Project II: Consulting & Customer Retention

VLBAII – System Architectures

Magdeburg Research and Competence Cluster
Workgroup Business Informatics I

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Agenda

1. Introduction
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   - 1.2. Objectives and Tasks of the project
2. System Architecture
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   - 2.2. Project architecture and components
3. Data Preparation Using BigQuery
4. Visualization of Business Trips
   - 4.1. Calculation of travel distances using Google Distance Matrix API
   - 4.2. Visualization of trips and their costs
5. Study and Recommendations for New Branch Office Location
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6. Conclusion

Overview of MWW

- Headquarters: Magdeburg
- Industry Leader: Innovation, production, talent promotion, and comprehensive services in the mobility sector.
- Departments:
  - Consulting & Customer Retention (CCR)
  - Manufacturing & Product Distribution (MPD)
  - Research & Solution Development (RSD)
  - Maintenance & Service (MS)
- Strategy: Independent yet collaborative departments for overall success.

Overview of the CCR Department

Consulting & Customer Retention (CCR)

- Key Role: Essential for MWW's success and reputation.
- Responsibilities:
  - Consulting for large dealerships and premium driving service providers.
  - Representation at trade fairs.
- Structure:
  - Divided into strategic regions with multiple branch offices.
- Objective: Ensure efficient service delivery and client engagement.

Objectives and Tasks of the project

1. The average costs for a branch office must be evaluated. Consider all given data regarding rent, personnel, maintenance costs etc.

2. Visualize the business trips of the consultants. If a client is at least a 60-minute drive away, the company allows the consultants to book an accommodation for the entire trip.

3. Investigate whether it would be sensible to open a new branch office. Use your findings from the previous tasks and try to suggest the board where a new branch could be located. You can also reason about what effect it would have had if a new branch would have been opened at the suggested location one year ago

System Architecture

The general architecture of our Project involves a layered design, including a presentation layer (Looker Studio), an application layer (Cloud Shell, API, BigQuery View & ML), and a database layer (SAP DWC & BigQuery).

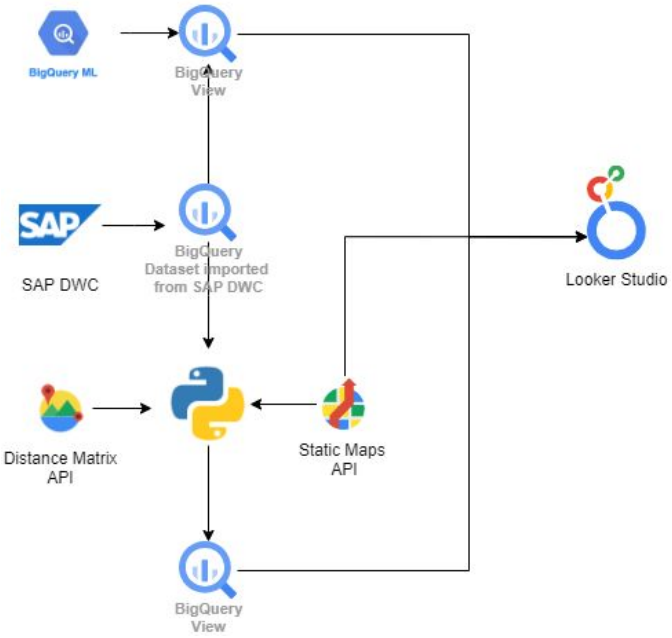

Fig: UML Diagram of System Architecture

Justification of Architecture Design Using BSP Diagram

BSP diagrams model the architecture in terms of business functions, processes required for the business function, and components used for the processes, ensuring the architecture aligns with business needs.

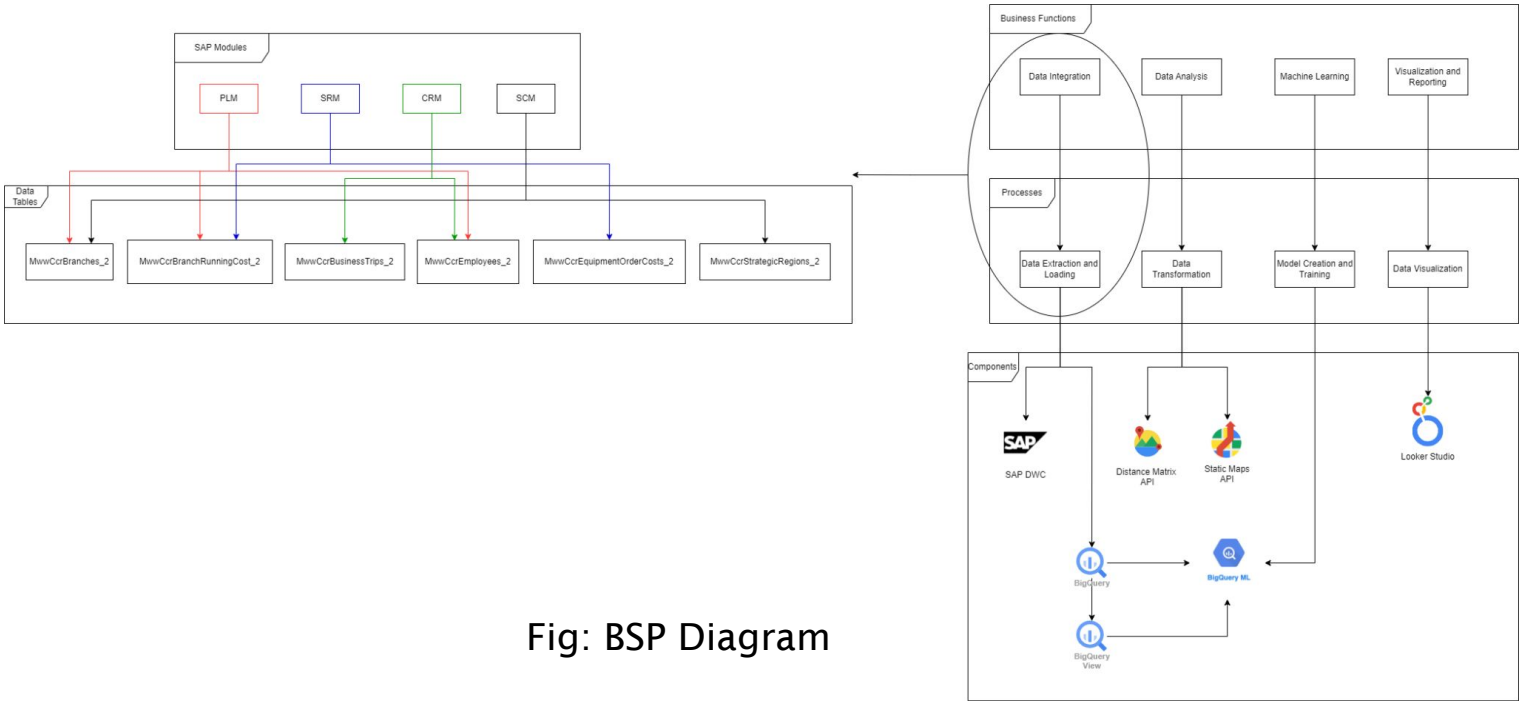

Fig: BSP Diagram

Understanding and Highlighting Cloud Patterns

Cloud patterns provide reusable solutions to common problems in cloud-based architecture. Our project architecture utilizes several cloud computing patterns to achieve its functionality.

- **Cloud Offering Patterns**: Utilized in storage (SAP DWC, BigQuery) and communication (Google Maps APIs, Looker Studio).
- **Cloud Integration Patterns**: Seen in the integration of SAP DWC data into BigQuery and the incorporation of external API data.
- **Cloud Application Architecture Patterns**: Present in the data management and presentation layers, including custom BigQuery views and Looker Studio dashboards.

Datasets

- **MwwCcrBranches_2**: Contains information on the branch offices in each region.
- **MwwCcrBusinessTrips_2**: Historical records of business trips made by employees
- **MwwCcrEmployees_2**: Details of currently employed persons, including their branch assignments.
- **MwwCcrEquipmentOrderItems_2**: Orders placed by employees for office supplies and equipment.
- **MwwCcrStrategicRegions_2**: divides Germany into regions based on postal codes.
- **MwwCcrBranchRunningCosts_2**: All costs associated with the operation of the branch offices.

Evaluation of the average costs for a branch office

Data Preparation Using BigQuery

Goal: evaluate the average costs for a branch office

Steps:

- import data to BigQuery
- Analyze the data by creating Views
- Visualization of the data using Looker Studio

Fig: Steps for Task 1

Views

several views in BigQuery to streamline the data analysis process and enhance query performance:

- branch running costs categorization and costs
- branch equipment order items categorization and costs
- total number of employees and salaries per branch
- target regions / branches
- total costs of a branch with and without trips and hotel staying
- total costs of a branch with and without trips per year

=> These views will allow us to solve the first task, and also give an overview to the board members about the costs included in a branch.

Costs Visualization

- Visualize average annual expenditures for each branch
- Provide breakdowns of specific costs such as salaries and business travel expenses
- Analyze the distribution of wage expenses among branches
- Visualize business trip expenditures
- Identify cost trends to make informed decisions on opening new branches

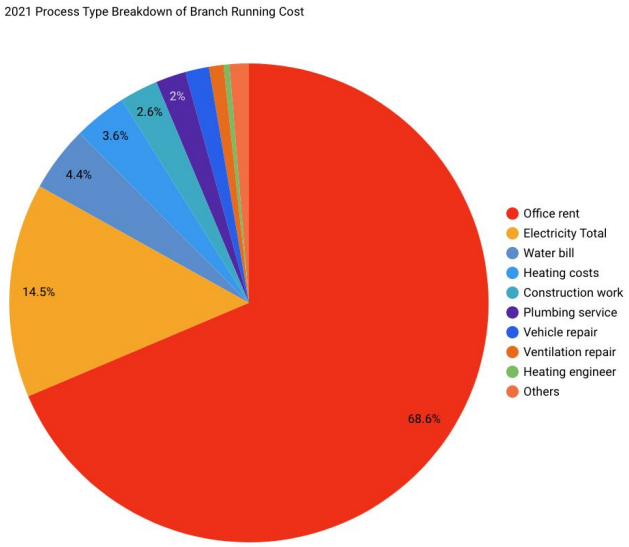

Fig: Breakdown of Branch Running Cost

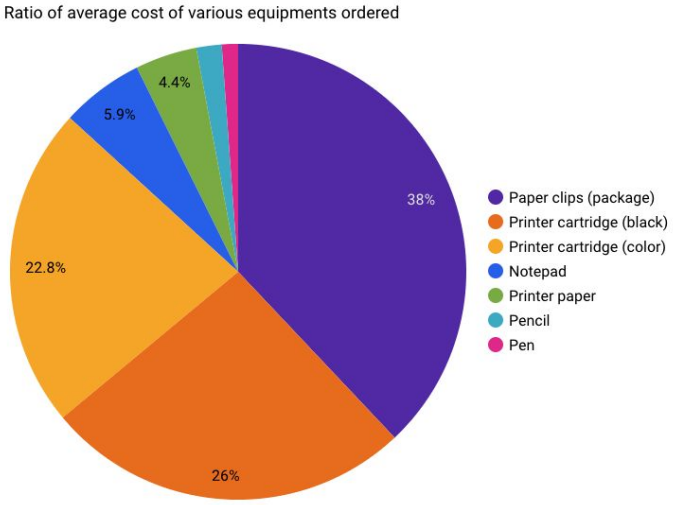

Fig: Breakdown of Equipment Order Cost

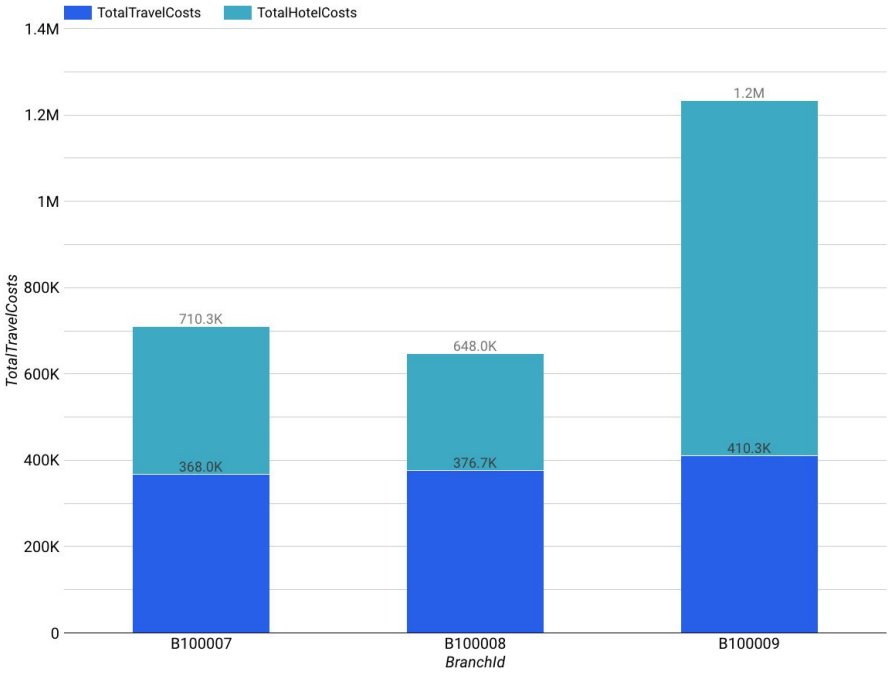

Fig: Hotel and Trip Cost

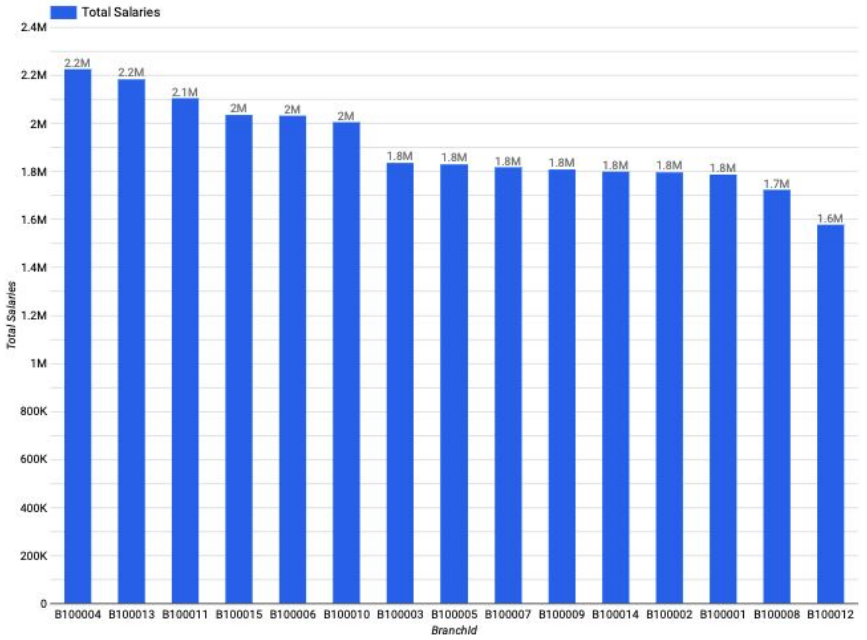

Fig: Total Salaries of Branch (2021)

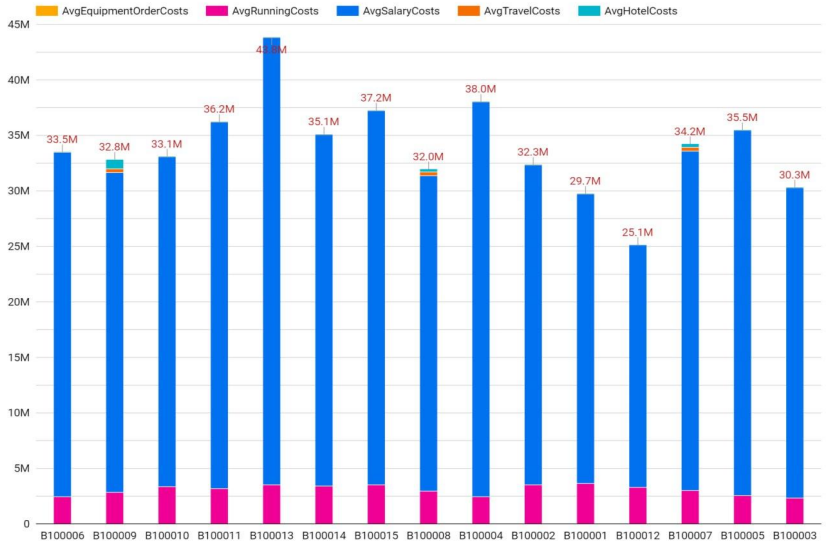

Fig: Total Average 2000-2021

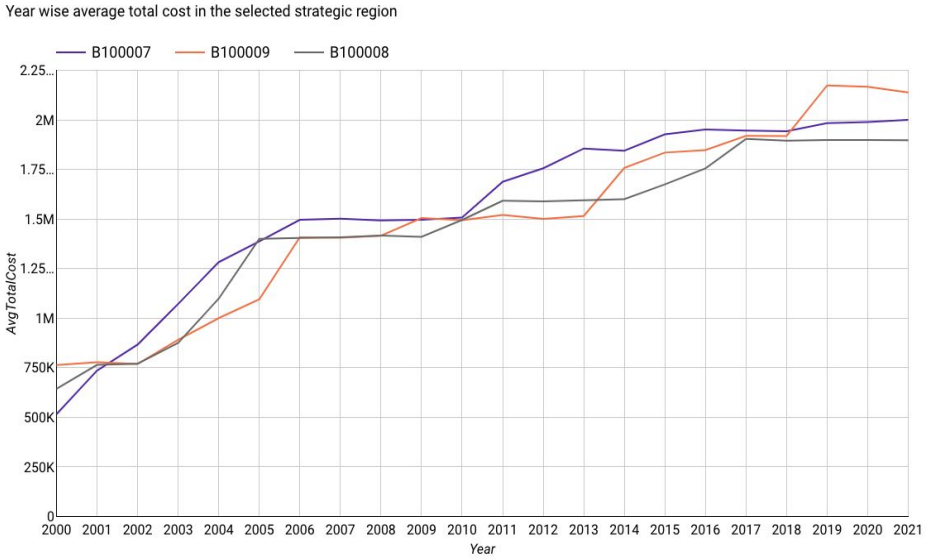

Fig: Year wise average Total Cost in the selected Strategic Region

Visualization of the business trips of the consultants

Visualization of Business trips

Steps:

- create necessary views
- import views to google cloud shell
- use Google Distance Matrix API to calculate both distance and travel time
- export the new data to bigQuery
- use Looker Studio to visualize trips

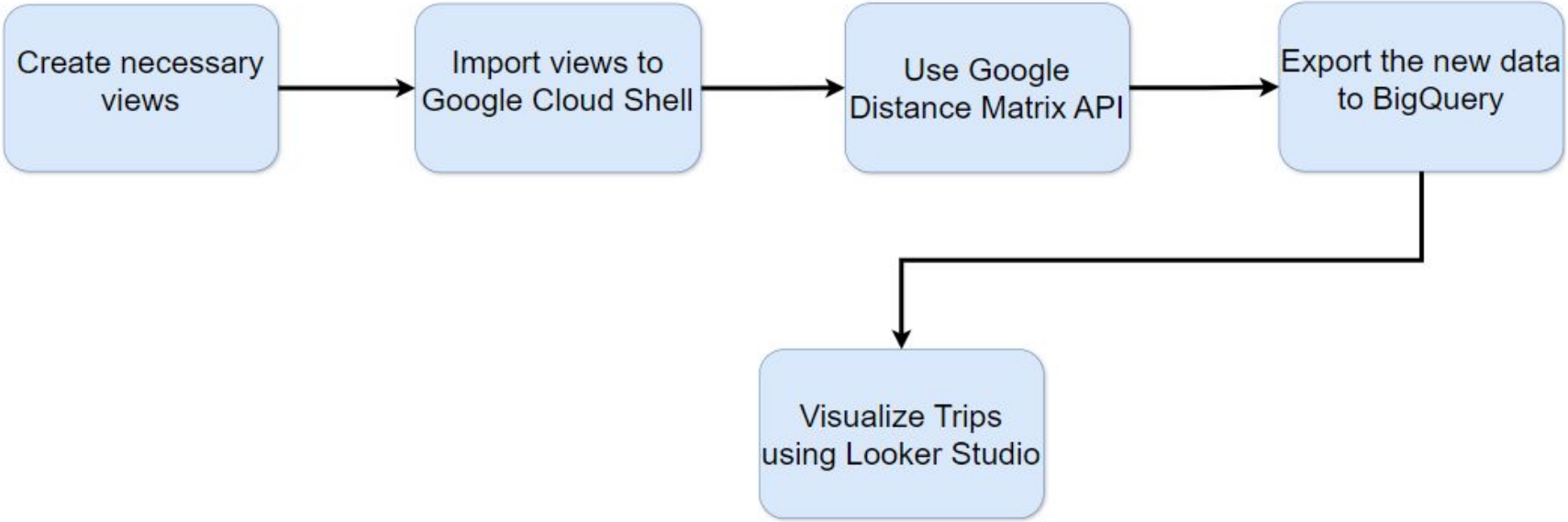

Fig: Steps for Task 2

Data Preparation

- extract the origin city with its amplitude and longitude and the destination city for each trip
- Export BusinessTripsSummaryNew to Google Cloud Shell

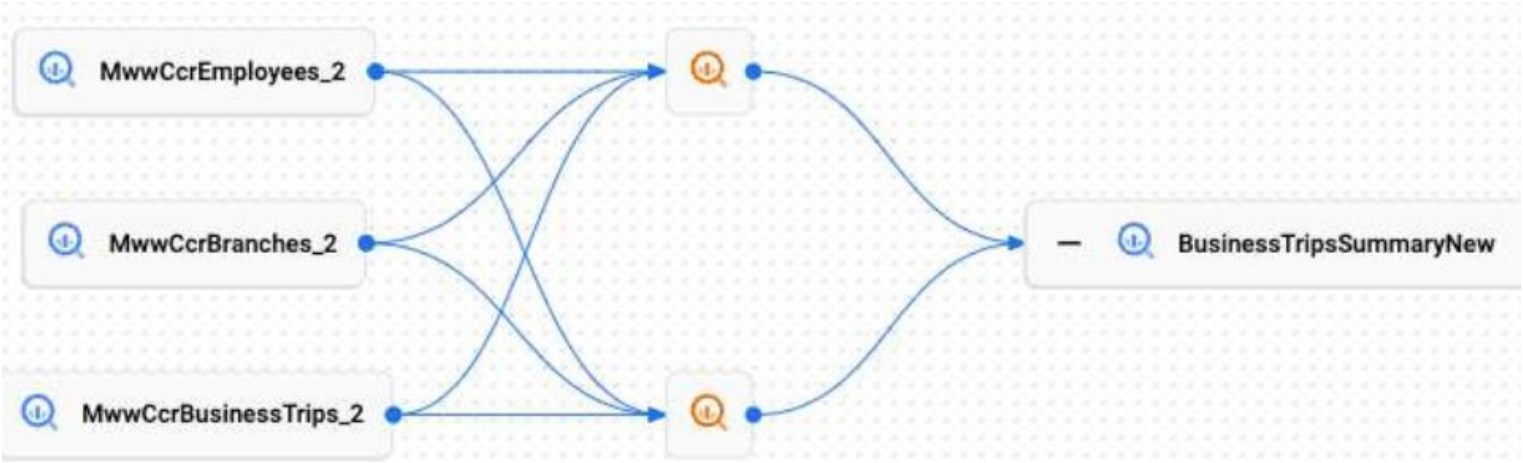

Fig: data lineage of BusinessTripsSummaryNew

distance and travel time

- The origin and destination cities are appended with ", Germany" to ensure accurate geocoding
- the latitude and longitude of the destination city are added to help in the visualisation later.
- travel times and distances are calculated for each trip
- distances are converted from meters to kilometers
- travel times are converted from seconds to minutes
- new CSV file called UpdatedBusinessTripsSummaryNew.csv is uploaded to BigQuery

Trips visualization

- Visualizing business travel data to derive actionable insights
- Efficiently visualize business travel data
- Utilize bubble maps for trip origins (BranchID)
- Analyze destination density with heat maps
- Assess travel and lodging expenses with cost distribution maps
- Optimize branch locations based on insights

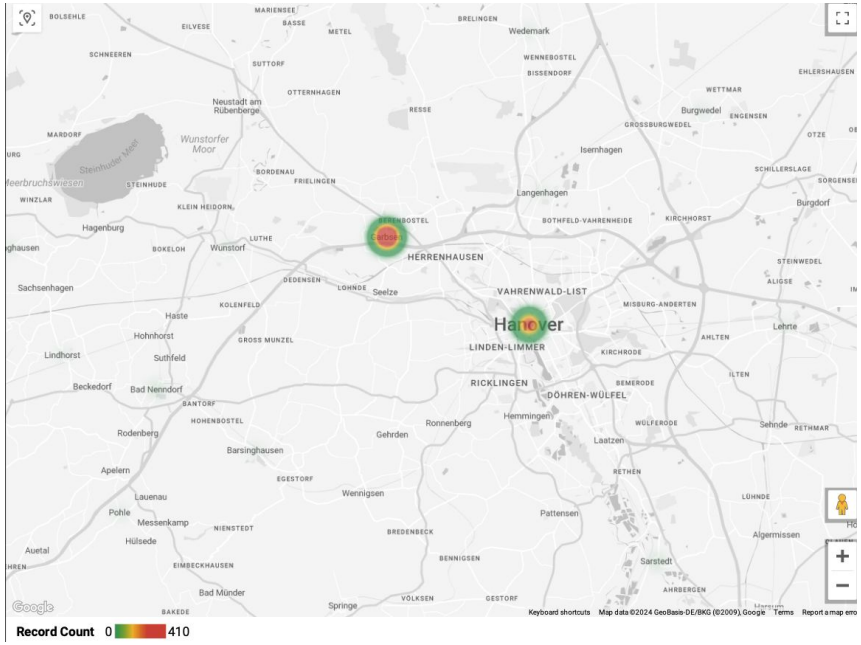

Fig: Heat Map Visualization

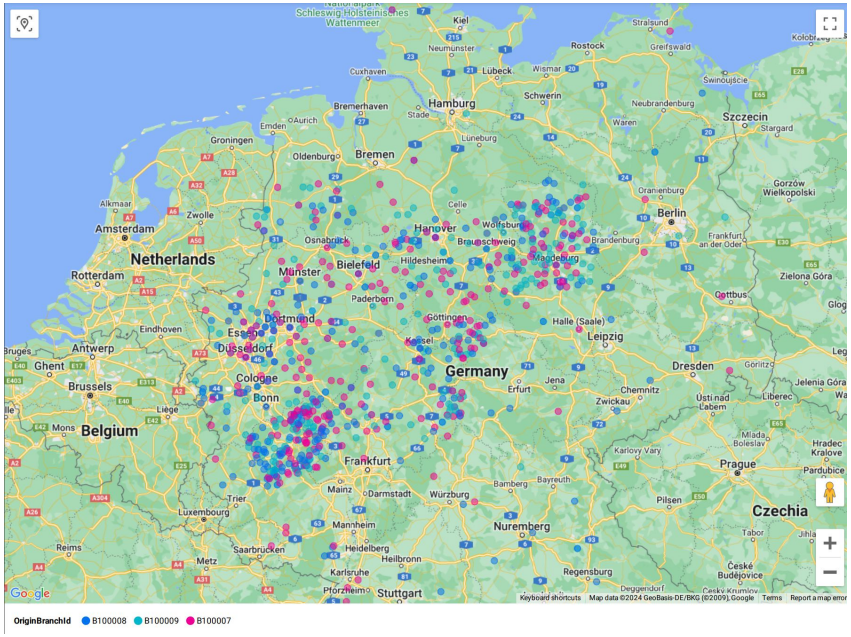

Fig: Bubble Map Visualization

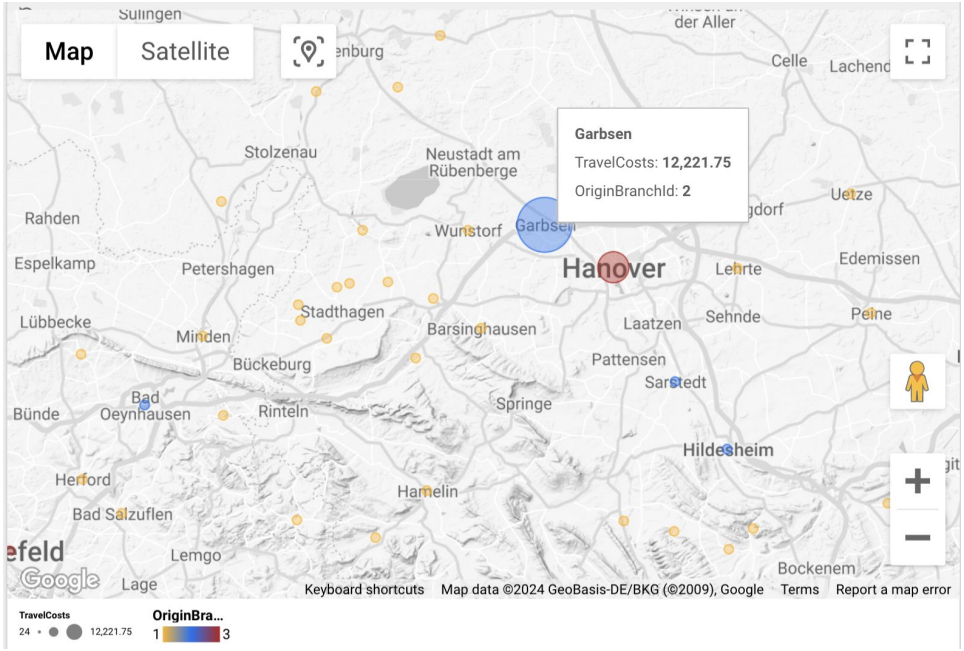

Fig: Travel Cost Distribution

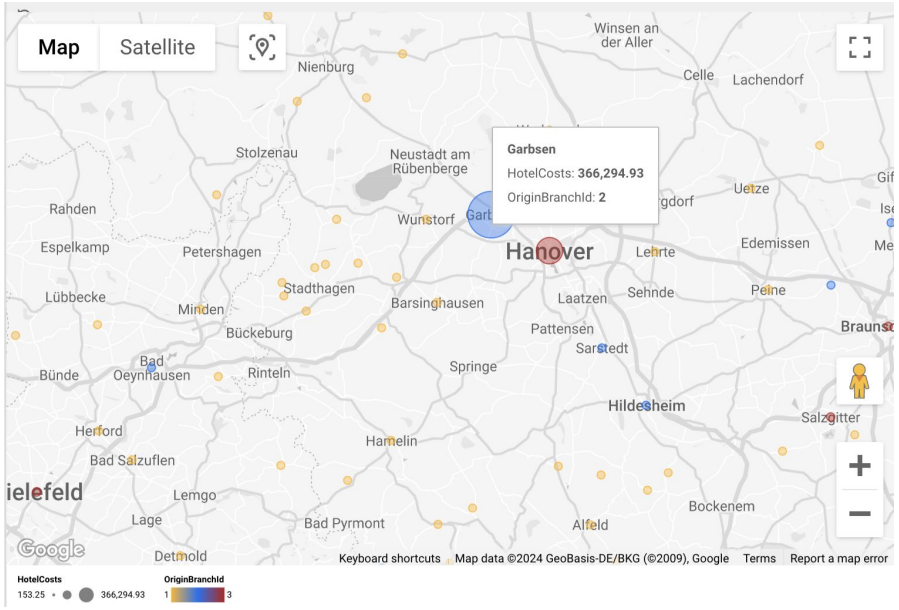

Fig: Hotel Cost Distribution

Feasibility Study and Recommendations for New Branch Office Location

Analyzing Business Trip Data

Destination City	total trips
Garbsen	410
Hanover	196
Cologne	19
Essen	15

=> Garbsen and Hanover are prime candidates for opening a new branch office

New Branch Office in the Hannover/Garbsen

- **Approach 1: Direct Cost Comparison**

- We first compared the average running costs of our existing branches (B100007, B100008,B100009) for the latest year ,2021 with the combined travel and hotel costs incurred for trips to Garbsen and Hanover in 2021.

- Existing Branches: The average running cost for these branches for the year 2021 was 157.266K

Fig: Average value of running costs(B10007,B10008,B10009) for the year 2021

New Branch Office in the Hannover/Garbsen

- Garbsen and Hanover:
  The total travel and hotel costs for these cities in 2021 amounted to 165.426K (see Figure 5.3). This figure represents a significant financial burden associated with serving clients in this region.

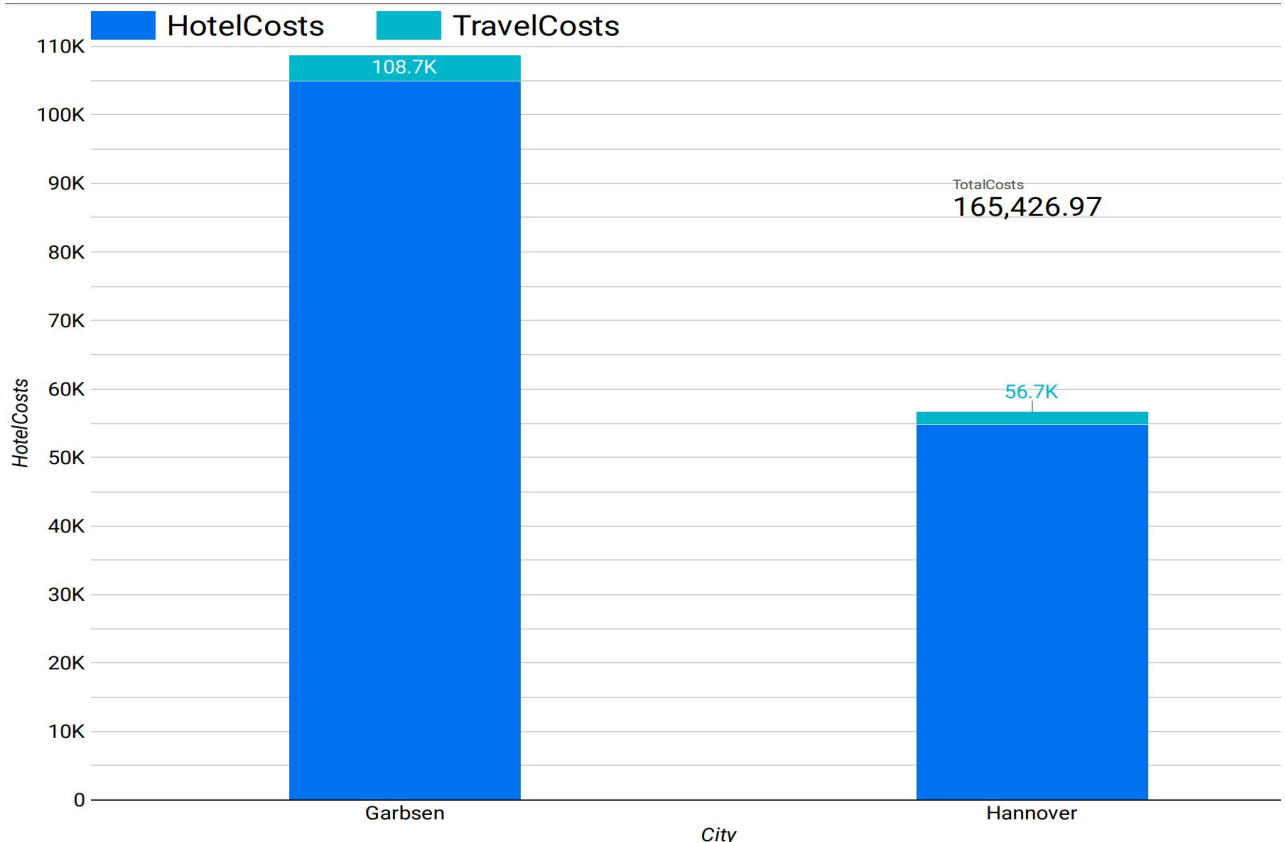

Fig: Total trip costs(Hotel+Travel) for Hanover and Garbsen region for the year 2021

New Branch Office in the Hannover/Garbsen

- Approach 2: Comparison with ML predicted value
- Machine Learning Model in BigQuery ML
- Model Creation:
  - Type: Linear Regression
  - Target: Average Running Cost (AvgRunningCost)
  - Training Data: Running Costs from branches B100007, B100008, B100009 (2000-2021)

- Predicted Average Running Cost for New Branch
- New Branch: B100016
- Year: 2022

Key Findings:

- Predicted

Running Costs: For new branch B100016: 153.9K

- Comparison:

Combined Travel and Hotel Costs for Hannover and Garbsen (2021): 165.4K

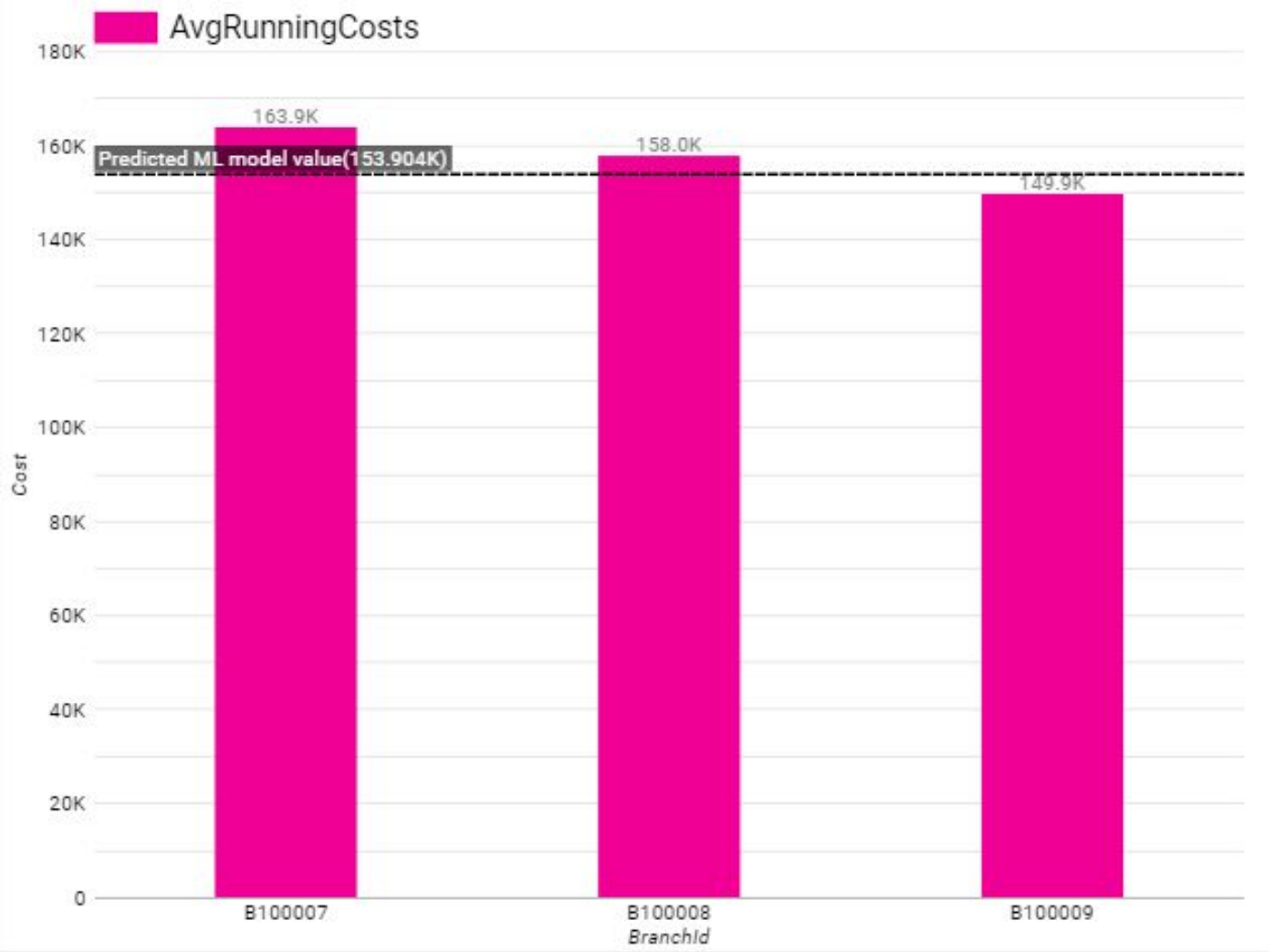

Fig: Average Running Costs(B10007,B10008,B10009) for the year 2021

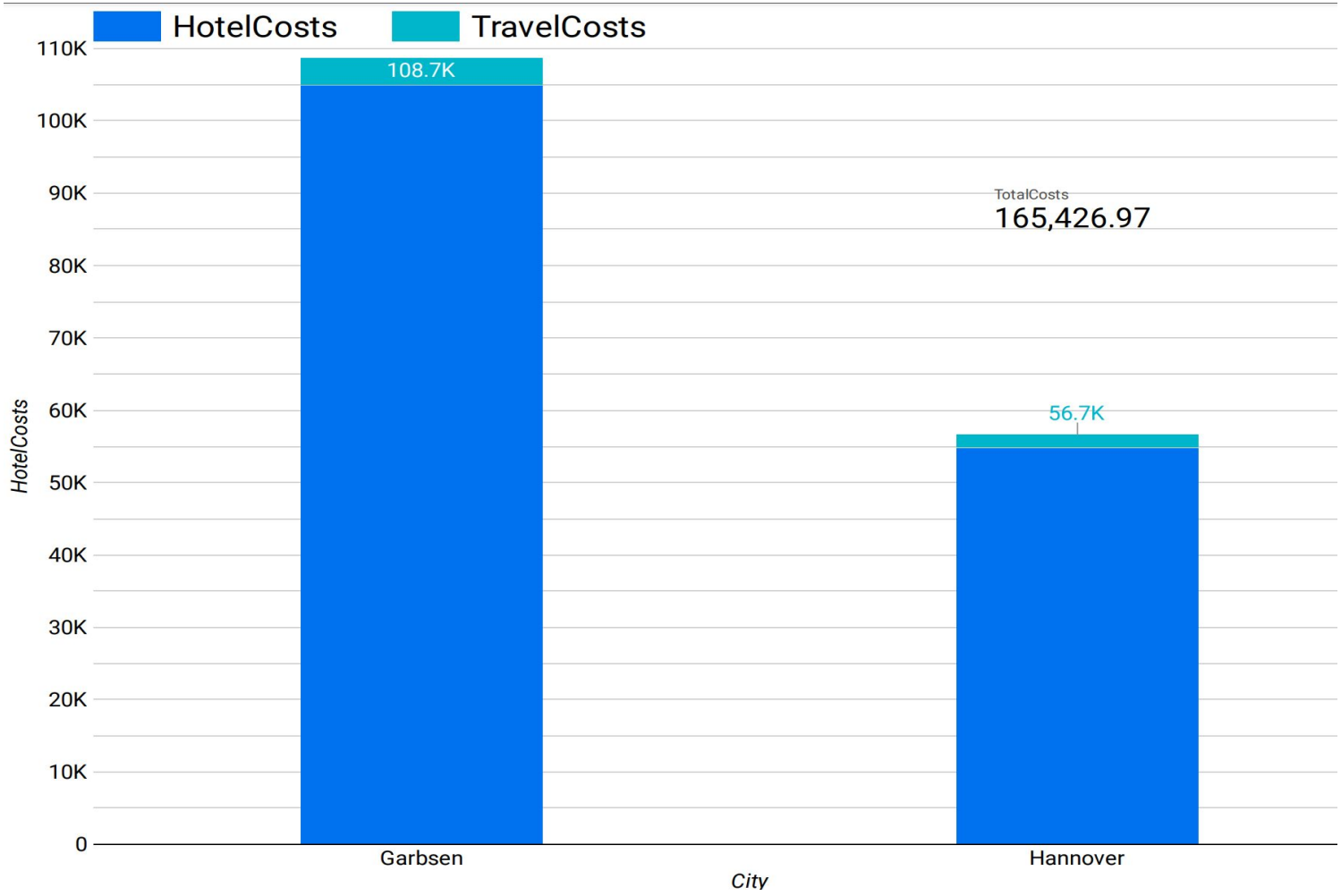

Fig: Average Running Costs(B10007,B10008,B10009) for the year 2021

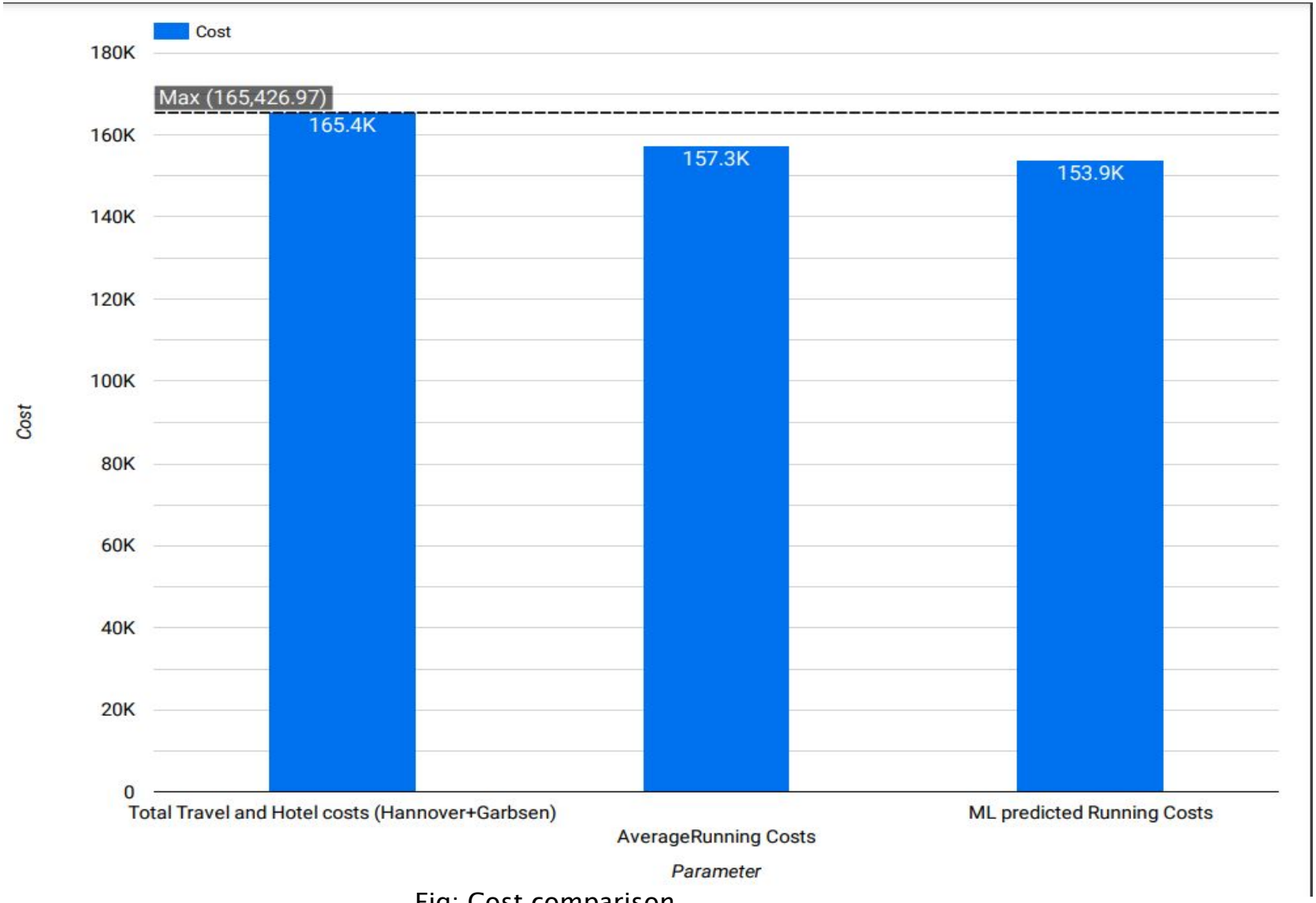

Fig: Cost comparison

Branch Office Location

- two candidates cities to open the new branch
- Distance between Garbsen and Hanover is 12.69 km
- driving time 18 minutes

=> open a branch only in Garbsen

- 2 approaches to calculate cost savings of opening a new branch:
  - Native Approach
  - Machine Learning Approach (using clustering)

Native Approach

- calculate the driving distance and time between Garbsen and various other cities listed in MwwCcrBusinessTrips2

- the number of cities and their trip costs with driving times less than 60 minutes from Garbsen

  => more than 42 cities

  => a branch in Garbsen will save approximately 165427 euro in total in the year 2021

Clustering Approach

- Used K-means clustering to find optimal location for the new branch.
- Historical data of business trips along with the coordinates obtained from using distance matrix api was used to cluster the business trips to 5 clusters.
- Identified the cluster with highest number of locations.
- Centroid of this cluster (2.392908618435023, 9.55142128527852) is was proposed as the optimal location for the new branch which happens to be in Garbsen itself.

Clustering Approach

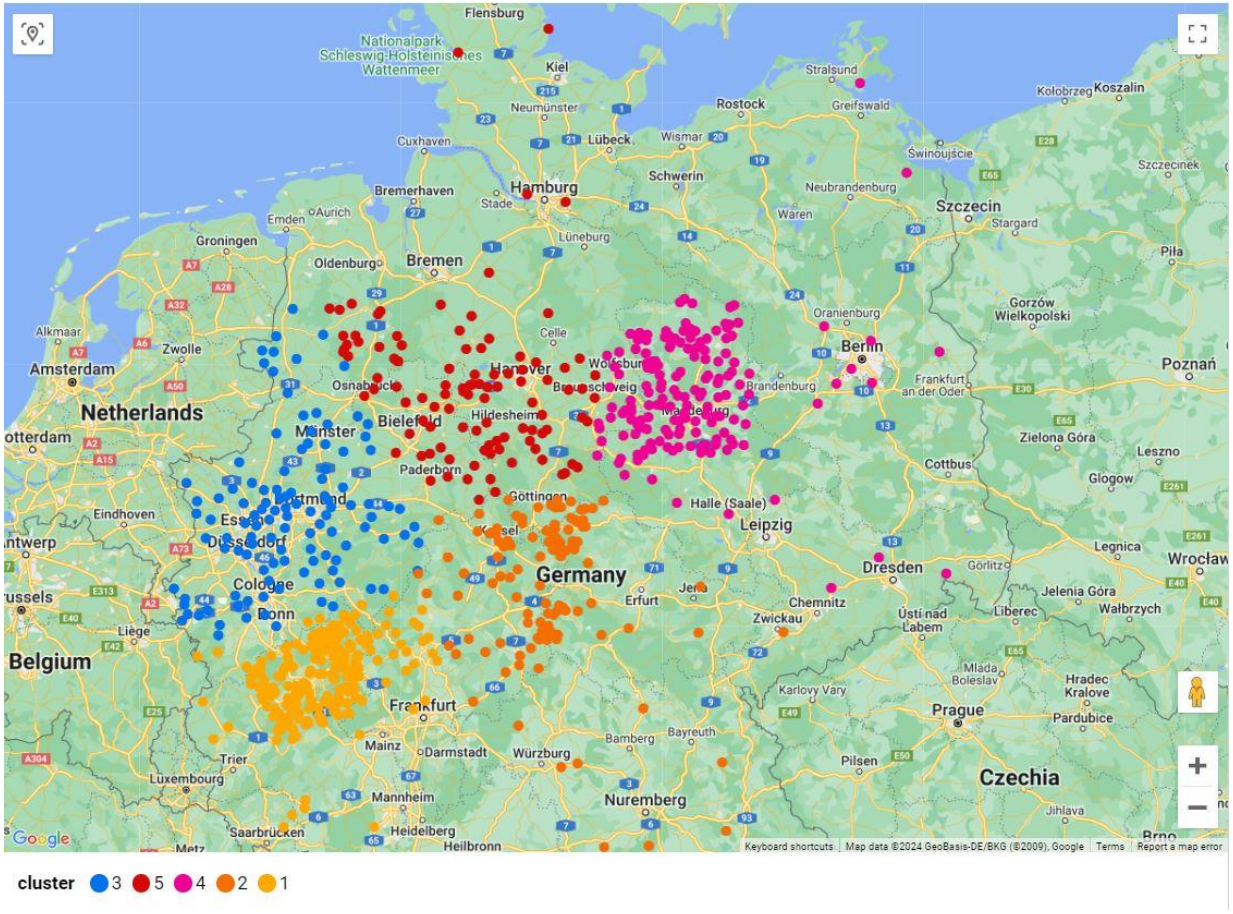

Fig : Clustering of client Locations using K-means clustering

Cities close to Centroid (Garbsen)

- From the above cluster centroid, we calculated the distance and travel time between centroid (Garbsen) and various cities around Garbsen.

- We filtered those cities which were within 60 minutes drive around Garbsen. These cities could be potentially served while opening a new branch at Garbsen.

- The filtered locations around Garbsen was then used to visualise using Google Maps Static API

Clients close to Centroid

Key Findings:

- more than 42 Cities close to Centroid
- Centroid is too close to Garbsen
- Garbsen is the new branch office for MWW

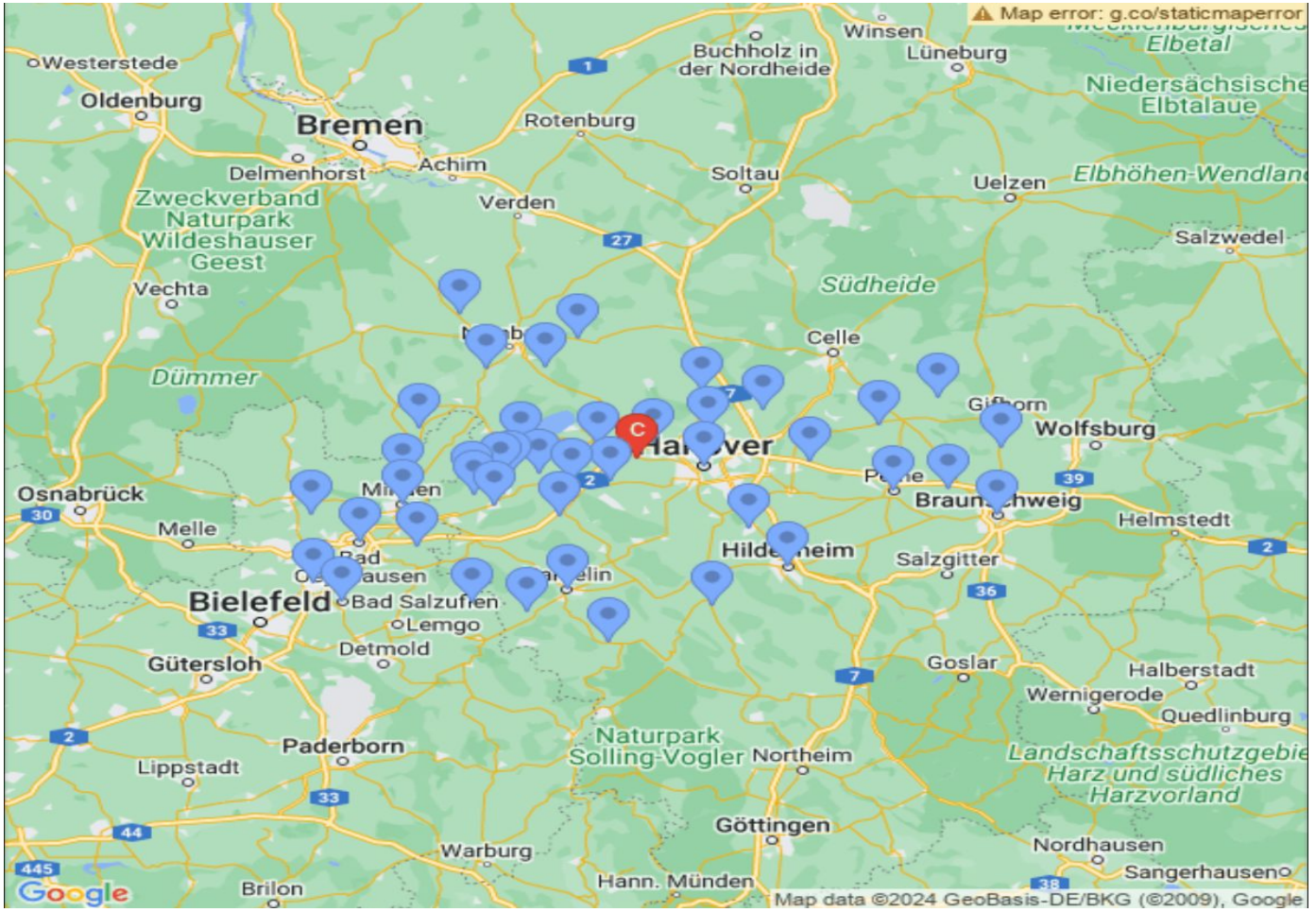

Fig: Map visualization using google map API

Conclusion

- This project examines Mobility Worldwide's Consulting & Customer Retention (CCR) department
- Average costs for a branch
  - differs from region to another
  - various factors
- Business Trips
  - Direct Cost Comparison
  - Predictive Cost Modeling
  - Garbsen and Hanover have the highest number of business trips.
  - Garbsen is within a 60-minute drive of many destinations.
- Cost Savings
  - Opening a branch in Garbsen can significantly reduce travel costs and time
  - If it was potentially opened in the last year it could have save upto 165427 €
  - save more with the new branch located located close to 42 client locations