

## **1. Hypothesis Development**

This study proposes several research hypotheses regarding the factors influencing consumer acceptance of electric vehicles.

The electric vehicle market is dominated by globally established players such as Tesla (US), BYD (China), BMW (Germany), Volkswagen (Germany), and Nissan (Japan). These companies developed new products, adopted expansion strategies, and worked on acquisitions to gain traction in this high-growth electric vehicle market.

The future is expected to be bright and with time technological improvements and developments, the electric vehicles can be more affordable. The electric vehicles provide several advantages, such as a higher efficiency in energy use and reduction in emissions and the energy needed to power the vehicle can easily be obtained from any electricity source. However, electric vehicles only have a limited distance which can be driven before the battery is depleted and recharging the battery can take a substantial amount of time. Furthermore, the battery packs are heavy and are considerably expensive (Argueta and Holms 2010).

The adoption of electric vehicles is impacted by several factors such as customer attitude, subject knowledge, government norms, cost savings, charging stations, driving range, safety features, technology development and market share.

### **1.1 Purchase Intention**

Purchase intention refers to the customers' ability and necessity to purchase based on certain factors and can be measured on the possibility of purchasing. Some of the factors determining purchasing intentions are customers attitude, knowledge, government norms. The customer attitude includes the external influence of society and people feedback on purchases. The influence can also be internal (family, friends) and external (media, expert opinions). Government norms include allowance on income tax, discounts on purchases, allowances on parking, preferences on HOV lanes

***Hypothesis 1:*** Consumers attitude toward self-driving/electric vehicles has a positive impact on their purchase intention.

***Hypothesis 2:*** Consumers subjective knowledge regarding self-driving/electric vehicles has a positive impact on the purchase intention.

***Hypothesis 3:*** Government norms on electric vehicles has a positive impact on purchase intention

## **1.2 Cost Savings**

Lane and Potter (2006), mentions that purchase price is a deciding factor in determining vehicle acceptance. Now with Tesla's model starting as low as \$20,000 and to factor in the savings on fuel/gas, the cost savings on purchasing the electronic vehicles can have an effect on customers.

***Hypothesis 4:*** Annual cost savings have a positive effect on purchase intention

## **1.3 Charging Stations**

Charging stations are absolutely essential for an electric vehicle. Without a charging station you cannot charge your battery and in particular, public charging stations are very important. There are several barriers for public charging stations such as regulatory uncertainty, a lack of infrastructure and high cost.

***Hypothesis 5:*** Charging station accessibility has a negative effect on electric vehicle purchase

***Hypothesis 6:*** Regular charging time has a negative effect on electric vehicle purchase

## **1.4 Driving Range**

Driving range is another factor influencing electric vehicle adoption and purchasing decision. Most drives are being afraid of battery depletion before arriving at the destination and hence choose to use electric vehicle for normal range drives and avoid them for road trips and vacations

***Hypothesis 7:*** Driving range has a positive effect on electric vehicle purchase

## **1.5 Safety Features**

Customers interest in adopting enhanced safety/automation features plays a role in their vehicular purchase.

Customers driving history also plays a factor in deciding on the safety features of the car.

***Hypothesis 8:** Safety Features on the vehicle has a positive effect on electric vehicle purchase*

## **1.6 Research and Technology Development**

While some of the safety features are currently only available in high-end models, the preferences about adding enhanced safety/automation features to enhance their driving experience will be included in the study.

The battery has seen clear technological improvements, thereby making it cheaper, lighter and giving it a bigger range. Technological developments as well as economies of scale could play a factor in improved sales of electric vehicles.

***Hypothesis 9:** Technology improvements has a positive effect on electric vehicle purchase*

## **1.7 Market Share**

The number of employees and revenue per employee can affect the growth/market share of a company. The more number of employees, more research and marketing can be performed, and this can have a positive impact on the technical improvements for the product

***Hypothesis 9:** Employee share has positive impact on market growth*

## **2. Methodology:**

### **2.1 Research Design:**

The research design is a framework for planning the research and answering the research questions.

A very significant decision in research design process is the choice to be made regarding research approach since it determines how relevant information for a study will be obtained. This empirical analysis majorly involves Correlational and Comparative research design to derive at the hypothesis.

We need primary data (through online survey) using random sampling method as well as secondary data (through statistics and publications available online). This study employs a mixed type of sources including well-structured questionnaire (online survey) along with secondary data from online sources.

The variables required for each hypothesis is mentioned in the below data collection phase. The participants for our online survey would be students, friends, professors and colleagues. The estimated timescale for this research to complete would be 5-6 months.

Few examples of online survey questionnaire would be:

1. Demographics question (such as age, gender, annual income)
2. Are you presently using self-driving vehicle or EV?
3. Are you familiar with self-driving vehicle or EV?
4. Commute characteristics (such as total time spent on commute per day, commonly used mode for various trips)
5. Crash history (such as vehicular damage level, injury severity level)
6. Will you buy an EV because it saves cost from better fuel economy and has positive environmental impact?

Few online sources referred for data collection:

<https://www.marketwatch.com/investing/stock/tsla/financials/cash-flow>

<https://evadoption.com/ev-market-share/ev-market-share-state/>

<https://evadoption.com/research-statistics/>

## **2.2 Data Collection:**

After deciding the kind of data needed, we will have to decide how and where we will collect it, and this involves the process of data collection. For the purposes of this research, we will be collecting data through an online survey with at least 150-200 respondents, along with secondary data.

### ***2.2.1 Purchase Intention:***

*Factors influencing consumers to buy an electric vehicle or self-driving vehicle:*

This section elicited consumer demographics (such as age, gender, annual household income range, place they live in) , information regarding their current commute characteristics (such as total time spent on commute per day, commonly used mode for various trips, number of vehicles in the household) and user's attitude towards electric and autonomous vehicles. The influence to own an electric or self-driving vehicle can be formed by internal and external factors, like knowledge about the technology or words from friends and family, to the media marketing and government incentives. To extend as an example, certain attitudes like the thought of helping out to ease global warming by driving an electric vehicle or being interested in the technology and to be invested in the future of automotive industry can make a consumer lean towards purchase of electric or autonomous vehicles. This data can be collected through an **online survey** with close-ended questionnaire.

### ***2.2.2 Cost Savings: Do EV drivers enjoy saving money & the planet with their vehicles:***

We can derive this through **online survey** using closed-ended questionnaire by gathering information regarding their opinion on buying an electric vehicle because they consider that it saves cost from better fuel economy, does it have less dependence on non-renewable resources and positive environmental impact.

### ***2.2.3 Charging Stations: Purchase of electric vehicle vs charging stations:***

This section involves usage of both secondary data and data from *online survey*. We would be using number of charging stations in each state that has been published in the *secondary data sources* and the geographic data from the *online survey (place they live in)*, we will be able to produce a relationship between purchase of electric vehicles in particular state is dependent on charging stations.

### ***2.2.4 Driving Range:***

Using information regarding their current commute characteristics (such as total time spent on commute per day, commonly used mode for various trips) from the *online survey* using closed-ended questionnaire, we will be able to arrive at the hypothesis.

### ***2.2.5 Safety Features: Consumer perception on safety and benefits of autonomous vehicles:***

This section extracts the information using *online survey*, using information such as user's familiarity with autonomous vehicles, safety rating scale, their crash history (such as vehicular damage level, injury severity level) using closed-ended questions with a rating scale and if they are familiar then the other information regarding benefits can also be gathered through *online survey* by considering features (such as fewer traffic crashes, less stressful driving experience, more productive use of travel time, lower car insurance rates, increased fuel efficiency, lower vehicle emissions). This can also be performed using closed-ended questions using options (like unlikely, unsure, likely)

### ***2.2.6 Research and Technology Development:***

This section extracts the information using *online survey* by asking questions like what would make one more interested in an electric vehicles or autonomous vehicles would help arrive at the results. These would include variables like range, charging speed, quite comfort, speed, continuous software updates to driving technology.

### ***2.2.7 Market Share: Study on how market share is affected by financial variables***

Using *secondary data* from online, we can generate a report on how the number of employees and revenue per employee will be affecting the market share of a company in the self-driving market (considering 3-4 companies like Tesla, Toyota, Volvo)

## **2.3 Data Analysis:**

To answer the research questions, we will have to analyze the collected data and the type of analysis would differ for each hypothesis. We will be using applications like Excel or SPSS to analyze our data. We are collecting data through survey and working also along with secondary data to arrive at conclusions. This would mean that we need to perform quantitative and qualitative analysis based on the variables considered for each hypothesis.

Using variables that reflect peoples' opinion in relation to cost savings, driving range and perception of safety would lean more towards Qualitative analysis. While using number of vehicles, employees and market share would require quantitative analysis as well.

### ***2.3.1 Purchase Intention:***

For this purpose, we will have to perform quantitative and qualitative analysis because it involves both numeric data and words.

### ***2.3.2 Cost Savings:***

As it involves opinions about electric vehicles which contains only words as data from the online survey, this can be performed using qualitative analysis.

### ***2.3.3 Charging Stations:***

As this will have number of charging stations in numeric data and also involves words as data, for the location, we need to use both qualitative and quantitative analysis.

### ***2.3.4 Driving Range:***

As this includes commute characteristics which will have both numeric data and words, therefore we will need to perform both qualitative and quantitative analysis.

### 2.3.5 Safety Features:

This section includes rating scale which would be numeric data as well as opinions about benefits which will be words and hence, we need to perform both qualitative and quantitative analysis

### 2.3.6 Research and Technology Development:

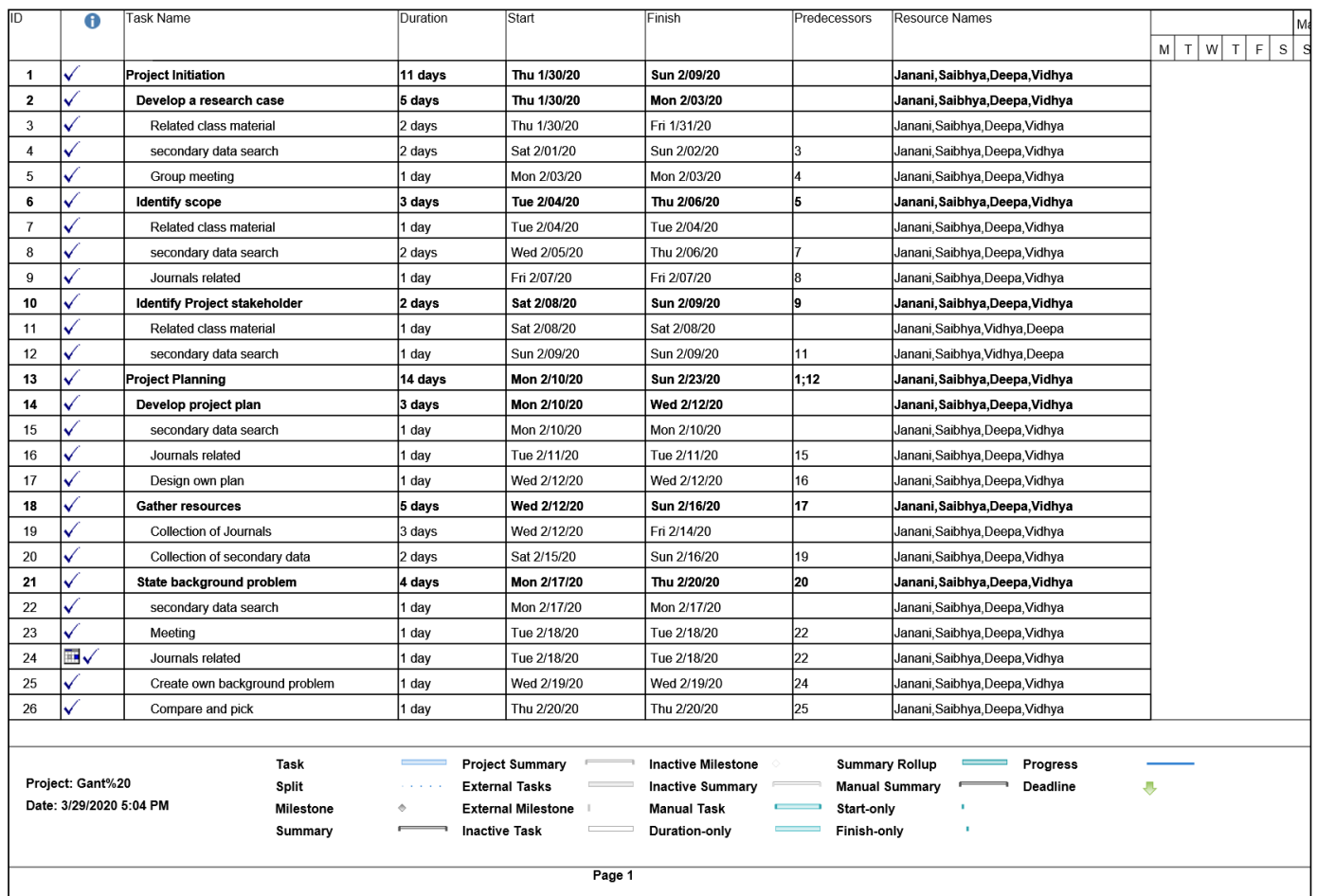
This section majorly includes analyzing words so we will be performing qualitative analysis.

### 2.3.7 Market Share:

This focuses on numeric data and statistical methods to generate a report hence we will be using quantitative analysis for this purpose.

## 3. Appendix:

### 3.1 Gantt Chart:





| ID |   | Task Name                 | Duration | Start       | Finish      | Predecessors | Resource Names                 | M | T | W | T | F | S | S |
|----|---|---------------------------|----------|-------------|-------------|--------------|--------------------------------|---|---|---|---|---|---|---|
| 27 | ✓ | Define Objectives         | 3 days   | Fri 2/21/20 | Sun 2/23/20 | 26           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 28 | ✓ | secondary data search     | 1 day    | Fri 2/21/20 | Fri 2/21/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 29 | ✓ | Journals related          | 1 day    | Sat 2/22/20 | Sat 2/22/20 | 28           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 30 | ✓ | Create own define         | 1 day    | Sun 2/23/20 | Sun 2/23/20 | 29           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 31 | ✓ | Submission of phase 1     | 1 day    | Sun 2/23/20 | Sun 2/23/20 | 29           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 32 | ✓ | Project Implementation    | 35 days  | Mon 2/24/20 | Sun 3/29/20 | 13,31        | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 33 | ✓ | Brief team work           | 1 day    | Mon 2/24/20 | Mon 2/24/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 34 | ✓ | Group meeting             | 1 day    | Mon 2/24/20 | Mon 2/24/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 35 | ✓ | Assign the next step work | 1 day    | Mon 2/24/20 | Mon 2/24/20 | 34           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 36 | ✓ | Monitor quality of work   | 4 days   | Tue 2/25/20 | Fri 2/28/20 | 35           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 37 | ✓ | send email to professor   | 1 day    | Tue 2/25/20 | Tue 2/25/20 |              | Janani                         |   |   |   |   |   |   |   |
| 38 | ✓ | Meeting                   | 1 day    | Tue 2/25/20 | Tue 2/25/20 | 37           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 39 | ✓ | Revise it                 | 1 day    | Fri 2/28/20 | Fri 2/28/20 | 38           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 40 | ✓ | Develop hypothesis        | 14 days  | Sat 2/29/20 | Mon 3/16/20 | 39           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 41 | ✓ | secondary data search     | 7 days   | Sat 2/29/20 | Fri 3/06/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 42 | ✓ | Journals related          | 7 days   | Fri 3/06/20 | Thu 3/12/20 | 41           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 43 | ✓ | write own hypothesis      | 4 days   | Fri 3/13/20 | Mon 3/16/20 | 42           | Janani, Deepa                  |   |   |   |   |   |   |   |
| 44 | ✓ | Group meeting             | 1 day    | Mon 3/16/20 | Mon 3/16/20 | 43           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 45 | ✓ | Research Methodology      | 13 days  | Tue 3/17/20 | Thu 3/26/20 | 44           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 46 | ✓ | secondary data search     | 5 days   | Tue 3/17/20 | Sat 3/21/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 47 | ✓ | Journals related          | 5 days   | Sun 3/22/20 | Thu 3/26/20 | 46           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 48 | ✓ | Meeting                   | 1 day    | Tue 3/24/20 | Tue 3/24/20 | 46           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 49 | ✓ | Group meeting             | 1 day    | Wed 3/25/20 | Wed 3/25/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 50 | ✓ | Create a survey           | 2 days   | Wed 3/25/20 | Thu 3/26/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 51 | ✓ | WBS and Gantt chart       | 3 days   | Fri 3/27/20 | Sun 3/29/20 | 50           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 52 | ✓ | Create WBS                | 2 days   | Fri 3/27/20 | Sat 3/28/20 |              | Deepa                          |   |   |   |   |   |   |   |

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Task

Split

Milestone

Summary

Project Summary

External Tasks

External Milestone

Inactive Task

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Manual Task

Duration-only

Summary Rollup

Manual Summary

Start-only

Finish-only

Progress

Deadline

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| ID |   | Task Name                             | Duration | Start       | Finish      | Predecessors | Resource Names                 | M | T | W | T | F | S | S |
|----|---|---------------------------------------|----------|-------------|-------------|--------------|--------------------------------|---|---|---|---|---|---|---|
| 53 | ✓ | Create Gantt chart                    | 2 days   | Fri 3/27/20 | Sat 3/28/20 |              | Vidhya                         |   |   |   |   |   |   |   |
| 54 | ✓ | Risk Breakdown Structure and Register | 1 day    | Sun 3/29/20 | Sun 3/29/20 | 53           | Saibhya                        |   |   |   |   |   |   |   |
| 55 | ✓ | Submission of phase 2                 | 1 day    | Sun 3/29/20 | Sun 3/29/20 | 53           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 56 | 🚫 | Survey                                | 25 days  | Mon 3/30/20 | Thu 4/23/20 | 32;55        | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 57 | 🚫 | Data collection                       | 16 days  | Mon 3/30/20 | Tue 4/14/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 58 | 🚫 | Submission of survey                  | 1 day    | Mon 3/30/20 | Mon 3/30/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 59 | 🚫 | Send survey out for responses         | 2 days   | Tue 3/31/20 | Wed 4/01/20 | 58           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 60 | 🚫 | Wait for responses                    | 15 days  | Tue 3/31/20 | Tue 4/14/20 | 58           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 61 | 🚫 | Data analytics                        | 9 days   | Wed 4/15/20 | Thu 4/23/20 | 60           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 62 | 🚫 | Export data from Qualtrics            | 1 day    | Wed 4/15/20 | Wed 4/15/20 |              | Vidhya                         |   |   |   |   |   |   |   |
| 63 | 🚫 | Manage data                           | 3 days   | Thu 4/16/20 | Sat 4/18/20 | 62           | Janani, Saibhya, Deepa         |   |   |   |   |   |   |   |
| 64 | 🚫 | Analysis data                         | 5 days   | Sun 4/19/20 | Thu 4/23/20 | 63           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 65 | 🚫 | Closure                               | 10 days  | Fri 4/24/20 | Sun 5/03/20 | 56;64        | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 66 | 🚫 | Draw conclusion                       | 3 days   | Fri 4/24/20 | Sun 4/26/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 67 | 🚫 | Create executive solution             | 4 days   | Mon 4/27/20 | Thu 4/30/20 | 66           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 68 | 🚫 | Document project                      | 3 days   | Fri 5/01/20 | Sun 5/03/20 | 67           | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |
| 69 | 🚫 | Submission of final report            | 1 day    | Sun 5/03/20 | Sun 5/03/20 |              | Janani, Saibhya, Deepa, Vidhya |   |   |   |   |   |   |   |

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Task

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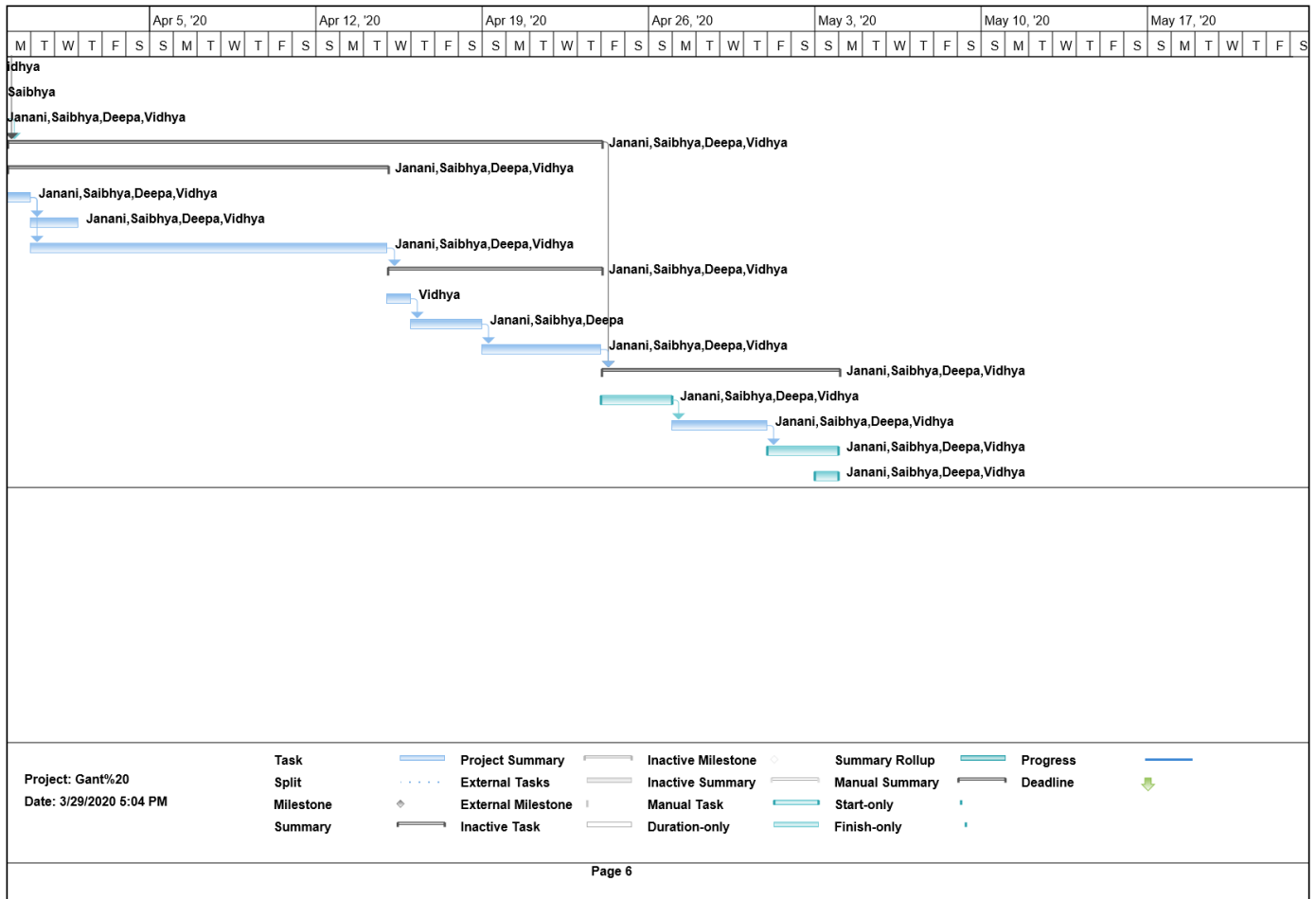
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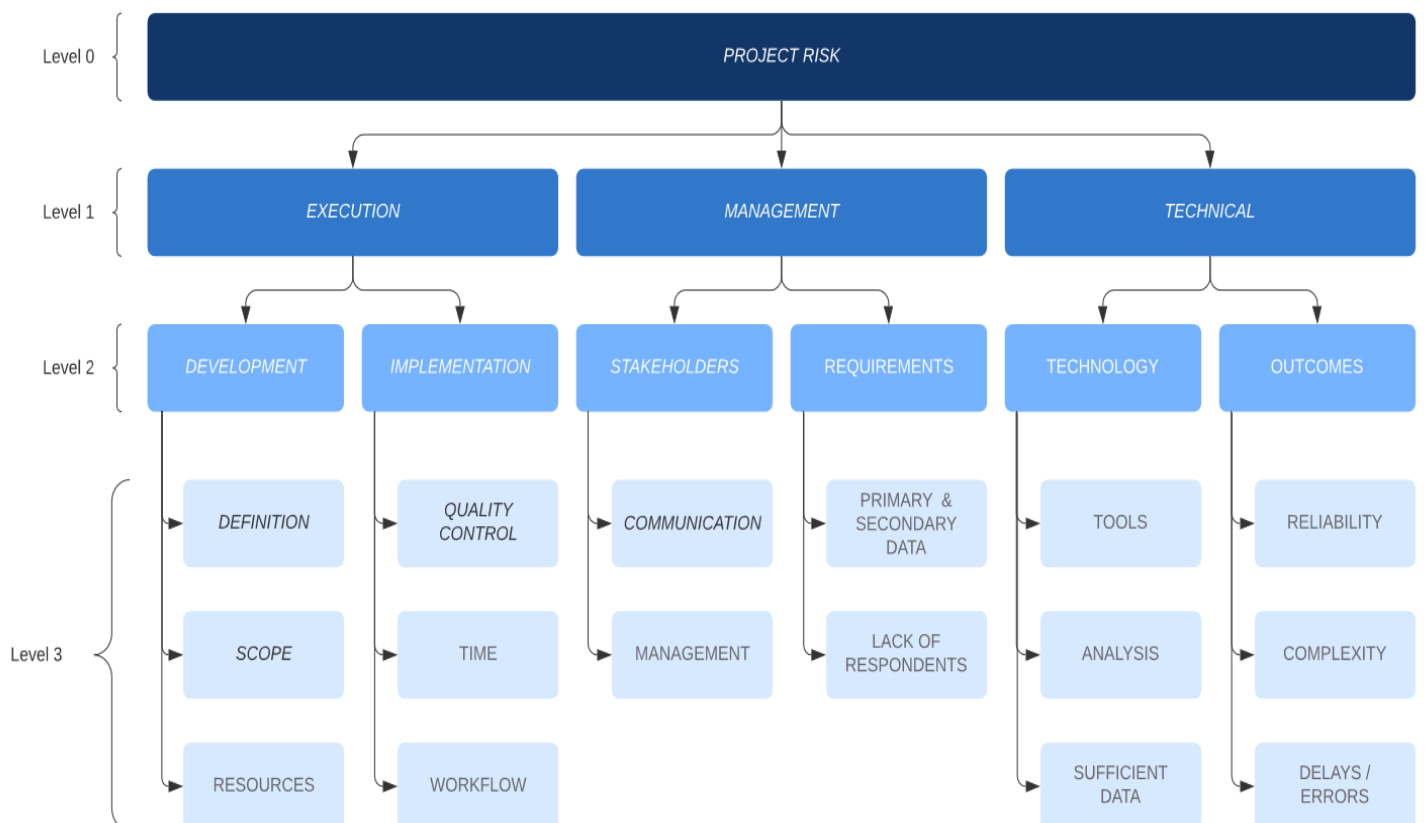
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### 3.2 Risk Breakdown structure:



### 3.3 Risk Register:

| RISK IDENTIFICATION |            |                |                          | RISK ASSESSMENT   |                   |                             |                   |                   |                             | RISK RESPONSE   | MONITOR & CONTROL |          |
|---------------------|------------|----------------|--------------------------|-------------------|-------------------|-----------------------------|-------------------|-------------------|-----------------------------|---|-------------------|----------|
| LEVEL-0             | LEVEL-1    | LEVEL-2        | LEVEL-3                  | RANK              |                   |                             | SCHEDULE IMPACT   |                   |                             | RESPONSE  | STATUS            | COMMENTS |
|                     |            |                |                          | PROBABILITY (1-5) | CONSEQUENCE (1-5) | SEVERITY ( LOW/MEDIUM/HIGH) | PROBABILITY (1-5) | CONSEQUENCE (1-5) | SEVERITY ( LOW/MEDIUM/HIGH) |   |                   |          |
| PROJECT RISK        | EXECUTION  | DEVELOPMENT    | DEFINITION               | 1                 | 1                 | L                           | 1                 | 1                 | L                           | Define Problem statement accurately                     |                   |          |
|                     |            |                | SCOPE                    | 2                 | 3                 | M                           | 1                 | 1                 | M                           | Scope should be tangible and achievable                 |                   |          |
|                     |            |                | RESOURCES                | 4                 | 5                 | H                           | 4                 | 4                 | H                           | Need to find accurate resources                         |                   |          |
|                     |            | IMPLEMENTATION | QUALITY CONTROL          | 3                 | 3                 | M                           | 2                 | 2                 | M                           | Meet often to maintain utmost QC                        |                   |          |
|                     |            |                | TIME                     | 3                 | 3                 | M                           | 5                 | 5                 | H                           | Complete targets to stay on Schedule                    |                   |          |
|                     |            |                | WORKFLOW                 | 4                 | 4                 | H                           | 4                 | 4                 | H                           | Lay out proper workflow to avoid delays                 |                   |          |
|                     | MANAGEMENT | STAKEHOLDERS   | COMMUNICATION            | 5                 | 5                 | H                           | 5                 | 5                 | H                           | Keep all the stakeholders properly informed             |                   |          |
|                     |            |                | MANAGEMENT               | 5                 | 5                 | H                           | 5                 | 5                 | H                           | Teamwork and thorough communication                     |                   |          |
|                     |            | REQUIREMENTS   | PRIMARY & SECONDARY DATA | 3                 | 3                 | M                           | 3                 | 3                 | M                           | Collect accurate primary and Secondary Data             |                   |          |
|                     |            |                | LACK OF RESPONDENTS      | 5                 | 5                 | H                           | 5                 | 5                 | H                           | Have a large respondent samples to increase reliability |                   |          |
|                     | TECHNICAL  | TECHNOLOGY     | TOOLS                    | 4                 | 4                 | H                           | 4                 | 4                 | H                           | Be equipped with proper tools and softwares             |                   |          |
|                     |            |                | ANALYSIS                 | 3                 | 3                 | M                           | 3                 | 3                 | M                           | Careful Analysis of data collected                      |                   |          |
|                     |            |                | SUFFICIENT DATA          | 4                 | 4                 | H                           | 4                 | 4                 | H                           | Have ample data to increase reliability of results      |                   |          |
|                     |            | OUTCOMES       | RELIABILITY              | 5                 | 5                 | H                           | 5                 | 5                 | H                           | Authenticate and double check analysis and data         |                   |          |
|                     |            |                | COMPLEXITY               | 3                 | 3                 | M                           | 1                 | 1                 | L                           | Try to reduce complexity of analysis                    |                   |          |
|                     |            |                | DELAYS / ERRORS          | 3                 | 3                 | M                           | 2                 | 2                 | L                           | Try to eliminate errors in analysis and data collection |                   |          |

### References:

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