Pie Chart |
| 3. Increasing customer satisfaction | (MIS) 3.1. What is the current customer satisfaction?<br><br>Metrics:<br>- Meet stated objectives<br>- Meet business requirements<br>- Quality of functionality<br>- Quality of documentation<br>- Ease of use<br>- Training given<br>- Speed of defining solution<br>- Speed of providing solution | - Pie Chart |
| 3. Increasing customer satisfaction | (MIS) 3.2. How many problems are affecting the customer?<br><br>Metrics:<br>- Total Impl Defects<br>- Total Build Defects<br>- Total Test Defects<br>- Plan Defects<br>- Specification Defects<br>- Design Defects<br>- Total Defects Delivered<br>- Defect Density | - Pie Chart |
| 3. Increasing customer satisfaction | (DSS) 3.3. What would be the change in customer satisfaction if we reduce the total defect count?<br><br>Metrics:<br>- Total Defects Delivered<br>- Quality of functionality<br>- Meet stated objectives | - Clustered Column Chart |

## 2. DATASET DESCRIPTION

Dataset Name : ISBSG D&E Repository Data

Purpose of Data Use : This dataset consists of a wide range of attributes related to various project data types. Over thirty nations contributed data for the Repository projects, with 48% of those projects being finished during the last decade. Our purpose of using this dataset is improving the software quality via raising questions to be answered using MIS and DSS.

**Table 2.** Dataset attributes used in BI Project and their descriptions

| Attribute | Description |
|---|---|
| Summary Work Effort | Provides the total effort in hours recorded against the project. |
| Defect Density | Defects per 1000 FP calculated as Total Defects Delivered * 1000 / Functional Size<br>Measures the quality of software in terms of defects delivered in unit size of software. It is defined as the number of Defects per 1000 Functional Size Units of delivered software, in the first month of use of the software. It is expressed as Defects per 1000 Functional Points. |
| Speed of Delivery | Functional Size Units per elapsed month calculated as Functional Size / Project Elapsed Time<br>Measures the speed achieved in delivering a quantity of software over a period of time. It is defined as the Functional Size of the delivered software (measured in functional size units), over the Project Elapsed Time (measured in months). It is expressed as Functional Points per elapsed month. |
| Survey Questions (8 columns) | The following questions are rated on a scale of 1-4 where:<br>1 = Poorly met, or not at all<br>2 = Largely met<br>3 = Fully met<br>4 = Exceeded expectations<br>· Meet stated objectives - User satisfaction with the ability of system to meet stated objectives.<br>· Meet business requirements - User satisfaction with the ability of system to meet business requirements.<br>· Quality of functionality - User satisfaction with the quality of the functionality provided.<br>· Quality of documentation - User satisfaction with the quality of the documentation provided.<br>· Ease of use - User satisfaction with the ease of use. User satisfaction with the ease of use.<br>· Training given - User satisfaction with the training given.<br>· Speed of defining solution - User satisfaction with the speed of defining solution.<br>· Speed of providing solution - User satisfaction with the speed of providing solution |
| Total Impl Defects | Total number of defects reported in the Implementation activity. This column shows the total of defects reported (Minor, Major and Extreme) or where no breakdown is available, the single value is shown here (if known). |
| Total Build Defects | Total number of defects reported in the Build activity. This column shows the total of defects reported (Minor, Major and Extreme) or where no breakdown is available, the single value is shown here (if known). |
| Total Test Defects | Total number of defects reported in the Test activity. This column shows the total of defects reported (Minor, Major and Extreme) or where no breakdown is available, the single value is shown here (if known). |
| Plan Defects | Defects reported in the Planning activity. This column is the total number of defects reported for the activity. |
| Specification Defects | Defects reported in the Specification activity. This column is the total number of defects reported for the activity. |
| Design Defects | Defects reported in the Design activity. This column is the total number of defects reported for the activity. |
| Total Defects Delivered | Total number of defects reported in the first month of use of the software. This column shows the total of defects reported (Minor, Major and Extreme). Where no breakdown is available, the single value is shown here. |
| Manpower Delivery Rate | Functional Size Units per person per elapsed month calculated as Functional Size / Project Elapsed Time * Max Team Size<br>Measures the speed achieved by the project team in delivering a quantity of software over a period of time. It is defined as the Functional Size of the delivered software (measured in functional size units), over the Project Elapsed Time (measured in months) multiplied by the number of people in the project team. It is expressed as Functional Points per person per elapsed month. The ISBSG previously called this metric speed of delivery. In comparing projects, speed of delivery will vary according to team size. In order to compare like with like the ISBSG normalize speed of delivery with the team size to compare projects by manpower delivery rate. |
| Project Elapsed Time | Total elapsed time for the project in calendar months. |
| Project Inactive Time | This is the number of calendar months in which no activity occurred, (e.g. awaiting client sign off, awaiting acceptance test data). This time, subtracted from Project Elapsed Time, derives actual time working on the project. |
| Max Team Size | The maximum number of people that worked at any time on the project (peak team size). This number is given for the Development Team (level 1) only. |

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|---|---|
| Average Team Size | The average number of people that worked on the project (calculated where available from the team sizes per activity). This number is given for the Development Team (level 1) only. |
| Ratio of Project Work Effort to Non-Project Activity | The ratio of Project Work Effort to Non-Project Activities. |
| Team Size of Group | Categories Max Team Size by into groups to increase number of projects selected, as:<br>1 => 1.55<br>2 = 1.55 to <2.5<br>3-4 = 2.5 to <4.5<br>5-8 = 4.5 to <8.5<br>9-14 = 8.5 to <14.5<br>15-20 = 14.5 to <20.5<br>21-30 = 20.5 to <30.5<br>31-40 = 30.5 to <40.5<br>41-50 = 40.5 to <50.5<br>51-60 = 50.5 to <60.5<br>61-70 = 60.5 to <70.5<br>71-80 = 70.5 to <80.5<br>81-90 = 80.5 to <90.5<br>91-100 = 90.5 to <100.5<br>100 + => 100 |
| Experience of Teams | ● BA team experience: Number of team members with business area experience.<br>● IT experience: Number of team members with software development experience<br>● Project manage experience: Number of past projects (IT and non-IT) for which the project manager has been responsible. This is an indication of the past experience of the project manager. |
| Working Hours per Role | **Project Manager Effort**<br>This field contains the breakdown of Project Team Effort reported for Project Manager when provided in the submission.<br>**Business Analyst Effort**<br>This field contains the breakdown of Project Team Effort reported for Business Analyst when provided in the submission.<br>**Software Architect Effort**<br>This field contains the breakdown of Project Team Effort reported for Software Architect when provided in the submission.<br>**User-Interface Effort**<br>This field contains the breakdown of Project Team Effort reported for User-Interface when provided in the submission.<br>**Graphic Artist Effort**<br>This field contains the breakdown of Project Team Effort reported for Graphic Artist when provided in the submission.<br>**Developer Effort**<br>This field contains the breakdown of Project Team Effort reported for Developer/Programmer when provided in the submission.<br>**QA/Tester Effort**<br>This field contains the breakdown of Project Team Effort reported for QA/Tester when provided in the submission.<br>**Training & Documentation Effort**<br>This field contains the breakdown of Project Team Effort reported for Training & Documentation when provided in the submission.<br>**Database Administrator Effort**<br>This field contains the breakdown of Project Team Effort reported for Database Administrator when provided in the submission.<br>**IT System Administrator Effort**<br>This field contains the breakdown of Project Team Effort reported for IT System Administrator when provided in the submission |
| Productivity | **Normalised Level 1 Productivity Delivery Rate (unadjusted function points)**<br>Project productivity delivery rate in hours per functional size unit calculated from Normalised Level 1 Work Effort for the development team only divided by Functional Size (Unadjusted Function Points). This is the delivery rate currently recommended by the ISBSG. Use of normalized effort for the development team and unadjusted count should render the most comparable rates. |

| | |
|---|---|
| | **Normalised Productivity Delivery Rate (unadjusted function points)**<br>Project productivity delivery rate in hours per functional size unit calculated from Normalised Work Effort divided by the Functional Size (Unadjusted Function Point count). This is the delivery rate for the project used and reported by the ISBSG since the year 2002. Use of normalized effort and unadjusted count should render more comparable rates than unnormalized effort and adjusted count.<br><br>**Pre 2002 Productivity Delivery Rate**<br>Project productivity delivery rate in hours per functional size unit calculated from Summary Work Effort divided by Function Point count. This is the delivery rate for the project that was used and reported by the ISBSG prior to the year 2002. Since that time the Normalised PDR has been used for analysis and reporting. |

## 3. QUESTIONS ANSWERED

**Table 3.** Questions answered and attributes used in BI Project

| Type | Question | Attributes Used | Responsible Student |
|---|---|---|---|
| MIS | 1.1.What is the quality of deliveries? | - Minor Defects<br>- Major Defects<br>- Extreme Defects<br>- Defect Density<br>- Total Defects Delivered<br>- Meet stated objectives | *Meltem Kaya* |
| MIS | 1.2.How efficiently do we deliver? | - Delivery rate<br>- Speed of delivery<br>- Ratio of Project Work Effort to Non-Project Activity | *Meltem Kaya* |
| DSS | 1.3. What would happen if we reduce the defects? | - Minor Defects<br>- Major Defects<br>- Extreme Defects<br>- Defect Density<br>- Speed of Delivery | *Meltem Kaya* |
| MIS | 2.1. What is the cost of people related aspects? | - Team size of group<br>- Experience of teams<br>- Working hours per role | *Muhammet Ali Çaki* |
| MIS | 2.2. What is the time cost of the project? | - Speed of delivery<br>- Average Team Size<br>- Recording Method<br>-Functional Size<br>- Speed of defining solution<br>- Speed of providing solution | *Muhammet Ali Çaki* |
| DSS | 2.3. What would happen to the total project cost if project size attributes are decreased? | - Functional Size<br>- Relative Size<br>- Average Team Size<br>- Lines Of Code<br>- Total Project Cost<br>- İmplementation Cost | *Muhammet Ali Çaki* |
| MIS | 3.1. What is the current customer satisfaction? | - Meet stated objectives<br>- Meet business requirements<br>- Quality of functionality<br>- Quality of documentation | *Beyza Erdoğan* |
| MIS | 3.2. How many problems are affecting the customer? | - Total Impl Defects<br>- Total Build Defects<br>- Total Test Defects<br>- Plan Defects<br>- Specification Defects<br>- Design Defects | *Beyza Erdoğan* |

| | | | |
|---|---|---|---|
| DSS | 3.3. What would happen if we reduce the total defect count? | - Total Defects Delivered<br>- Quality of functionality<br>- Meet stated objectives | *Beyza Erdoğan* |

## 3.1. Questions Answered by Meltem Kaya

### 3.1.1. (MIS) Q-1.1: What Is The Quality of Deliveries?

Purpose of question : The purpose of this question is to identify the factors that decrease the quality of project deliveries. By analyzing the relation between types of defects and the customer survey results, we can determine which type of defect has a great impact on the quality of deliveries.

BI feature used : Stacked Bar Chart,Clustered Bar Chart, Pie Chart

BI output description :Stacked bar chart visualizes average of minor defects, average of major defects and average of extreme defects by “meet stated objectives”. Clustered Bar Chart visualizes the average of defect density, average of total defects delivered by “meet stated objectives”. Pie chart visualizes the distribution of survey answers related to the question “Meet stated objectives”.

Implementation details : I ignored null values when preparing the chart. There were recurring groups in the responses given in the user survey e.g. “2-Largely Met” and “2-Mostly Met”. Although they refer to the same group, they looked like two separate groups because they were named differently. I combined them and simplified the view to a single group. I used a stacked bar and clustered bar charts to better understand the relationship between defects and users' comments. I used the pie chart for identifying whether there is a bias on the given survey answers or not. These actions were undertaken with the aim of using the necessary metrics to answer the question as effectively as possible.

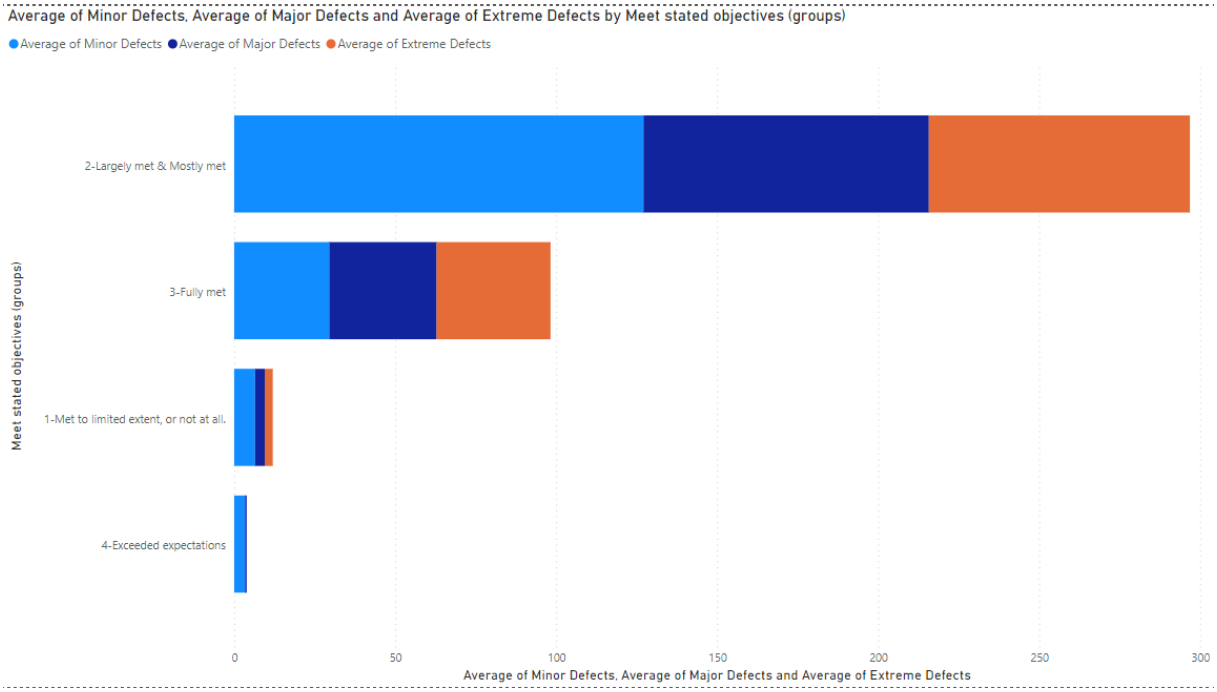


**Figure 1.1.1.** Average of Minor Defects, Average of Major Defects and Average of Extreme Defects by Meet Stated Objectives

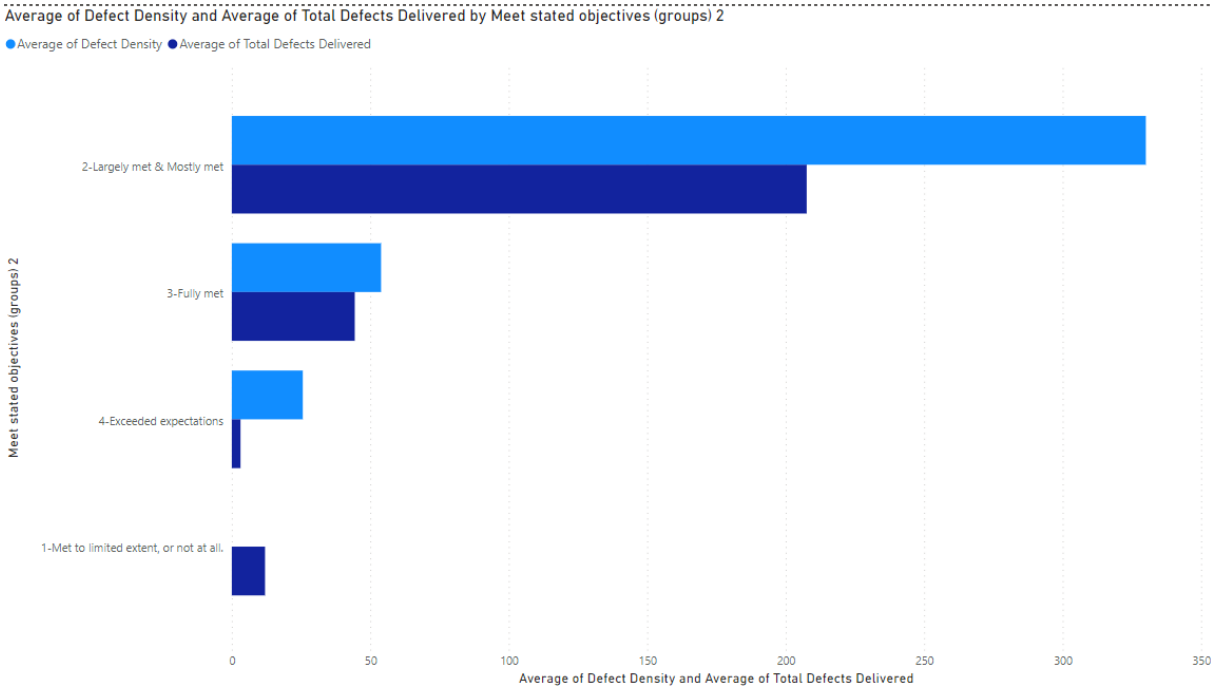


**Figure 1.1.2.** Average of Defect Density and Average of Total Defects Delivered by "Meet Stated Objects"

*Based on the data presented in the graph, it appears that the quality of deliveries varies based on the customer survey results. Specifically, it seems that deliveries with "4-Exceeded Expectations" have the fewest defects, while deliveries with "2-Largely met & Mostly met" have the most defects. In addition, the data suggests that there is a positive correlation between the average defect density and the total number of defects delivered, and that deliveries with a customer survey result of "2-Largely met & Mostly met" had the highest average defect density and total number of defects delivered. Overall, these results suggest that the quality of deliveries may be related to customer satisfaction and that there may be an opportunity to improve the quality of deliveries by addressing any issues that lead to lower customer satisfaction.*

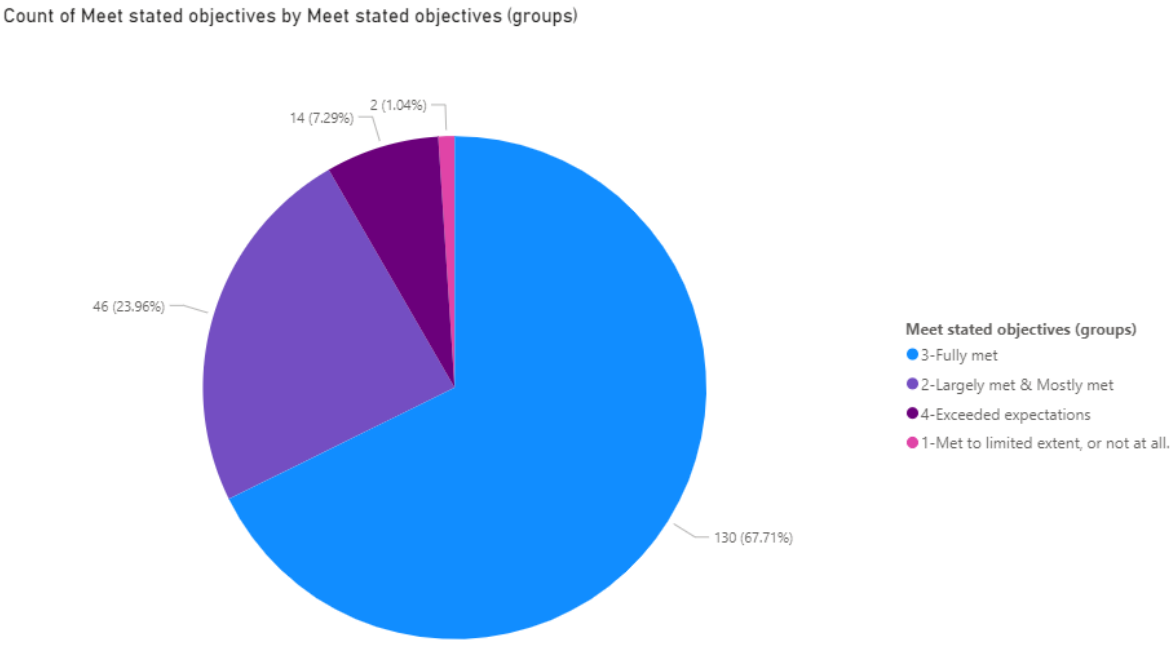


**Figure 1.1.3.** Distribution of customer answers on the question "Meet Stated Objects"

I felt the need to plot this graph because I found an overall positive correlation in my results, so I thought there might be a bias in the data. That is, the distribution of the number of answers obtained may not be close to each other. I got the result exactly as I expected. Most of the answers consist of "3-Fully met" and there is just a small amount of "1-Met to Limited extent, or not at all." I would prefer studying on a balanced dataset.

### 3.1.2. (MIS) Q-1.2: How Efficiently Do We Deliver?

Purpose of question : The purpose of this question is to identify the factors that affect the delivering projects on time. We will examine the effects of the ratio of project work effort to non project activity on the speed of delivery and productivity delivery rate.

BI feature used : Clustered Bar Chart, Pie Chart

BI output description : Clustered bar chart visualizes the average of speed of delivery and average of manpower delivery rate by ratio of project work effort to non-project activity. Pie Chart visualizes the distribution of the ratio of project work effort to non-project activity

Implementation details : I ignored null values while preparing the chart. The values in the Project Work Effort to Non-Project Activity column were continuous data consisting of decimal values between 0 and 1. Here I scaled the values between 0-100% in order to obtain a more meaningful result in the graph and created 5 discrete groups, each of which consists of 20% intervals. You can better understand what I'm doing by looking at the y-axis. I used the pie chart for identifying whether there is a bias on the distribution of the ratio of project work effort to non-project activity.

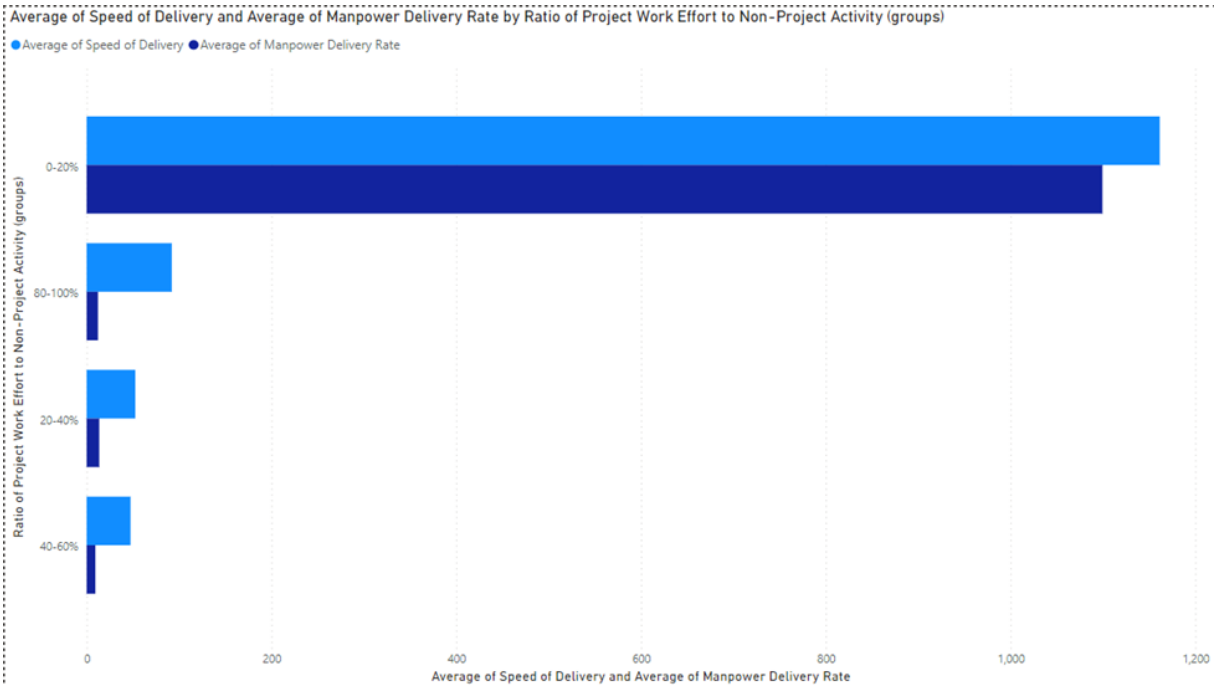


**Figure 1.2.1.** Average of Speed of Delivery and Average of Manpower Delivery Rate by Ratio of Project Work Effort to Non-Project Activity

*Based on the data presented in the graph, it appears that the speed of delivery and manpower delivery rate are highest when the ratio of project work effort to non-project activity is between 0-20% and 40-60%. This suggests that there may be an optimal range of project work effort to*

*non-project activity that leads to the most efficient deliveries. In addition, the data suggests that there is a positive correlation between the average speed of delivery and the average manpower delivery rate, and that both are negatively correlated with the ratio of project work effort to non-project activity. This suggests that increasing the amount of project work effort relative to non-project activity may lead to improvements in the efficiency of deliveries. Overall, these results suggest that non-project activity has a significant impact on the efficiency of deliveries and that there may be an opportunity to improve efficiency by adjusting the balance between project work effort and non-project activity.*

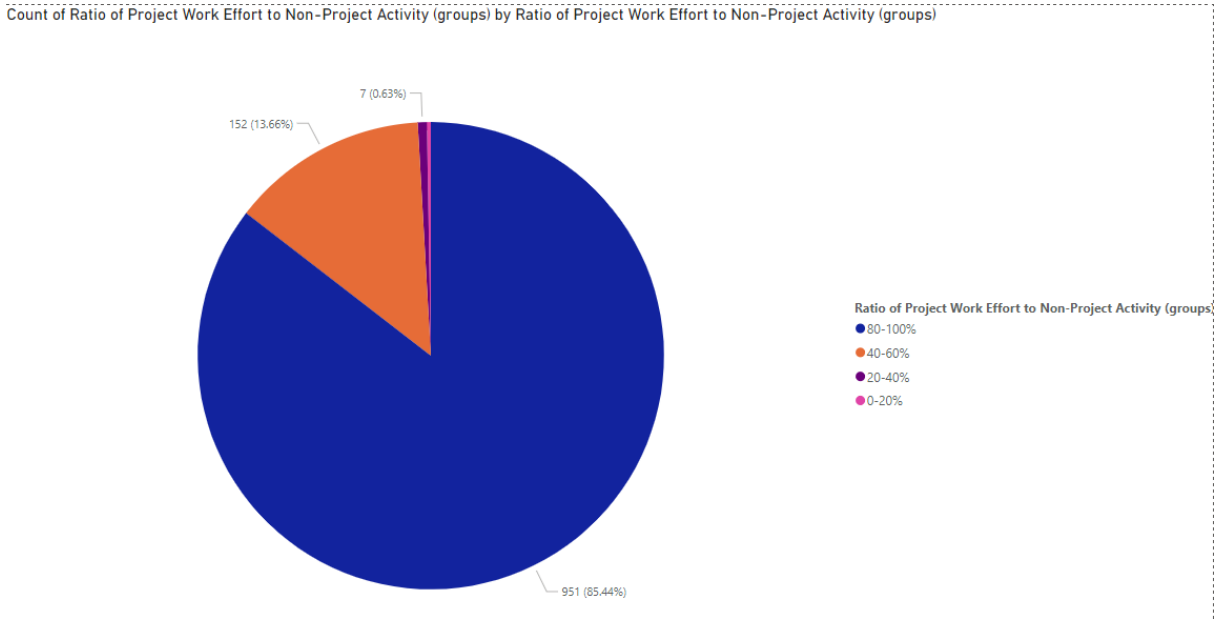


**Figure 1.2.2.** Distribution of the ratio of project work effort to non-project activity

I again felt the need to plot this graph for identifying whether there is a bias on the distribution of project work effort to non-project activity. In ***Figure 1.2.2***, the distribution is highly biased and more than %85 of the data is between the interval "80-100%". I got the result exactly as I expected. As I said before I would prefer studying on a balanced dataset.

### 3.1.3. (DSS) Q-1.3: What Would Happen If We Reduce the Defects?

Purpose of question : The purpose of the question is to assess the potential impact on speed of delivery of reducing the number of defects that occur while a project is in the build phase. Defects can cause projects not to be delivered on time, and sometimes even lead to different errors in the project as a chain, and these errors may be overlooked. This can affect the performance of the product. By reducing the number of defects, we can reduce both the speed of delivery and the amount of defects reported after the project is deployed.

BI feature used : Line and Stacked Column Chart

BI output description :Line and Stacked Column Chart visualizes average of minor/major/extreme defects and the average of defect density by the speed of delivery.

Implementation details : I ignored null values when preparing the chart. For better understanding the correlation between speed of deliveries and defects, I used a stacked bar chart. I also visualized the defect density as a line to identify how the performance of deliveries are affected by defects and speed of deliveries.

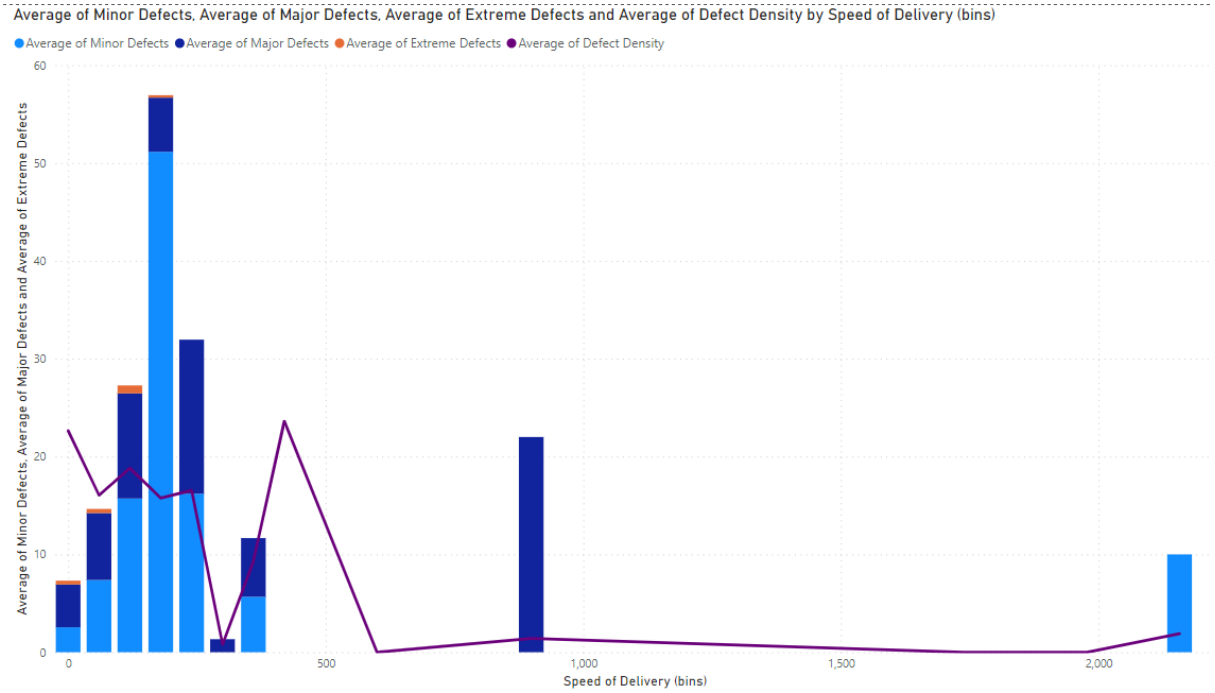


**Figure 1.3.1. Average of Minor Defects, Average of Major Defects, Average of Extreme Defects and Average of Defect Density by Speed of Delivery**

*Based on the data presented in the graph, it appears that reducing defects may lead to improvements in the efficiency of deliveries. The data shows that there is a positive correlation between the average number of minor defects and the average number of major defects, and that the average number of minor defects ranges from 2.55 to 59.65 across different levels of speed of delivery. This suggests that reducing the number of defects may lead to improvements in the efficiency of deliveries, as lower numbers of defects may allow for faster delivery times. Defect density indicates the quality of software in terms of defects delivered in the first month of use of the software. As shown in Figure 1.3.1, if we ignore the outliers, as long as the total defects are reduced, the defect density is also minimized. This means defects delivered in the first month of use of the software is minimized and this is one of the success measurements of the product.*

## 3.2. Questions Answered by Muhammet Ali Çaki

### 3.2.1. (MIS) Q-2.1: Question Description

Purpose of question : The purpose of this question is to identify the factors that contribute to the cost of people related aspects in the project, in order to achieve the goal of decreasing the total project cost. By analyzing the data on team size, experience, and working hours per role, we can determine which factors have the greatest impact on the cost of people related aspects, and use this information to make informed decisions about how to reduce those costs

BI feature used : Clustered Column Chart

BI output description : Clustered Column Chart include related Metrics

Implementation details : While preparing the chart, I filtered out missing data and certain team size values such as groups with 1 member, groups with 2 members, groups with 3-4 members, and groups with 21-30 members in order to avoid displaying

unnecessary data and ranges in the table. I also filtered out certain experience values that were not relevant to the analysis. These actions were taken in order to use the metrics required to answer the question as effectively as possible.

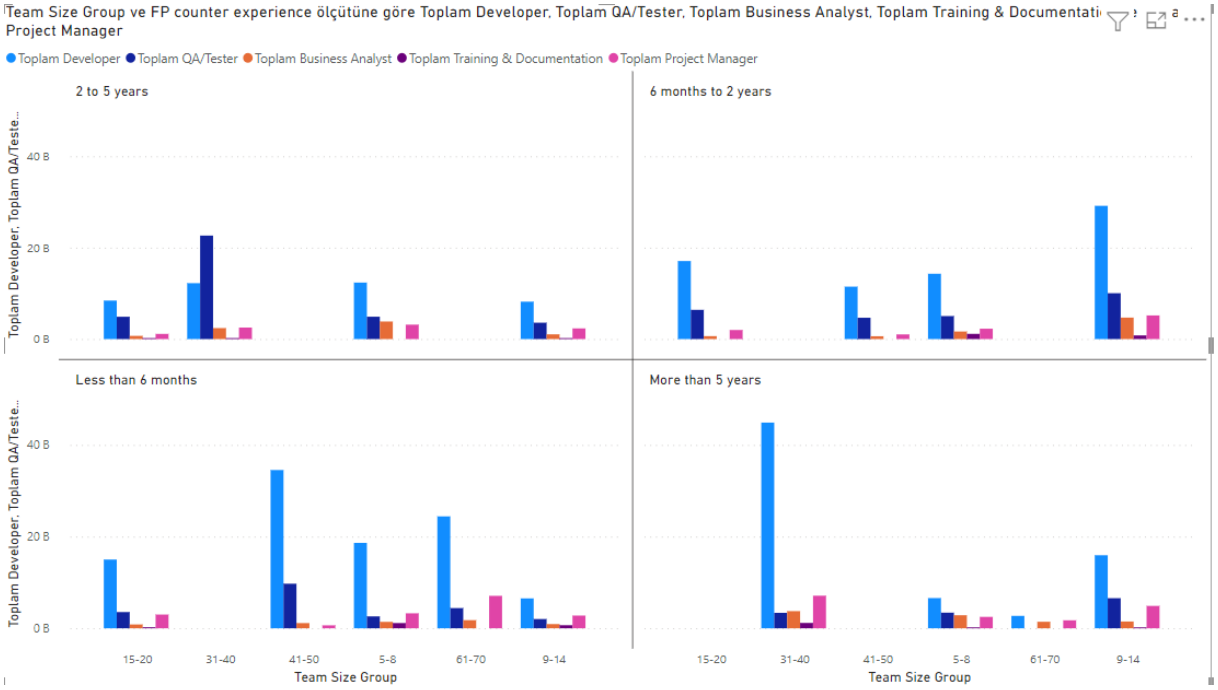


**Figure 2.1 BI output for answering Q-2.1**

*Based on the analysis of the data (and Figure 2.1), it appears that the cost of people-related aspects in this project is influenced by several factors, including team size, the experience of team members, and working hours per role. Specifically, the data shows that the group with the most time spent on the project is the Developers. The amount of time spent by Developers is generally inversely proportional to their experience. However, in groups with more than 30 people, experienced Developers also spend a lot of time on the project, which could be due to the fact that these groups are working on larger projects and more work is being delegated to experienced Developers. Additionally, the data shows that the amount of time spent by Project Managers is directly proportional to team size. Therefore, in order to decrease the total project cost, it may be beneficial to consider reducing team size and prioritizing the allocation of work to more experienced team members.*

### 3.2.2. (MIS) Q-2.2: Question Description

Purpose of question : The purpose of this question is to identify the factors that contribute to the time cost of the project, in order to achieve the goal of decreasing the total project cost. By analyzing the data on the speed of delivery, average team size, recording method, functional size, speed of defining a solution, and speed of providing a solution, we can determine which factors have the greatest impact on the time cost of the project, and use this information to make informed decisions about how to reduce those costs.

BI feature used : Clustered Column Charts and Line Chart, Summarize

BI output description : Clustered Column Charts and Line Chart include related Metrics and Summarization of graphics

Implementation details : While preparing the charts, I filtered out data points with missing or low values in order to avoid displaying unnecessary data and ranges in the table. I

also filtered out certain average team size values that were not relevant for the analysis. Additionally, I used the Power BI "summarize" feature to help identify any relationships that may not have been immediately apparent from the raw data. These actions were taken in order to use the metrics required to answer the question as effectively as possible.

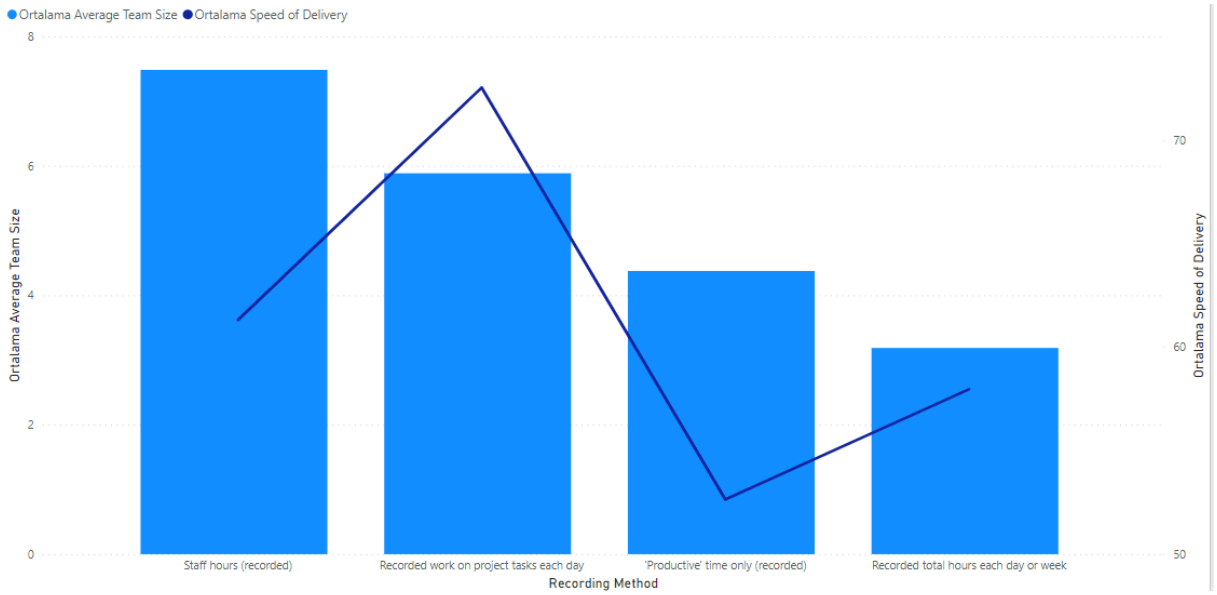


**Figure 2.1 BI output for answering Q-2.2**

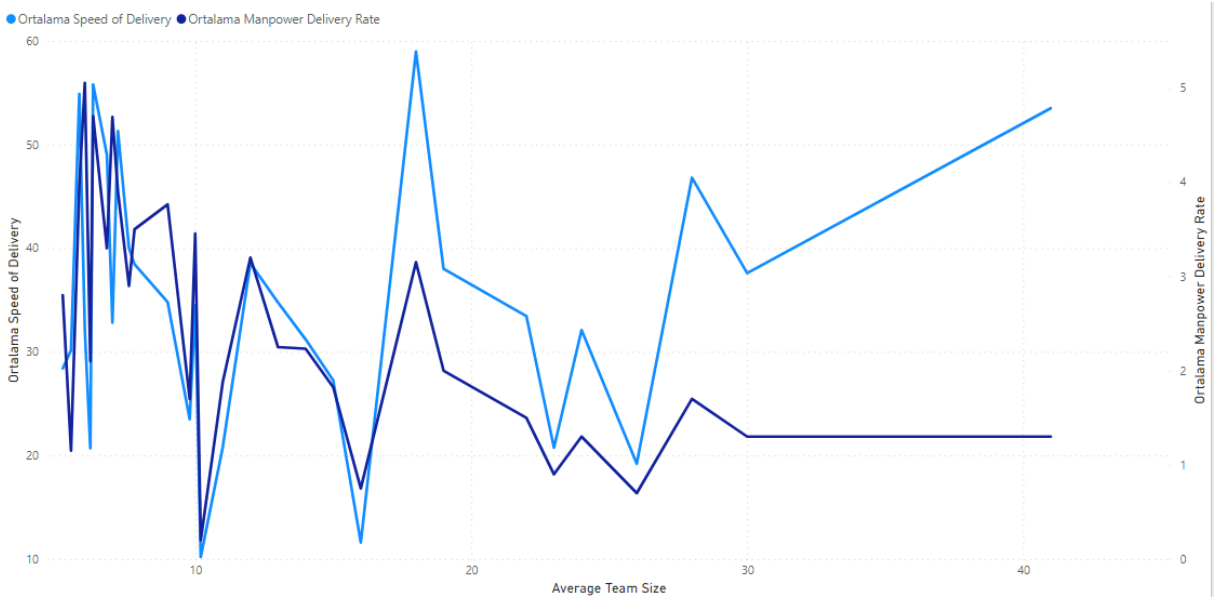


**Figure 2.2 BI output for answering Q-2.2**

*Based on the analysis of the data, it appears that the time cost of the project can be influenced by several factors, including speed of delivery, average team size, recording method, functional size, speed of defining a solution, and speed of providing a solution. The data shows that there is a positive correlation between the average speed of delivery and the average manpower delivery rate, and that the speed of delivery generally increases as the team size decreases. (Figure 2.2) Additionally, the data indicates that the highest speed of delivery is achieved when the recording method is "recorded work on project tasks each" and the average team size is around 6. (Figure 2.1) Therefore, in order to decrease the time cost of the project, it may be beneficial to increase the*

*manpower delivery rate per person, reduce the average team size, and record work on project tasks each.*

### 3.2.3. (DSS) Q-2.3: Question Description

Purpose of question : The purpose of this question is to determine the impact of decreasing various project size attributes (Functional Size, Relative Size, Lines of Code) on the total project cost. By understanding the relationship between these attributes and the cost of the project, we can make informed decisions about how to reduce the total project cost.

BI feature used : Pie Chart

BI output description : Pie Chart include related Metrics

Implementation details : In order to analyze this DSS question, I selected certain intervals for the size attributes and filtered out exceptional values. I also filtered out any empty values in the dataset. These steps were taken in order to use the relevant metrics in the most efficient manner and to provide accurate results for the analysis.

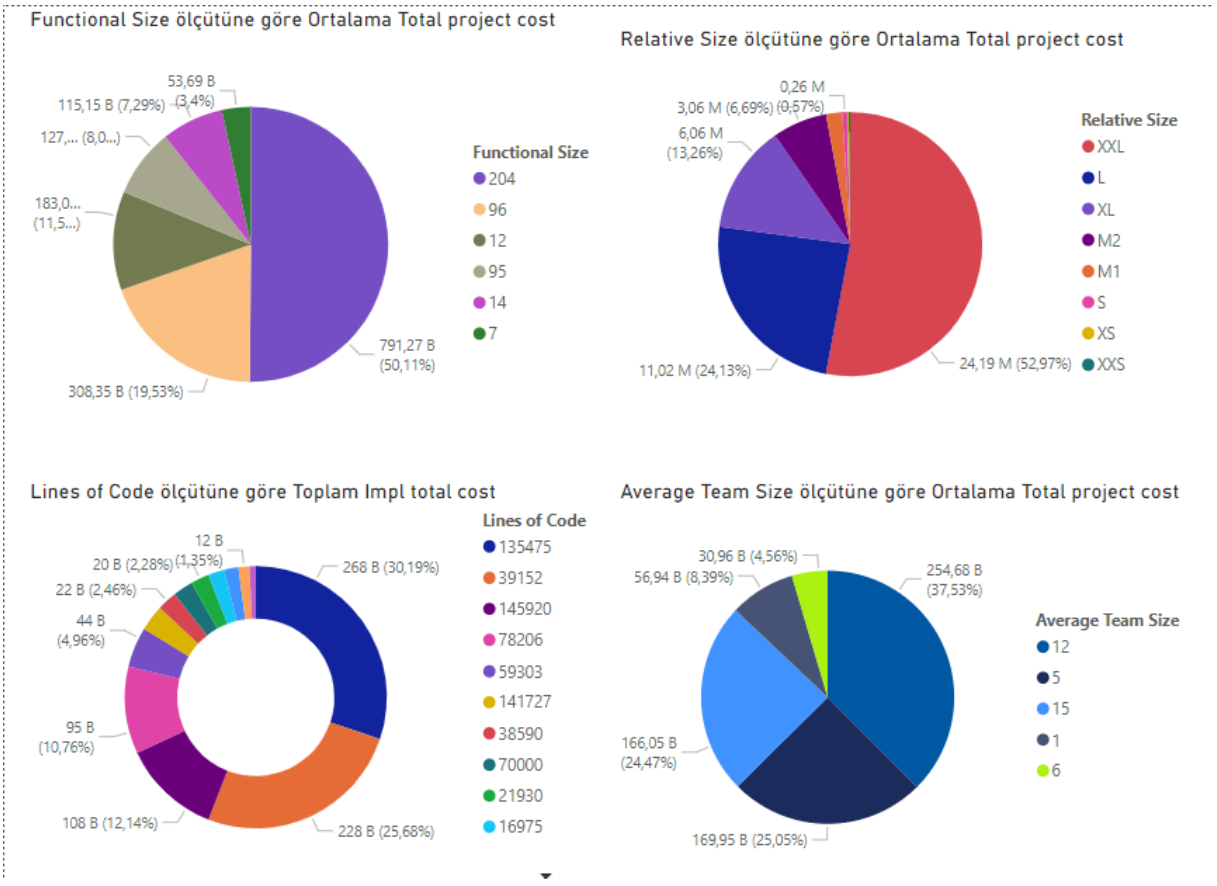


**Figure 2.3 BI output for answering Q-2.2**

*Based on the analysis of the pie chart, it appears that decreasing the Functional Size, Relative Size, and Lines of Code attributes can lead to a decrease in the total project cost. However, there is no correlation between the Average Team Size attribute and the cost of the project. Therefore, decreasing the Functional Size, Relative Size, and Lines of Code attributes may be effective in reducing the total project cost.*

## 3.3. Questions Answered by Beyza Erdoğan

### 3.3.1. (MIS) Q-3.1: What is the current customer satisfaction?

Purpose of question : The purpose of the question is to establish a baseline measure of customer satisfaction. This will allow us to determine how well your organization is currently meeting the needs and expectations of its customers, and will provide a reference point against which we can measure the effectiveness of any changes or improvements that we make. By answering this question, we will be able to identify areas where customer satisfaction is high and areas where it is low, which will help us to focus our efforts on the most important issues. Additionally, tracking changes in customer satisfaction over time can help us to identify trends and patterns, and to identify the root causes of any problems that may be occurring.

BI feature used : Pie Chart

BI output description : Pie Chart include related metrics

Implementation details : I used Pie Charts for metrics individually so that I can analyze the overall satisfaction by inspecting them one by one. I filtered out the missing and not applicable data. I chose the most relevant 4 metrics to measure the current satisfaction.

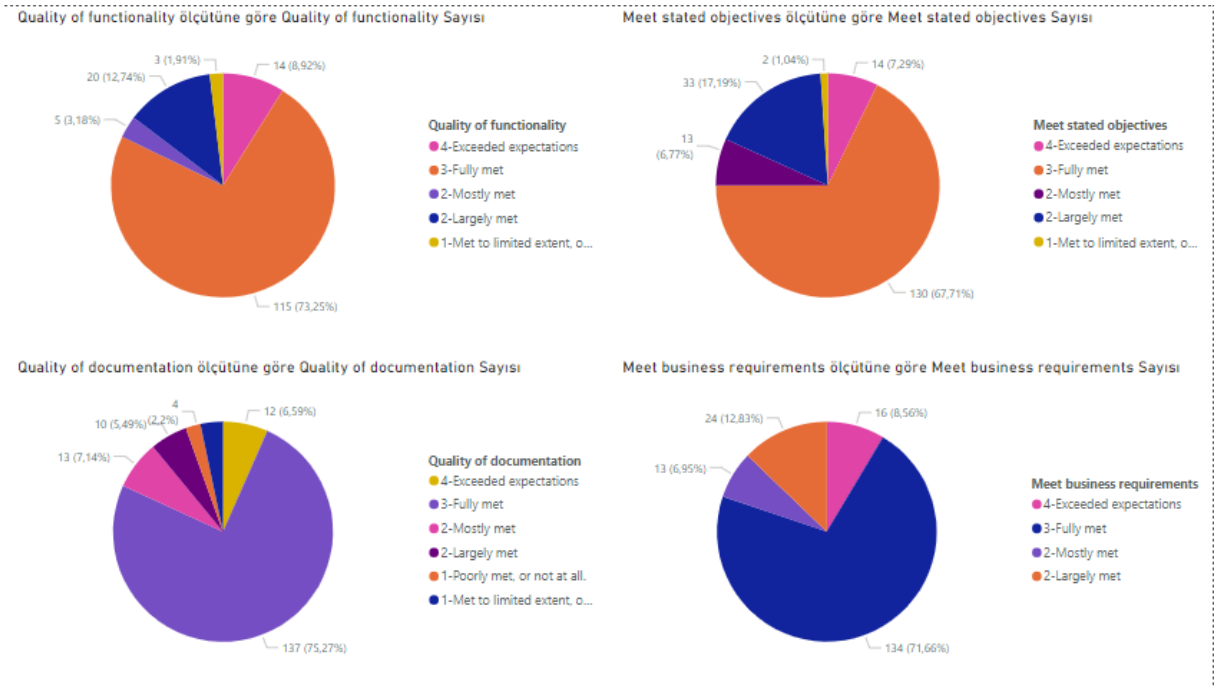


**Figure 3.1 BI output for answering Q-3.1**

*Overall, it appears that customer satisfaction is quite high, with a majority of responses falling into the "fully met" or "exceeded expectations" categories for all four charts. This suggests that customers are generally satisfied with the quality of functionality, the ability of the product or service to meet stated objectives, the quality of documentation, and the ability to meet business requirements. However, it is worth noting that there is still a significant number of responses that fall into the "mostly met" category, which suggests that there may be some areas where customer satisfaction could be improved.*

### 3.3.2. (MIS) Q-3.2: How many problems are affecting the customer?

Purpose of question : The purpose of the question is to identify the specific issues or challenges that are impacting customer satisfaction. By understanding the specific problems that customers are experiencing, we can take targeted action to address those issues and improve the overall customer experience.

For example, if we find that a high number of customers are experiencing problems with the quality of our product or service, we might focus on improving the quality of our offerings. On the other hand, if we find that many customers are having difficulty navigating our website or using our customer service hotline, we might focus on improving the usability of those channels.

By answering this question, we can gain a better understanding of what is causing dissatisfaction among our customers and take steps to address those issues in order to improve customer satisfaction.

BI feature used : Pie Chart

BI output description : Pie chart includes all categories of defects

Implementation details : I needed to analyze all the defects that customers will be affected by. So, I plotted all the defects into the pie chart. We can see the percentages of the defect categories and analyze the results accordingly.

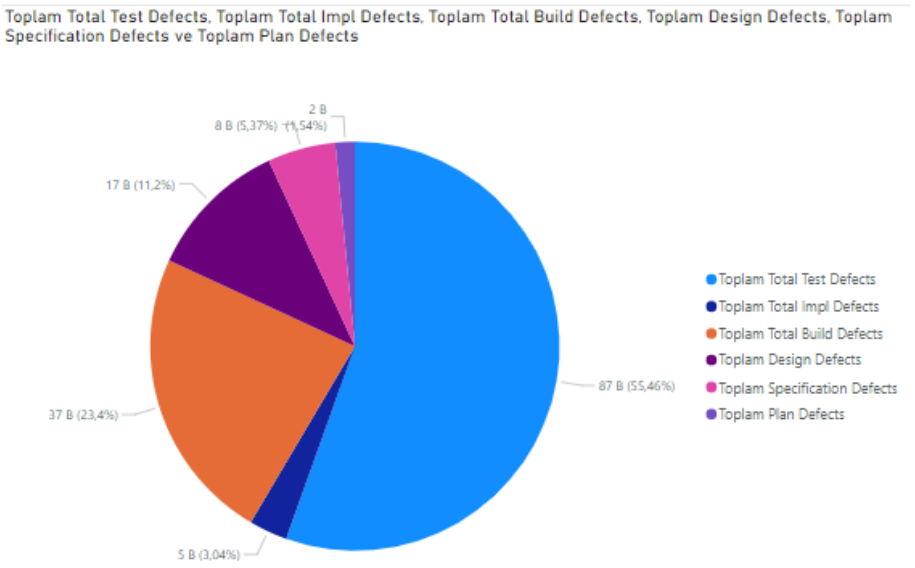


**Figure 3.2.** All categories of defects with their percentages

*Based on the pie chart, it appears that the majority of defects are occurring in the "Total Test Defects" category, followed by the "Total Build Defects" category. The other categories (Design Defects, Specification Defects, Total Implementation Defects, and Plan Defects) account for a smaller percentage of the total defects.*

*This suggests that the main problems affecting customers are likely related to defects occurring during the testing phase and defects occurring during the build phase. These issues may be causing frustration for customers and potentially leading to dissatisfaction with the product or service.*

*To address these problems and improve customer satisfaction, it may be necessary to focus on improving the quality of the testing and build processes. This could involve implementing more thorough testing procedures, increasing the number of test cases, or improving the quality of the code*

*being written. By addressing the issues that are causing the majority of defects, we may be able to significantly reduce the number of problems affecting customers and improve their overall satisfaction with our product or service.*

#### 3.3.3. (DSS) Q-3.3: What would be the change in customer satisfaction if we reduce the total defect count?

Purpose of question : The purpose of the question is to evaluate the potential impact of reducing the number of defects in a product or service on customer satisfaction. Defects are typically a source of frustration for customers and can lead to dissatisfaction with the product or service. By reducing the number of defects, we may be able to improve the overall customer experience and increase customer satisfaction.

By answering this question, we can assess the potential benefits of reducing the defect count and determine whether it is a worthwhile goal. For example, we might find that reducing the defect count significantly improves customer satisfaction, or that it only has a minimal impact. This information can help us to prioritize efforts to improve the quality of our products or services and make informed decisions about where to focus our resources.

BI feature used : Clustered Column Chart

BI output description : Clustered Column Chart of Quality of Functionality and Meet Stated Objects with respect to Total Defects Delivered

Implementation details : I used clustered column charts to inspect the Quality of Functionality and Meet Stated Objects. I discarded the empty and non-applicable data. We can see that there is also missing data in column “1-Met to limited extent, or not at all”, and it can cause a wrong analysis. So, we will not consider that column while analyzing the charts.

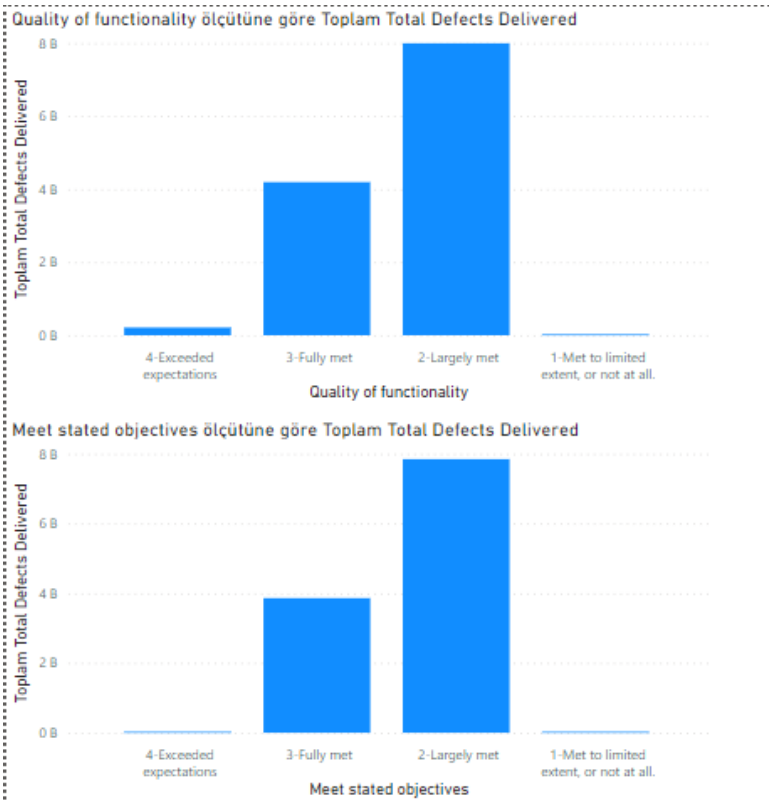


**Figure 3.3.** Quality of Functionality and Meet Stated Objectives with respect to Total Defects Delivered

*Based on the information provided in the two clustered column charts, it appears that reducing the total defect count is associated with an improvement in both the quality of functionality and the*

*ability to meet stated objectives. As the number of defects decreases, the quality of functionality and the ability to meet stated objectives both seem to increase.*

*This suggests that reducing the total defect count could have a positive impact on customer satisfaction. Customers are likely to be more satisfied with a product or service that has fewer defects, as it is more likely to function as expected and meet their needs. Therefore, reducing the total defect count could be a useful strategy for improving customer satisfaction.*

*It is worth noting that this analysis is based on the data provided in the charts and may not necessarily reflect the full range of factors that influence customer satisfaction. However, it does suggest that reducing the total defect count could be a worthwhile goal that could potentially contribute to improved customer satisfaction.*

## 4. OVERALL EVALUATION

**Table 4.** Overall evaluation of the results in BI Project

| Goal | Related Questions | Achieved or Not? | Reason of Evaluation |
|---|---|---|---|
| 1.Improving the performance of deliveries | 1.1.What is the quality of deliveries?,<br>1.2.How efficiently do we deliver?,<br>1.3.What Would Happen If We Reduce the Defects? | Achieved | Evaluating the goal of improving the performance of deliveries is important for determining the extent to which the goal has been achieved, identifying areas for improvement, and understanding the impact it has had on the organization. By collecting and analyzing data and feedback, we can assess our progress, identify any issues that need to be addressed, and understand the benefits that have been realized as a result of the improved performance of deliveries.<br><br>The goal related to improving the performance of deliveries were achieved through the analysis of the questions we posed. Specifically, we were able to identify that the quality of deliveries varies based on customer satisfaction, and that there is an optimal range of project work effort to non-project activity that leads to the most efficient deliveries. In addition, we found that reducing defects may lead to improvements in the efficiency of deliveries, as lower numbers of defects may allow for faster delivery times and minimize defects delivered in the first month of use of the software. Overall, these findings suggest that there are opportunities to improve the performance of deliveries by addressing issues related to customer satisfaction, balancing project work effort and non-project activity, and reducing defects. |
| 2. Decreasing the total project cost | 2.1. What is the cost of people related aspects?<br>2.2. What is the time cost of the project?<br>2.3. What would happen to the total project cost if project size attributes are decreased? | Achieved | It is important to evaluate the goal of reducing the total project cost for several reasons.<br><br>Firstly, evaluating the goal allows us to determine whether the changes that we have implemented have been successful in achieving the desired outcome. This can help us to identify any areas where further improvement is needed, and to adjust our strategy accordingly.<br><br>Secondly, evaluating the goal can provide valuable insights into the factors that influence the cost of the project, which can help us to optimize our |

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|---|---|---|---|
| | | | project management processes and make more informed decisions in the future.<br><br>Finally, evaluating the goal can help us to demonstrate the impact of our efforts to stakeholders, and to justify any resources that have been invested in achieving the goal. This can help to build support for our project and to secure funding for future endeavors.<br><br>From our analysis, it seems that reducing team size, prioritizing the allocation of work to more experienced team members, increasing the manpower delivery rate per person, recording work on project tasks each, and decreasing the Functional Size, Relative Size, and Lines of Code attributes may be effective in reducing the total project cost. Based on the data and our analysis, it seems that the goals of reducing the total project cost have been achieved to some extent. However, it would be beneficial to also consider other factors that may impact the cost of the project. |
| 3. Increasing the customer satisfaction | 3.1. What is the current customer satisfaction?<br>3.2. How many problems are affecting the customer?<br>3.3. What would be the change in customer satisfaction if we reduce the total defect count? | Achieved | Our goal is to increase customer satisfaction, and the evaluation is being conducted to determine if the goals that relate to the questions are being achieved. This is important because customer satisfaction is a key indicator of the success of a product or service and can have a significant impact on the overall performance and success of a business. By regularly evaluating and analyzing customer satisfaction, businesses can identify areas where they are performing well and areas where they need to improve in order to better meet the needs and expectations of their customers. This can help businesses to make informed decisions about how to allocate resources and make changes to their products, services, or processes in order to better serve their customers and achieve their goals.<br><br>Based on our analysis, it appears that customer satisfaction is currently quite high but there is still room for improvement. The main problems affecting customers seem to be related to defects occurring during the testing and build phases. Reducing the total defect count is likely to have a positive impact on customer satisfaction, as it would improve the quality of functionality and the ability to meet stated objectives. To achieve this goal, it may be necessary to focus on improving the quality of the testing and build processes. This could involve implementing more thorough testing procedures, increasing the number of test cases, or improving the quality of the code being written. Ultimately, the success of these efforts will depend on the specific details of the product or service and the needs of the customers. |

## 5. LESSONS LEARNED FROM THE PROJECT

What we learned from this BI project is the importance of using the goal-question-metric (GQM) approach when collecting and analyzing data. The GQM approach helps to ensure that the data being collected is relevant to the goals being pursued and that the appropriate metrics are being used to answer key questions. By using the GQM approach, we were able to identify specific goals, ask targeted questions, and collect and analyze data in a way that helped us to better understand customer satisfaction and the factors that are impacting it.

We also learned about the role of management information systems (MIS) in supporting decision-making within organizations. By collecting and analyzing data, MIS can help managers to make more informed decisions and identify opportunities for improvement. In this project, we used MIS to gather data on customer satisfaction and defects, which helped us to identify areas for improvement and develop strategies for addressing them.

Another lesson learned was the usefulness of decision support systems (DSS) in helping to analyze data and make informed decisions. DSS can assist with data analysis by providing tools and resources for visualizing and interpreting data in meaningful ways. In this project, we used DSS tools such as Power BI to create charts and graphs that helped us to understand the results of our analysis and identify key trends and patterns.

Overall, this BI project has provided valuable insights into the importance of collecting and analyzing data in a systematic way, and the role that MIS and DSS can play in supporting decision-making and improving performance.

## 6. REFERENCES

***[1]*** *Basili, V.R., Caldiera, G., & Rombach, H.D. (1994). The Goal Question Metric Approach.*

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*https://people.ucalgary.ca/~far/Lectures/SENG421/PDF/SENG421-03.pdf*

***[3]*** *https://powerbi.microsoft.com/en-au/*

***[4]*** *LeadingAgile. "Agile Metrics: A GQM Approach - LeadingAgile." LeadingAgile, 24 May 2017, www.leadingagile.com/2017/05/agile-metrics-gqm-approach/.*