

**UNIVERSITY OF VAASA FACULTY  
OF TECHNOLOGY  
COMMUNICATIONS AND SYSTEMS ENGINEERING**

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**DEVELOPMENT OF DATABASE BASED FIELD TEST APPLICATION FOR  
INDUSTRY**

Master's thesis for the degree of Master of Science in Technology submitted for inspection,  
Vaasa, January 20, 2020.

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## SYMBOLS AND ABBREVIATIONS

AI	Artificial Intelligence
API	Application Programming Interface
CPU	Central Processing Unit
CR	Cognitive Radio
DB	Database
DBA	Database Admin
DBMS	Database Management System
DML	Data Manipulation Language
DMS	Distribution Management System
DRUM	Diagnostic Recorder for Usability
FFI	Feedforward Interview
GNU	GNU's Not Unix
I/O	Input/output
IT	Information Technology
IOT	Internet of Things
KSDMS	Korean Smart Distribution Management System
ODBC	Open Database Connectivity
PU <sub>s</sub>	Primary Users
RDBMS	Relational Database Management System
RTDB	Real Time Database
SDLC	Software Development Life Cycle
SEQUWL	Structured English Query Language
SQL	Structured Query Language
SU <sub>s</sub>	Secondary Users

TV

Television

UI

User Interface

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**Pages: 78****ABSTRACT**

The fast development of automation has led many different dynamics of different applications. According to worldwide statistics, the number of smartphone users has grown exponentially which also persuaded software developers and engineers to make numerous mobile applications. Generally, field testing is only carried out when there is in need of collecting important data from individual to figure out blunders and database technology allows storing all the information.

In this work, a Microsoft based PowerApps application was created for a company. The requirements necessary for the application was given by the customer and in the process of making the application any improvements which was obligatory was also specified by the client. I have had a chance to learn the complete PowerApps UI with the resources provided by the company I work for. Firstly, the concepts of database has been introduced to give a general idea of how Microsoft SQL server is used for the entire project. Secondly, there is a a discussion about how PowerApps is used and how unified the system is when connecting the database server. After that, I have discussed step by step of how the PowerApps application is sending the data to the database server when a user is using the mobile application. In short, the PowerApps application provides easier field testing approach for the workers.

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**KEYWORDS:** PowerApps, Database, SQL, field testing, DBMS, sanding sheet, Microsoft, usability



## **1. INTRODUCTION:**

Technology, the term defines the aspect of the modern era. Nowadays, the depth of high-tech telecommunications is very broad with fantastic applications, especially when it comes to Microsoft related applications like visual studio, word, SQL, Power Apps and many other tools and applications. Moreover, there are a various number of ways to gather information or data from different sources and connect them with a suitable system. In addition, the overture of smartphone automation has led to the whole slew of applications which are not audible using traditional material devices (Lee, Suh & Park 2014:1). First, there are not many projects regarding field testing which makes it a bit harder for research. Second, the master thesis focuses on the several researches performed on field test applications which can be developed using different procedure and how the development of database allows to further intensify data and helps generate the whole field test application. Third, the proposition also targets the implementation of a field test application for a sanding sheet paper using PowerApps which has been implemented for a company.

This chapter mainly focuses on the introduction of the topic, how the study has been carried out in field testing and some research background similar to the topic with contributions and outline of the thesis.

### **1.1. Study of field test**

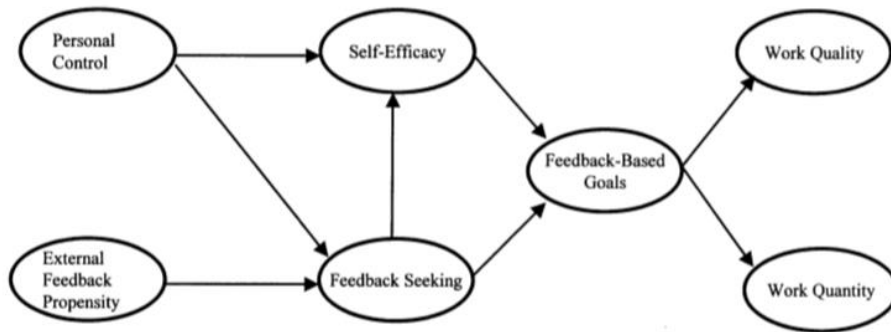
Field testing has been an interesting process throughout the years, allowing different organizations to carry out tasks that helps them distinguish a device or a product in a distinctive or diverse situation (Cartelli 2009). Evaluation and observation are utterly necessary when it comes to field testing. (Budworth, Latham & Manroop 2015: 1-2) conveyed:

“Because employee performance is critical to an organization’s effectiveness, a finding that there is a significant relationship between the FFI and employee performance relative to a PA would have practical significance for human resource managers.”

## 1.2. Relevant work and Literature review

Business models and organizations always look for the most efficient and easy way out to make something relevant for the company benefits making life easier for workers. Excel has become a bit time consuming and confusing for many people to use. Hence the main motivation of this thesis is to improve the working operation and to enhance the efficiency of the company by recording field test results in a database with the help of PowerApps. To the point, field testing has been successful in most occurrences. The question might arise why use field testing in software application and functioning, the answer is to assure and confirm quality. The following are a portion of examination papers and references which helped to build up the thesis work.

Early work in the field testing phase aims to a distinct approach, especially with performance management. To illustrate, According to (R.W.Renn & D.B.Fedor 2000: 563-566) the topic "Development and field test of a feedback-seeking, self-efficacy, and goal setting model of work performance" focused on the field test that was carried out based on work achievement determining the work quantity and the work quality. The accomplishment of numerous presentation improvements projects relies upon representatives drive to constantly improve their work amount and quality inside the framework set up by the executives, and the below figure demonstrates the workflow of the hypothesized model asserting the carried out analysis.



**Figure 1.** Workflow for the hypothesis (R.W.Renn & D.B.Fedor 2000: 564.)

The present field study looks to create and test a model of all individuals who develop liable enough to be identified with execution in work settings. Figure 1 draws information about seeking criticism, social cognition and objective setting. If people have significant power over their own work practices and work in a situation where efficiency is all about tasks, clients and individual work is promptly accessible, the work execution will be straightforwardly identified with the progress made from execution-related data. The model additionally identifies precursors to this sort of setting. Specifically, the model recommends that feedback goal setting and self-efficacy will be legitimately identified with this sort of objective setting, and based on the input related data it sets business related enhancement design (R.W.Renn & D.B.Fedor 2000: 564). In short, the tasks carried out using field testing is more organized and decisive.

Similarly, Buddworth, Latham & Manroop (2015) discussed the viability of the FFI (feedforward interview) for improving the activity proficiency of workers with respect to a customary presentation evaluation interview in a business hardware firm. Representatives (n= 70) who occupied in a feedforward meeting with their administrators were surveyed anonymously and found that workers are on better hands after four months compared with the employees who obtained the associations' achievement appraisal interview. The field test of the FFI strategy shows that it is conceivable to build fulfillment among workers utilizing the performance management technique. In fact, carrying out field tests lead to a better result in establishing a better result because it was easy to compare.

Yun & Choi (2014) describe in their paper “Development and Field Test of Real-Time Database in the Korean Smart Distribution Management System” that leads DMS in a periodical framework examination and control by mounting different applications project has been effectively created. In the paper, it condenses the advancement and shows the database structure that can perform continuous framework analysis and control of the Korean smart distribution management system (KSDMS). In order to conduct research KSDMS database performance, field testing procedure was used with a relevant set of data. There were essentially test results dependent on offline DB and RTDB that showed how test outcomes have fluctuated. The tables below give a proper

**Table 1.** System reduction of test framework (Yun & Choi 2014).

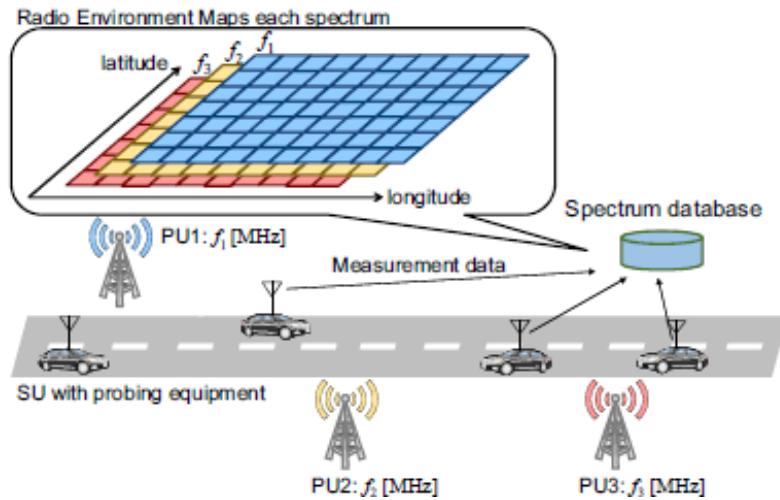
<b>Type</b>	<b>Before Reduction</b>	<b>After Reduction</b>	<b>Reduction %</b>
Node	12,343	8,240	33
Branch	8,970	4,867	46
Injection	10,283	5,858	43
Bus	8,401	4,874	42

**Table 2.** Test consequences of application running pace test (Yun & Choi 2014).

<b>Application</b>	<b>Average Running speed</b>
Network Topology processor	Less than 1s
Section load estimator	Less than 2s
Distribution state estimator	Less than 2s
Real-time power flow	Less than 2s
Voltage-Var Oprimization	Less than 2s

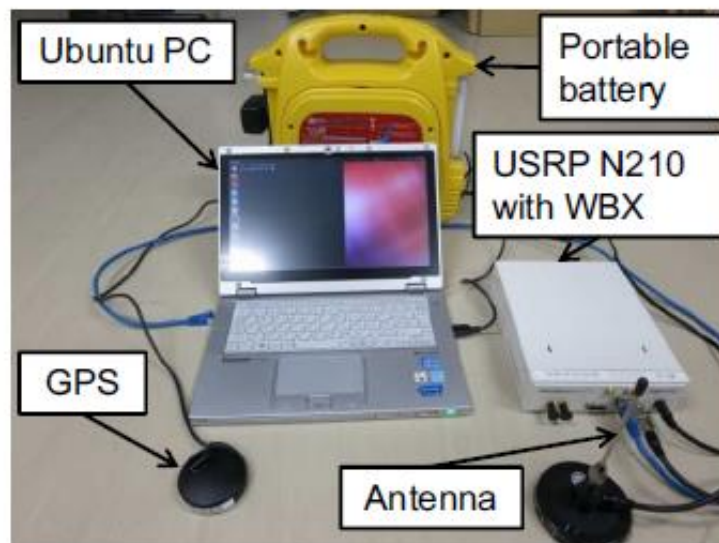
Table 1 and Table 2 encapsulate the database size before and after reduction. In addition, the continuous application project utilizes the proposed database model. The table mainly demonstrates the application project was executed in reach to two seconds. In short, the planned database structure defines the reenactment, field test, and the study with the help of data study and inquiry.

Consequently, Sato, Kosugi & Fujii (2014) displayed in their paper about spectrum geo-positioning database which is one of the peak radio condition estimation system. In this strategy, the database stores the range accessibility of every area. SUs must question a database when they need to use the range and the database gives the accessible range rundown to SUs.



**Figure 2.** The idea of the estimation based range database (Sato, Kosugi & Fujii 2014)

To accomplish exceptionally productive range sharing, it proposed the estimation based range database. Figure 2 demonstrates the idea of an estimation based range database. The database comprises of radio condition data estimated by SUs with portability. In the experiment, it played out a huge scale field test utilizing five vehicles with range sensors for about fourteen days.



**Figure 3.** Testing hardware, which was mounted on a vehicle (Sato, Kosugi & Fujii 2014).

Figure 3 shows the detection hardware to detect the range, which was implemented on the USRP N210 utilizing GNU radio programming. It gauged the received sign intensity of an advanced TV communicate station in Kumagaya city, Saitama, Japan. The TV signal, which is transmitted from Kumagaya transfer station, was examined by 200 kHz testing rate and 2,048 examples were averaged once per second. These perceptions were put away on the capacity of a PC together with area data gathered from Garmin GPS18xUSB. After the field test, all the estimated information was documented on the MySQL server.

### 1.3 Thesis motivations and Contributions

The main role of field testing is to get data about item fulfillment. Examining different analysis, differential thing, and try to carry out tasks to manage good business initiative. The consequential motive is to get measurements that can be utilized to gather operational structures. Progressively, field test information is utilized to get this information. (Kirkpatrick & D.Way 2008: 2).The principal of this experimentation is to a field testing mobile application for the company(the company name cannot be disclosed because of company policy) in order to use it for business experimentation improvement. The master's proposition focuses on the mobile application made

By PowerApps and Microsoft SQL database. The outcome of the implementation is to distinguish between the association's sanding paper and a reference sanding paper product, which gives the contrast between the tested product and the reference product.

### 1.4 Thesis outline

Chapter 1 focuses on the introduction, definition of field test and how it is carried out, relevant work and literature review. It also discusses the motivation and contributions made to the thesis. Gives an overview of the thesis with previous works on field testing

and how they were successful in the long process.

Chapter 2 mainly broadens the principal object of the thesis that is field testing. Logic behind field testing, and what approaches are done during the field testing process. It also discusses the fallback and benefits of using the field testing approach.

Chapter 3 discuss most of the things about database and database management system. It mentions how data's are stored, manipulated, deleted and used using the SQL commands. The advantages as well disadvantages of the usage of database are also addressed in this chapter.

Chapter 4 is the backbone of this thesis topic because this is the actual work carried out for this project. General idea about PowerApps and of how it is used with Microsoft account and how data's can be connected easily if a database server is created through Microsoft SQL server.

Chapter 5 gives an indistinct idea about future applications, which could be developed based on the same application.

Chapter 6

Chapter 6 is all about the references used for the purpose of the thesis.



## **2. FIELD TEST**

### 2.1 Definition

Field tests are generally perplexing and collective which draws upon the particular learning, abilities and gatherings of people to achieve high class data. To distinguish the leading root of an estimation mistake and to illuminate the ensuing structure/upgrade to limit the sources of blunder. During the production period a model poll has been drafted as a preliminary version, but not officially assessed in a field set up. After the production session eventually an overview survey has been handled, as a rule to evaluate information quality issues or concerns. Hence, using a variety of information and poll allows to limit the fault and inaccuracy. (L.Esposito 2009: 4-6.).

### 2.2 History of field testing

Quality assurance is very important in software development process and testing plays a crucial role during the procedure. According to Blackstone (2012: 180-182) there is a subjective strategy for information gathering planned for understanding, watching and collaborating with individuals in the characteristic settings. In this way when social researchers talk about being in “the field”, they are looking at being out in reality and engaged with the regular day to day existences of the individuals they are considering. Occasionally scientists utilize the terms ethnography or member perception to allude to this strategy for information gathering. Moreover, the field scientists take part when they gather information: they take an interest, they watch and for the most part, they talk with the portion of individuals and according to that the reports or antiquities are investigated. In the recent era, field testing became popular because of business related projects which involves different types of field testing techniques. In the age of smart phones, everyone expects a mobile application as it makes life easier for the user.



**Figure 4.** Field testing mainly carried out based on member input, meeting, data collection and finally carrying out field test. (Blackstone 2012)

Data collection plays a vital role in field testing (see Figure 4.) as it helps allow to make a comparison of different products/systems etc.

An effective field test will reveal the genuine, impartial observation and selection of the item that assists with understanding if it has really fixed the issues the objective market is confronting. During an alpha or beta test, the clients are directed to various encounters and additionally highlighted to get a lot of criticism about the particular subject. Similarly, in field test the user is playing an attentive job, providing no guidance and watching to perceive how clients connect to the the item all alone. What highlights do they like to overlook? Do they remain keen on the item to be utilized for two or three days or weeks? With regards to AI, field tests enable you to perceive how your item gains from and adjusts to your client's individual needs. Present day machines are getting more brilliant and more brilliant, however, individuals need to utilize them with the goal for them to learn and develop. Field tests enable the item to learn and communicate with individuals at scale before dispatching so investigators can assemble coordination and practices to upgrade the item. (Longacre n.a.)

### 2.3 Approach of field testing

To carry out field testing major things should be considered and examined to fetch or expect a phenomenal result. The more strategies are followed the better the outcome will be, so in order to execute a good approach certain criteria are inherited without affecting the client information and forms. As a result, the outlook is as follows (Gazzola 2017: 429-430):

A) Test blueprint- In test technique four initial components are well defined. For instance-

- i) Test commitment- is a commitment that defines which practices are ought to be tried in the field. Since field testing focuses only on various functionalities that cannot be adequately tried in a house. Additionally, field testing relies on field elements. A specific case determines communicating with a specific driver and a specific database configuration.
- ii) Test possibility- defines when the product application running in the field ought to be tried. When testing is performed, the testing methods are generally begun as the advanced exercises. The enactment of testing methodology for programming running in the field can be found on various perspectives.
- iii) Test generation methodology- stipulates how to acquire the experiments that must be prosecuted in the field anticipating unique sort of system: static and dynamic. Dynamic one produces experiments straightforwardly on the field. This should be possible by engineers, developers based on the light of issues announced by the end client.
- iv) Test authority- characterizes what the normal conduct of the test product is under at. This data is vital to identify any type of misfire that can be caused from the testing period.

B) Non-invasive-

- i) Isolation- A product application streaming in the field cooperates that are accessible inside the domain. The main idea is that while doing the isolated field testing there should be no disturbance around the environment, making it a reliable test process for the end-clients.

- ii) Projection- To carry out these tests the exertion of extra assets is beneficial, especially CPU cycles, memory and I/O but not recognizable by the customer.

In one of the study, it has been mentioned that there are two elemental approaches to field testing. One of them is the initial standalone method and the other one is embedded form of field test. To start, the embedded field testing method is more promising, but they seem to have noteworthy limitations. On the contrary, standalone practices give more adaptability as individual structures and outlines, plus they are easily managed. Moreover, this approach likewise requires exceptional testing discussion. But, embedded procedure does not require any extraordinary testing sessions hence this process is the best ones. Records a few qualities and shortcomings of the general field test design (see Table 3). (Kirkpatrick & D.Way 2008: 3.)

**Table 3.** Quality and fragility of general field test designs (Kirkpatrick & D.Way 2008: 3-4.)

<b>Condition</b>	<b>Standalone: Stability</b>	<b>Standalone: Deficiency</b>	<b>Embedded: Stability</b>	<b>Embedded: Deficiency</b>
New program	Resilient, smaller test schedule.	random selection of group leading to blunders	none	Not possible
Current product restoration	New feature does not affect the old features.	might lead to blunders when tested with random people	no additional regulation	lengthy process

Progressing program	flexible	not reasonable	no additional regulation	lengthy
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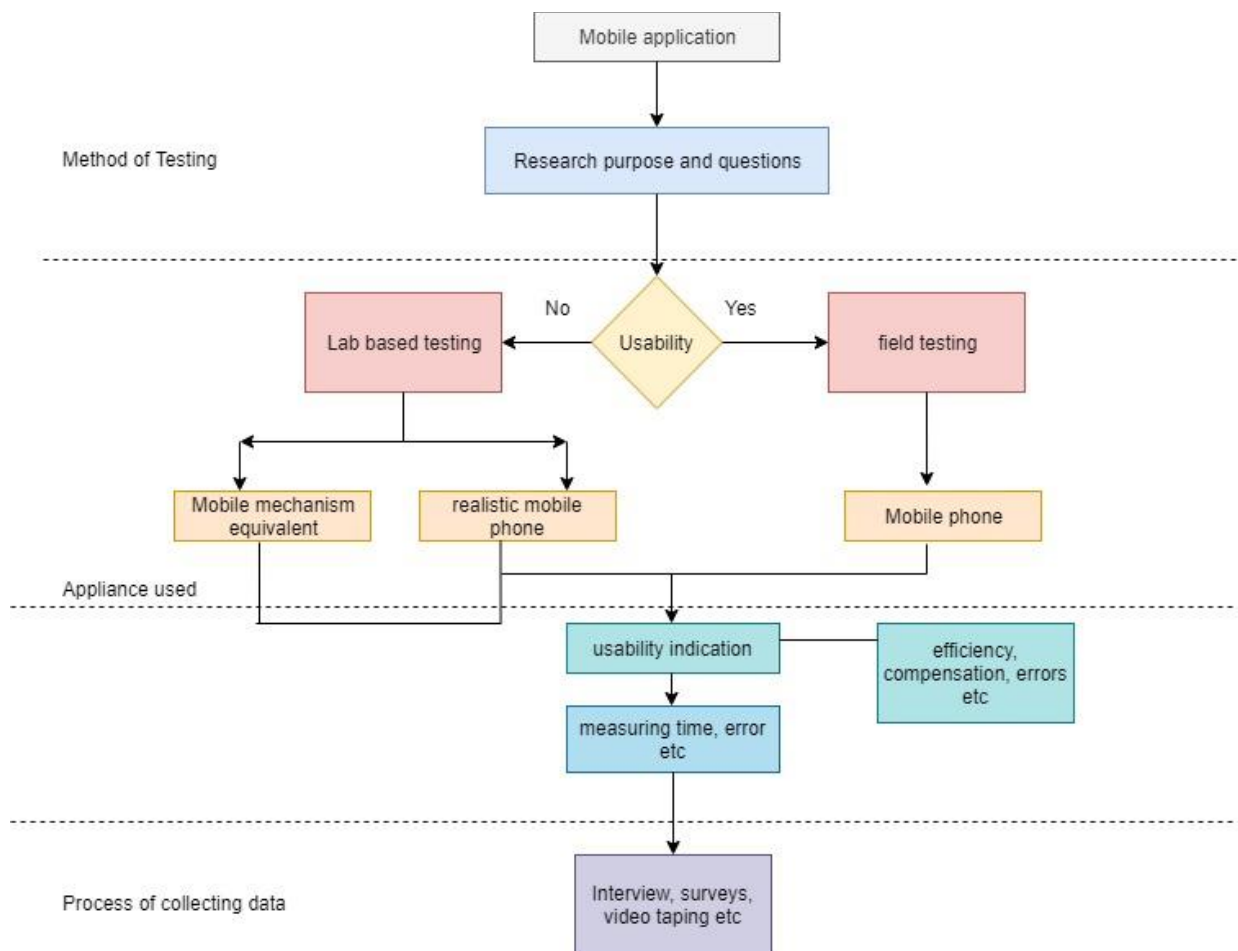
#### 2.4 Methods used while doing field testing

If a product needs to be at its peak and needs comparison with other merchandising product, then field testing is vital and decisive. There can be certain ways to do field testing according to follows:

- i) Usability testing- It is the most common way of examining when it comes to any kind of maintenance fulfillment. However, many confuse utility with the term usability which refers to a completely distinct way of valuating the service operation.

The usability of an item can be depicted as a subjective assessment property, extending the central into six (Delikostidis 2007: 20-21):

- a) Effectiveness- the ability of the item to empower clients with precise results and perfection.
- b) Efficiency- user execution is based on the tasks completed prior to the budget situation.
- c) Satisfaction- this decides how user friendly is the handiwork.
- d) Learnability- how satisfying it is easy to use when pre-owned for the first time.
- e) Memorability- managing the utilization after a certain period.
- f) Errors- how many times has the product let down for certain wrongdoing.



**Figure 5.** A general system of choice of usability testing approach (Delikostidis 2007: 41.)

- ii) Data collection- Clustering of data is compelling and crucial. It can be done in certain ways, but the most popular one can be through interviews, survey. Interviews can be hard for some people because some people might be shy to say something bad about the product or do not want to open up. However, surveys can be easier because everyone will be able to answer accordingly and none of the individual's identity will be revealed.
- iii) Think aloud protocol- this method allows the user to let out all the facts and ideas they have on their mind and put it up front so that actions can be taken

prior to the intention. It is a very cost-effective and productive way of collecting all the data needed for the process.

- iv) The videotaping - video examination is planned to apprehend the member's interrelation with a specific structure during testing, which is possible in the research center or in the field and kept for further investigation. This productive investigation is a significant part, as it can be used to determine an important strategy. One of these is the Diagnostic Recorder for Usability Measurement (DRUM).
- v) Information logging - another type of method, which utilizes the transcription and the sort of incidents that occur during the assessment procedure of a plan, applied to PC, based situations, as a computer interfaces programming assessments. Digging out information using data logging can be up to multiple times more productive than other different techniques.

All this method can be favorable to put through a good field testing leading it to a quintessential result.

## 2.5 Improvement of existing product aspect

The project I worked on was completely based on how their sanding sheet paper can be improved by comparing it with the reference product. The idea was to determine what could have been done better with the product of the company and how the field testing would help cultivate and upgrade the sanding sheet paper. All the data which are needed to be filled have been mentioned in an excel file from which I made a PowerApps mobile application, making it easier for the users to fill in the details with issues and make a list of a summary of what is good and bad. More will be discussed later in the paper.

## 2.6 Applications and development

When it comes to field test the demand can be slightly less, but in recent years, there have been developed many mobile applications, allowing users/customers to use the mobile application to carry out the different categories of business-related approaches making the product more valuable in the market. The field testing can be used for a variety of purposes, especially in the era of the latest mobile applications and domain. No one will like a product, which has flaws and has to wait after development. At the end of the day, everyone would want a fast, smooth and a product without insufficiency. For instance, field testing is always preferred to be conveyed in the ending phase when someone from the team says that the application is ready and set to go. The testing mainly determines the functionality and usability of the application. (Software Testing Help.)

## 2.7 Advantages and Disadvantages

Every general thing is considered to have an upper edge and a downside. Same with field testing it has some advantages and disadvantages. First, the major positive things about field testing is that a logical field test will set aside a great deal of cash with respect to the financial specialists who can save a ton of assets with respect to the organization. Second, the expense caused in field test is exceptionally less contrasted to the expense, acquired in huge scale venture. Third, blunders can be corrected without considering spending fortunes. Additionally, if there are changes or erasures, assuming any, it will not affect any huge field testing occurrence. Furthermore, it may be that the field test requires less costs, which is valid, but the reality remains that they require costs and if the tests are not effective or the outcomes are not getting as wanted, every single other asset are squandered. Be that as it may, the little it might be, the reality remains that they are misused. Moreover, there could be fallacious and faulty data during the field test. This data's could then be misjudged and the idea of carrying out field test would get confusing. Lastly, incorrect positives and untrue negatives are a typical issue in this type of testing and alert should be applied. (Bhasin 2019)

## 2.8 Future Opportunities



Openings never end for programming analyzers. Testing will never comprehend what sort of task someone will get the opportunity to take a shot at and what can be the necessities. Numerous customers like to have their testers chipping away at site to comprehend their needs for all intents and purposes and check if the product is good with their mechanical condition. Programming analyzers have reasonable odds of getting exposure. (Hackernoon 2019.)

### 3. Database Communication

#### 3.1 Database logic

Databases are considered a key component in the software development and testing phase. Without databases, it is nearly impossible to collect or record data in the cycle of bundle software. A database (DB), in the broadest sense is an information which is sorted in an appropriate manner. More explicitly, a database is an electronic framework, which enables information to be effectively controlled and refreshed.

To put it briefly, an association as a technique for putting away, overseeing and recovering data utilizes a database. Present day databases are overseen utilizing a database management system (DBMS) with large scale of information and data. (techopedia 2019 )

#### 3.2 Different types of database

Databases are of various types and the broad ones that are used are as follows (Hammink 2018.):

- Relational Database- RDBMS is more generally known better than their NoSQL accomplice. Relational databases rose in the 70s to store information as indicated by a blueprint/schema that enables information to be shown with lines and section. Think of a relational database as an assessment of tables, each with a formation and outline that speaks the fixed characteristics and the information sets of things the table will have. The tables in the databases have different keys related to them which are utilized to distinguish explicit segments or lines of a table and encourage quicker access to a specific table, line, or column of intrigue. RDBMS utilizes various imperatives to guarantee that the information contained in the tables is solid and exact. However, the most extensively used ones are Oracle, MySQL, Microsoft SQL server, PostgreSQL and DB2.

- Non-relational Database- NoSQL databases rose as a famous option in contrast to relational databases as there was a huge upswing in the world of web applications. NoSQL/Non-relational databases can take an assortment of structures, making it a bit tricky. The uppermost variance between these two databases is that RDBMS mappings continuously characterize that all information is embedded into a database must be typewritten and suppressed whereas NoSQL can be strategically materialistic, permitting unstructured and semi-organized information to be put away and controlled. Non-relational database types include graph database, search engines and wide column stores.

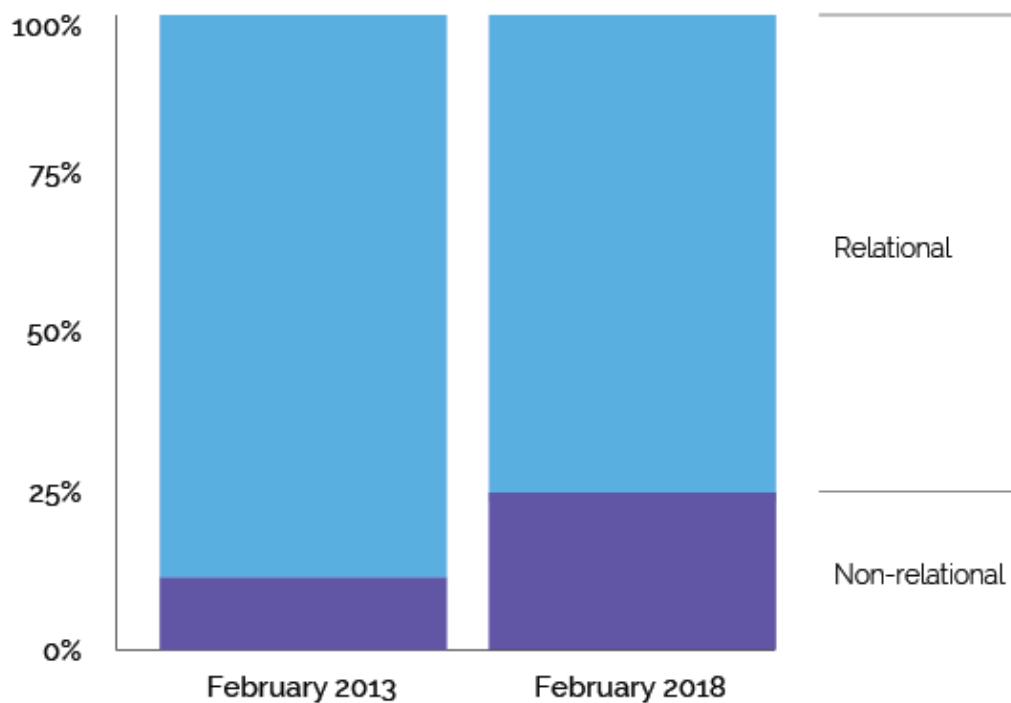


Figure 6. Reputation of Relational and Non-relational database (Hamminck 2018)

From the figure above, it can be determined that a large number of industries and big companies prefer using relational database which is more reliable and well built. On the other hand, very few uses non-relational as it can dissipate and disintegrate if there is no

general knowledge about it.

However, every technology has an upper hand and an inadequacy. With this in mind, the leverage of relational databases is advanced and well-archived with the intention to develop the latest thing possible. The SQL standards are generally more acknowledged with this type of database in big companies, software firms and other industries which require huge amounts of data. On the contrary, RDBMS does not function admirably because of a schema or type limitations making them incompatible for huge analysis or IoT occasion loads. The tables which are one-to-one with an object or the same data is portrayed in the relational database, it will not outline the overall table symbolizing compatible or related information. While relocating one RDBMS to another, patterns and standard should be identical among connection and design tables for the reallocation to work properly as expected. The challenging and hardest part to deal with the relational database diagram is the variable-length and unpredictable datasets. (Hammink 2018)

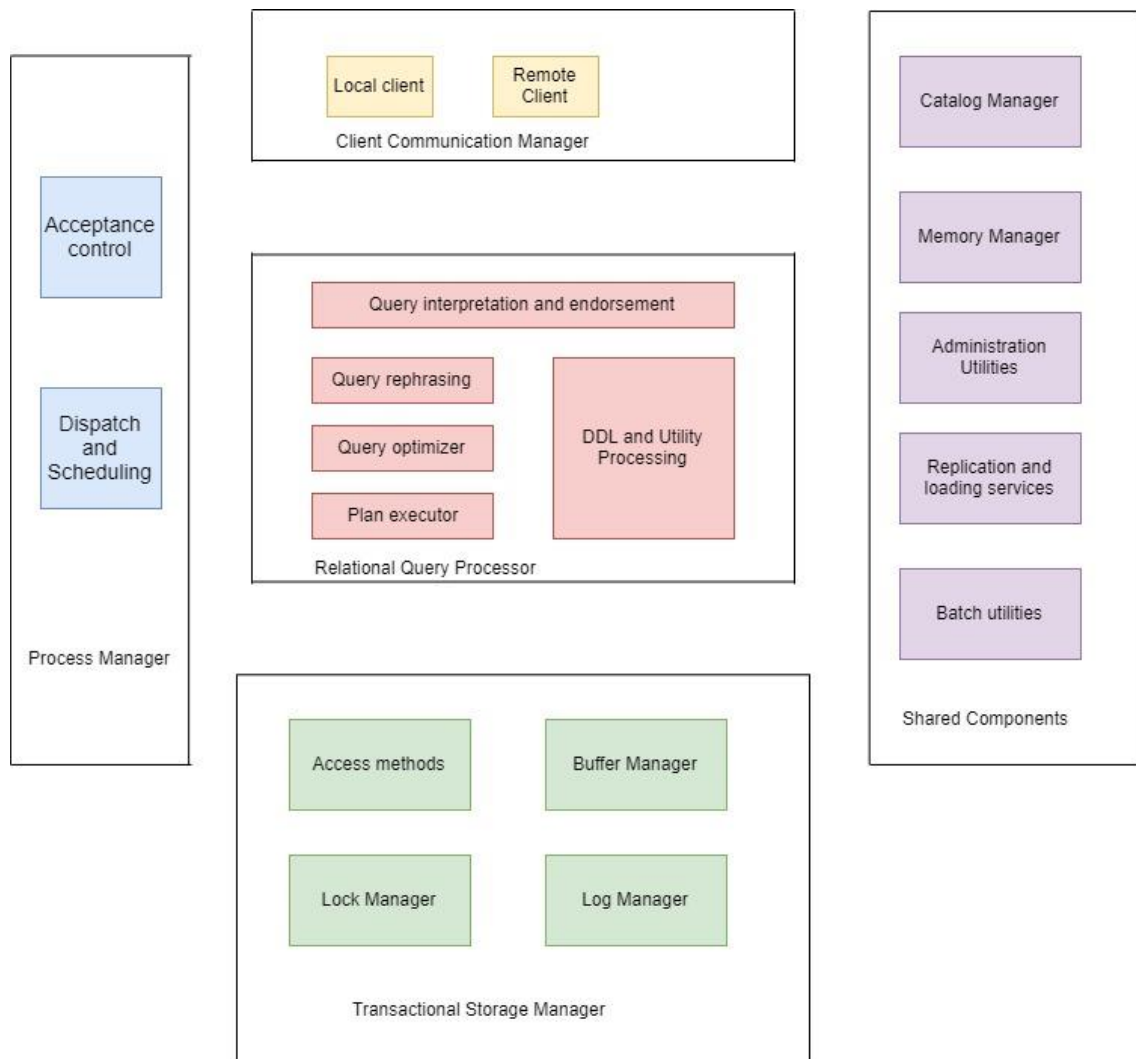
On the other hand, non-relational database is progressively adaptable and simpler to control. NoSQL databases are flawlessly tolerant and have more adaptability. Data can be stretched into various hubs improving accessibility and segment resistance. But, NoSQL is not as popular as RDBMS and non-relational database is generally less received and developed so a different level of skill set and expertise is required to master it. Also, there is a scope of dimensions to follow up. (Hammink 2018)

The overall idea was to mention the different type of databases which are used in the IT work and also very essential when there is a project which is all about data storage and migration. It is secured based on the company infrastructure and has a very powerful security system, there is often times when it can be hacked by professional hackers, leading it to a shortage of data or even tempering the whole framework. It does not happen often, but it is always good to have a background check.

### 3.3 Construction of database

In order to make a connection or creation of a database one must understand the norms and measures which needs to be ensured. The most ultimate and broad database

framework in elongation today are RDBMSs (relational database management systems). These setups can be initiated at the center of a significant part of the world's application groundwork including web based business, therapeutic records, payment slips, logistics, human resources, financial client relationship and supply chain management. Relational structure archives the most online board systems. (M.Hellerstein, Stonebraker & Hamilton 2007: 143.)



**Figure 7.** Major segment of RDBMS (M.Hellerstein, Stonebraker & Hamilton 2007: 144.)

On a basic level, a common RDBMS has five primary parts, as portrayed in the figure 7. As a prologue to every one of these parts and the manner in which they fit together, we

pace through the term of a query in a database framework. For example, in order to explain the figure more accurately, we evaluate and assess a database collaboration at an airport terminal where the door surrogate taps on a structure to demand the traveler index for a flight. Once the button is clicked it brings about a query inquiry that works generally as displaced. (M.Hellerstein, Stonebraker & Hamilton 2007: 144-147):

- API plays an important part when it is selected by the particular CPU, which authorizes a network of relation with the Client Communications Manager of a DBMS which can be spotted in the top of the figure (see Figure 7). A part of an illustration originates a network of relation dependent upon the database server and the client precisely through the medium of ODBC (open database connectivity). “Two tier” or “client server” entity is what the frame up is called up. Sometimes, the customer might proclaim and interface by “middle-tier server” which utilizes a convention to delegate the correspondence between the purchaser/client and the DBMS.
- After getting the customer’s first SQL direction, the DBMS must allocate a “string of calculation” to the request. It should likewise ensure that the thread’s data and control production are associated by means of the communication manager to the customer. These responsibilities are most important and the DBMS needs to make this phase in the query which respects acceptance control (see Figure 7). The task of the acceptance control is to verify if the query is stable enough to be carried out in the scheme or wait until enough framework assets are accessible to give to this inquiry.
- Once conditioned and designated as a string of control, the gate operators inquiry can start to knock off. All this happens in the Relational Query Processor (see Figure 7). The task of this component is to check if the client is sanctioned to run the query, and aggregates the client’s SQL question content into an inside query plan. Once accumulated, the subsequent inquiry plan is dealt with by means of the plan executor as shown in the figure. So basically, it runs the relational algorithm

implementation to comprise a suite of “administrators” that can execute any query.

- Transactional Storage manager from the diagram conducts data entry and administration, which allows creating, update and delete command. The cache framework appends calculations and information structures for sorting out and getting to information on disk known as “access strategies”. Buffer management on the other hand chooses when and what information to get from the determined disk and memory buffers. Also, the log manager induces if the performance and compact is persistent or it is completely fixed if prematurely ended.
- Lastly, the shared components persuade the catalog manager, memory manager, administration, monitoring, loading services and batch utilities.

### 3.4 Benefits and Limitations of database management system

With technology comes betterment, prosperity and also benefit of doubt leading to constraints and drawbacks. For example: (MyReadingRoom 2016) draws out the positive resources which can be managed via database systems and also the negative aspect, which leads to the disadvantages, all of which are as follows:

#### **Benefits:**

- 1) Sharing of data is very much reformed- data’s in the DBMS domain are more sophisticated and smoother for the final user. Hence, making it a simple and easy way to chunk the data.

- 2) Exceedingly well data synthesis- relatively easy to identify the big picture of all the data that have been used to see how the behavior of it affects the plan of the association's section with another.
- 3) Reliability and certainty of information is enriched- as long as it is data there is a risk factor of information's getting strayed and hacked exclusively when it has a larger set of data. In order to have safety, immunity and preservation the company spends a substantial amount of time, aspiration and funds. Therefore, a DBMS schema has a very good immunity to whip out all the security protocols.
- 4) Dissimilarities and divergence of data can be underplayed- disproportion of data can be a major factor in a huge company where the important material can be mixed up causing problems. For instance, the organization's individual can save an agent's name as "Bill Brown" and the organization's faculty retail notes it down as "William G. Brown". This type of blunder is essentially reduced when using the planned database.
- 5) Elaborated data connection- the database connection makes it conceivable to create fast responses to specially appointed inquiries. In the database there are certain things which can be done to manipulate data either by updating, refreshing or creating a new query. This is very important when the customer wants to have quick answers based on the appointed inquiry. To put it another way, a school has students in one section and the principal wants to know how much got an A in mathematics and need to see from the computer using the database system. The question can be- How many students got an A in mathematics? What is the number of students who failed in the exam? How many students have not given the exam? For all this purpose, it is very improved.
- 6) Elevated capacity for the final user- it is genuinely an easy way to get the connection between the data making it relatively effortless for the users.



**Drawbacks:**

- 1) The value of the DBMS is increasingly high- considering the fact that the database will need to manage thousands of practical and refined data and for that purpose there would be a need of immensely high proficient work force meaning more amount of money should be spent on them. Not only that, to maintain a smooth a database management system, there will be need of hardware and software care which is also a task of a very skilled individual. Authorization, preliminaries and governing passivity is not taken into account.
- 2) Complication in administration- a database can create a level of inconvenience and trouble while communicating with different assets in a company. The idea is to have a well suited environment and establishing a safeguard for the association. However, that might be a challenge and also a threat making it vulnerable to security attacks.
- 3) Nurturing it with updates- in order to keep the database updated, it is mandatory to let it update once in a while because there will be changes in the infrastructure all the time with new modernize technology. So, boosting the database system is very crucial which can be challenging at times. Not only that, redesigning the items on the DBMS been important which brings up new advanced rendition to the system. All these are time consuming and expensive.

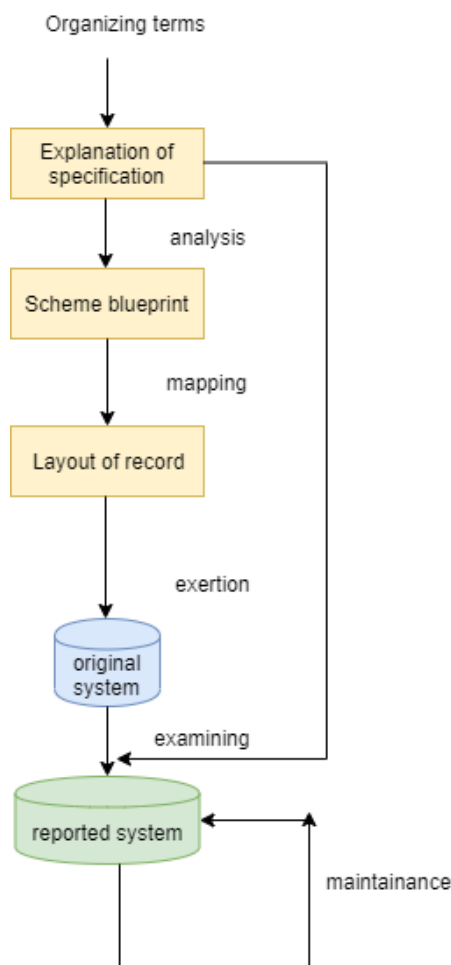
**3.5 Mechanism of a database**

Every type of technology has its own progression and evolution. In software engineering, database is compelling in any course of action, no matter if its software development, testing or engineering. However, the subsidiary of the development process is divided into a series of stages which is named software development life cycle (SDLC). The intent

of this procedure is to make the development more precise and faultless in the cycle. (Watt & Eng 2018: 83.)

### 3.5.1 Software development life cycle- Waterfall

Most of the common methods in software engineering is the waterfall technique. It generates all the principal specification of an expected output. The figure below will give a clearer picture of the concept.



**Figure 8.** Waterfall representation (Watt & Eng 2018: 83.)

The waterfall model is very important in data processing, engineering which basically links the input and put generalized through each action. Figure 8 can be illustrated as follows. (Watt & Eng 2018: 83-84.):

- Gathering information and specification is the first phase of the plan. The objective is to make an adjustment and an alliance with the contributor of what needs to be done and expected from the setup.
- Make an investigation of what the overall picture looks like that is proposed by the customer and what needs to be implemented to make the design infrastructure better, based on the system specification the tasks can be assigned to individuals.
- Systemization of the desired output needs precise and accurate representation.
- Next comes the utilization of all the above mentioned points. This will allow to get the idea of what type of software and hardware should be in use while in use and which type of development can be used leading to the perfect solution. Before getting into the original system it needs to be approved and trusty.
- Blunders and errors are a part of software engineering and without creating an error there is absolutely no way to improve the system overall. So, in that case the testing part comes in where the testers are all the time looking for bugs and reporting to the one who is implementing the solution. Then comes to maintaining all the hard work done to the system. This can be done by reallocating or copying the data to some other source just in case if the main data is lost or hacked.

All these steps (see Figure 8) are the main reasons why the waterfall model is always the best way to start a software development cycle leading it to a rightful and convenient result. According to the diagram explained in the waterfall model, the same initiative is taken for the lifecycle of a database which have a clearer picture of the figure above (see

Figure8).

### **3.5.2 How the database is occupied using current or new data**

Creation of the database can be colonized by a dual approach. First, from the current data which is already in use somewhere. Second, the means of the user which is refined for the database. Some of the information can already be put into the database from existing sources or records. Such as, it is expected from a hospital to have a detailed propaganda of all the crew and personnel which can be easily put into the database. A DBMS have a built in function of import and export which makes it easier for the data to be included. All can be done by putting it through the SQL code or query language. However, the immense and populous data can be transported into the database which is called a bulk load. (Watt & Eng 2018: 88.)

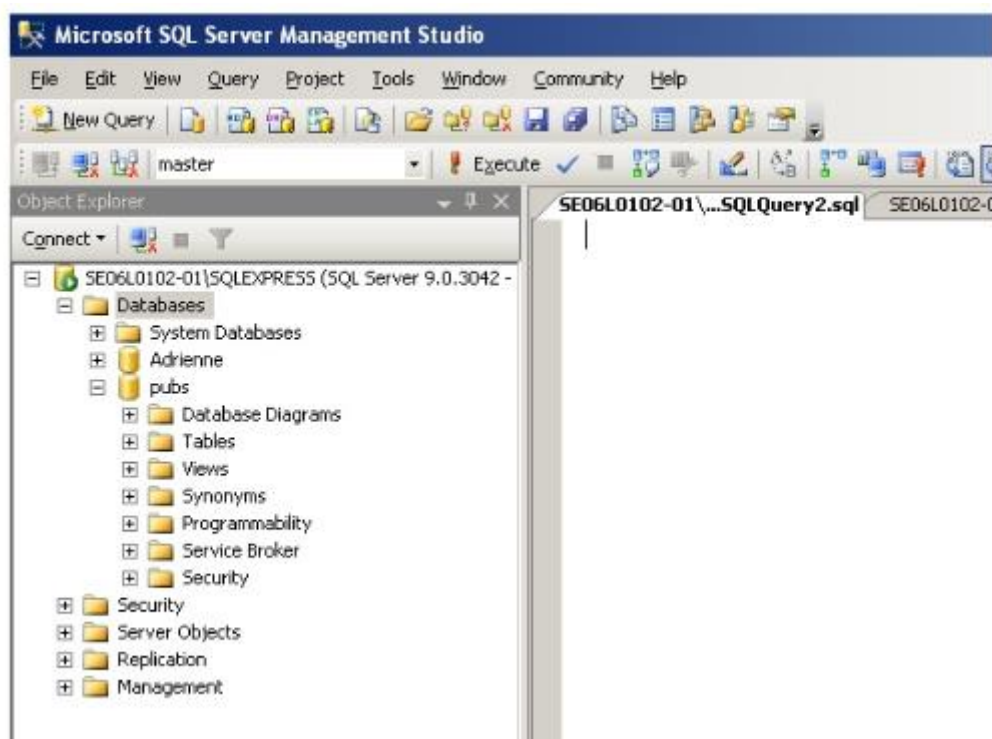
### **3.5.3 Classification of users**

User categorization and ranking is significant in the database. Without a user it is almost impossible to keep the system up to date. For example: (Watt & Eng 2018: 90) mentions that there are a few species of the users according to their skillfulness and expertise. First, program or application user is one of the important users. Their task is to conduct current programs on a regular basis most of which unveils the information. Second, exceptional user falls under the experienced and skeptical user whose task is not trivial, this type of users focuses to develop their own way of penetrating the database which they do through making their own SQL query or using the query language. These functional and specially designed individuals know their way of implementation and does it with the help of built in assortment from MS Access. Third, there is a type of computer specialist and this type of engineer is responsible to know the system function thoroughly, allowing them to execute a clear cut solution to approach the reserved data. At last, there is the DBA (database administrators) the most important and sophisticated users who are very skeptical and demanding. However, they can be a single person or in a group whose task is to supervise and conduct all the assisted allocation needed for the full database

architecture.

### 3.5.4 What is SQL and how to use it

Every type of programming has a different type of language so same goes for the database. Database, mainly requires SQL (structured query language) which was first introduced by the IBM, it was previously named as SEQUEL (Structured English query language) but has been changed later on. However, it was produced to redeem and manipulate all the data which is being stored in the DBMS. Then, after the infrastructure of the technology enhanced the relational software inc., which is now known as Oracle corporation came up with Microsoft SQL server, MySQL. (Watt & Eng 2018: 93.)



**Figure 9.** The application Microsoft SQL server management Studio. (Watt & Eng 2018: 93.)

Mostly the SQL data query is used to create, add, delete, modify and reconstruct the compounded and complicated data to favorable propaganda.

Before looking into the details there are different types of keys, but the thesis mainly focuses on the primary key and the foreign keys. Primary key is uncommon and exclusive for every table and is mandatory for each table to make it distinguishable and clear for the user because the DBMS cannot be identical. Foreign key on the other hand, is generally used to make a relationship with different tables allowing the conveyance between two various detail of entity (Guru99 n.d.).

Here are some examples of how “create” is used in SQL along with different data types and constraints (Watt & Eng 2018: 94-103):

```
1. CREATE TABLE <nameoftable>
(
    NameOfColumn, TypeOfData, Open Column Constraint,
    NameOfColumn, TypeOfData, Open Column Constraint
);
```

<nameoftable> refers to the label of the database archive and the create table consists of three elements, i.e. NameOfColumn, TypeOfData and Open Column Constraint.

The name of the column should be exclusive and uncommon for each instance of the table for example the most common name is First Name and Second Name. But it depends on the user and can make it with any names suitable for the project. Classification and nature of the data (type of data) and few of the data types include:

- I. Bit- fraction and numeral data which can be one of two 1 or 0.
- II. Int- it is a representation of any numbers which can be zero, positive or negative.
- III. SmallInt- it is the same as Int, but within a limit of  $2^{15}$ .
- IV. TinyInt- smaller values which range from 0 to 255.
- V. Decimal- rooted certainty.
- VI. DateTime- very popularly used in database to set a data automatically and have been used in the thesis purpose as well.
- VII. Text- a piece of text which can be implemented using a box.

Optional constraint is useful and beneficial while making a list of attributes. In other words, it is used to load a value for a unique directory. NULL, NOT NULL, PRIMARY Key is the ultimate optional constraints and has been used in the project.

**Table 4.** Generalization of employee list

FirstName	Char(25) or Varchar(25)	NOT NULL
SecondName	Char(25) or Varchar(25)	NOT NULL
BirthDate	Date	NOT NULL

The First Name refers to varchar(25) which means that the character length can be 25 words long and it can be changed to max or 500. NOT NULL initiates that the character cannot be empty and a value must be put in order to continue.

2. ALTER TABLE- The alter table acknowledgement can be used to add and vanish constraints.

```
USE HOME
```

```
GO
```

```
ALTER TABLE tblHome
```

```
ADD CONSTRAINT unqName Unique(Name)
```

```
ADD
```

```
ColumnName int IDENTITY(seed,increment)
```

3. DROP TABLE- clears away and discards a table which is made in the database.

```
DROP TABLE tblHome
```

### 3.5.5 How data's can be controlled using SQL language

DML known as the data manipulation language which prospers the use of database in various ways. It is important to use it as it allows to do many alterations and transformation to the database statistics, conclusion and details. The utmost and most

extensively used DML's are SELECT, INSERT, UPDATE and DELETE. All this is built in in SQL and can be used as a query to show different types of information and data (Watt & Eng 2018: 105). SELECT is a rule, which is basically a database command, the customer or the end user can easily infuse an information from the tables, established on a specialized and a unique pattern. An example of a SELECT statement to originate employee details from a table, which is named "Employees".

```
SELECT FirstName, LastName, phone
FROM EMPLOYEES
ORDER BY LastName
```

According to the code above, the response we will get through this action is the last name of the employee first because it has been ordered by "LastName" first and then it will show first name and the phone number of the employee.

Last Name	First Name	Phone Number
Zoha	Mohannad	604-256-3554

Next, INSERT is also an important command, which tiers a row into a table. The basic task of the insert is to look for a table where a new information can be inserted.

```
INSERT INTO jobs
VALUES ('DBA', 100, 175)
```

Then, the UPDATE command is a necessary statement, which manipulates the data in various amounts of ways. It can either transform the old data by adding a new or manipulate the actual information.

```
UPDATE Publishers
SET country= 'Finland'
```



Here at the publishers table the UPDATE command normalizes Finland in the country section for all enrollments.

Lastly, DELETE command removes a line or row from a specific table. The exception is that only one table or row can be eliminated at a time.

```
DELETE  
FROM Sales
```

The whole sales row has been completely deleted after the command is passed. However, if a certain part of row needs to be deleted by the user. The user can use the WHERE clause. For instance,

```
DELETE  
FROM Discount  
WHERE disc_id = '6380'
```

## 4. PowerApps

### 4.1 What is PowerApps

PowerApps is a well renowned Microsoft application tool. It is improving in the software development side with a steady pace. However, PowerApps is a collection of apps, facilities, junction and data platform that gives an expeditious and instantaneous application development to construct business applications for the enterprise needs. The building of PowerApps application is fast and reliable because it contains many built in data platform like Common data service. Not only that, it can be also connected via different on-bounds information sources like Sharepoint, Microsoft Excel, Office 365, SQL server and more.

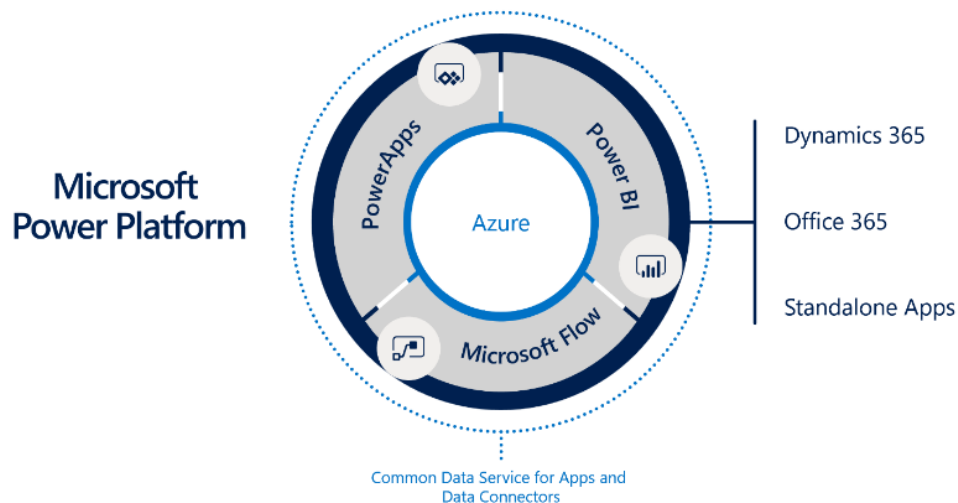
All the applications, which are constructed by PowerApps, indulges well-heeled profit-making solution to transpose the standard enterprise processes to digital automated tactics. Moreover, the usage of power apps enables a reactive perspective and design, and will run mercilessly in the web browser or on cell devices.

Powerapps also contributes an expandable podium, allowing the programmer/builder to interface other data and original data associating with peripheral data.

By utilizing PowerApps three sorts of apps can be made: canvas, model-driven and portal. It can be built through either Power Apps studio or App designer. (Microsoft 2019).

For the thesis purpose, the power apps for developers have been used where certain codes were written according to the customer criteria and make an app based on their user fulfillment. The PowerApps application was connected to the secured customer SQL database server. In addition, the PowerApps can be used in 30-day trial and can be extended through the company; the PowerApps version used for this project was community plan. Powerapps is a flexible tool and is compelled to an undertaking to get the work completed with no sweat. It can be exploited using the canvas application

or model-driven ones to complete the work rapidly and efficiently. After completion the app can be shared via an association. Canvas applications give a user a ton of authority over the client experience of the application. An application producer can bestow layouts to make a canvas application, or they can design the application any way they like. The application based on canvas is usually clear, unused and clean so the application can be made accordingly to fit the requirements of the client. But, it is not suitable to use this procedure because there is not enough documentation for it. Model driven application exploits the unified interface that gives an open structure and smooth response. It can be run on an internet browser as well as on a well-known versatile device. It consists of numerous parts including dashboards, structures, views, charts, and business forms that together help make the application lucid and manageable. After successful dispatch the application can be downloaded via google play or app store.



**Figure 10.** Architecture of PowerApps (Yack 2018: 6)

As shown in the figure above (see Figure 10) the PowerApps stage is a quota of the bigger Microsoft power platform that additionally incorporates PowerBI and Microsoft flow, grasping the regular foundation of the Common data service for Apps and data connectors. These capacities are based on the influence of Microsoft Azure cloud administrations. Hence, the cloud administrations make a huge scale of single

efficiency to the big business crucial line of applications. (Yack 2018: 6).

## 4.2 Beneficial things to know about PowerApps

### 4.2.1 Essential factors

While working with PowerApps there must be certain factors which need to be known and understood before proceeding to the actual project work. The necessary ones are (Yack 2018: 6-7):

**Table 11.** Factors related to PowerApps

Utilization of PowerApps	The clients operate with all the applications made by PowerApps on their work area or cell phones. As mentioned earlier in the paper that there is two types of driven apps one is Canvas and the other one is Model-driven. Likewise, the canvas made PowerApps applications can be installed into Sharepoint, Microsoft teams, Power BI and Dynamics 365 applications.
Microsoft Flow	Flows can be activated to run when occasions happen in different frameworks and administrations or planned to run at a particular time. Clients can likewise communicate with flows in the portable application.
CDS- Common Data service for Apps	Provides intrinsic adequate for business rules and workflow.
Microsoft Connectors	More than two hundred plus connectors are in use in PowerApps that makes it a

	<p>bit simpler for application manufacturers to associate with both Microsoft and outside administrations, from Dynamics 365 to Dropbox. It permits canvas apps and flows to effectively utilize API(application programming interfaces) administration with no designer information.</p>
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#### 4.2.2 Acceptance scheme

PowerApps is an adaptable platform and can be used in a few distinct sorts of situations (Yack 2018: 7):

- I. Self or organization based applications- when apps are made by an individual it is important to know the requirements and upgrades made by the client which is then implemented and expressed in the PowerApps application or Microsoft flow mechanization. These benefits can be imparted to other colleagues, when all the fruitful solutions are elevated with all the undertaking resources. All of these are easy to save and can be continued with one individual or a group when the developer leaves the team.
- II. Applications based on Dynamics 365- it was built on already into the PowerApps facility and use the Common data service for information stockpiling and center stage administrations. It is the speediest method to handle regular business situations.
- III. Excel, outlook, sharepoint and teams- applications can likewise be implanted into the application. This often improves user appreciation and acceptance as

because there is not much to be specialized for new application from what they are as of now utilizing. PowerApps is currently the essential method to modify SharePoint online rundown structures.

#### 4.3 Data collection and process

There are two ways of how data's can be collected and stored in PowerApps. The built in common data service or a whole new database server is created in Microsoft SQL server by the enterprise, both are equally good and can be used in long term purpose, but SQL servers with protected password can be hassle as it does not hinge on end-user authentication. But, the projects made through companies are well balanced and secured in their own cloud services, hence in this thesis project the target was Microsoft SQL server which was provided by the customer.

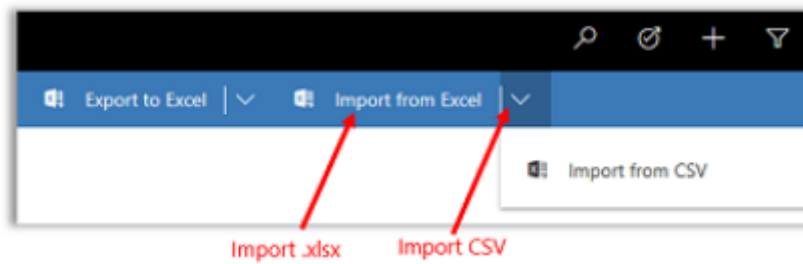
However, while importing data there is certain criteria's which are followed in PowerApps. Importing data is not a big deal in PowerApps no matter where the data is, suppose major data about a consumer is stored in file management system and can be accessed through cell phone or through email. All the information can be acquired from the excel data to the app listing all the association draft. (Microsoft 2019).

Step 1:

All the data and information should be embarked to excel file. For instance, the sustained file composition must be .csv and .xlsx. Files that are exported from a spreadsheet it is important to notice that the name of the column must be identical to the list otherwise the import will not work and data will not be sent.

Step 2:

Next step is to import the index from the options available in PowerApps.



**Figure 11.** Importing data option

Step 3:

Making sure every data is imported successfully.

Moreover, when it comes to exporting data it can rapidly do a specially appointed examination of the information provided from the information that is sending out the information from the application to excel on the web.

Information can be traded into a standard excel record that can be used in any gadget, for example, smartphones, tablet or work area PC. The information is sent out in a similar organization found in the application. So basically, the content will remain content, numbers will remain numbers, and dates will remain dates. Be that as it may, when the information is sent to the application to excel the arrangements in the cell may change.

Table 12. Data exportation in model-driven apps. (Microsoft 2019)

Data formation in Model-driven apps	Cell composition in Excel
Text, ticker symbol, phone	All shown as a text but with a drop-down option.
Email, URL	Usual arrangement
Number	Same arrangement
Currency	No \$ sign but shows just the number
Date only, date and time	Shows exclusively only date

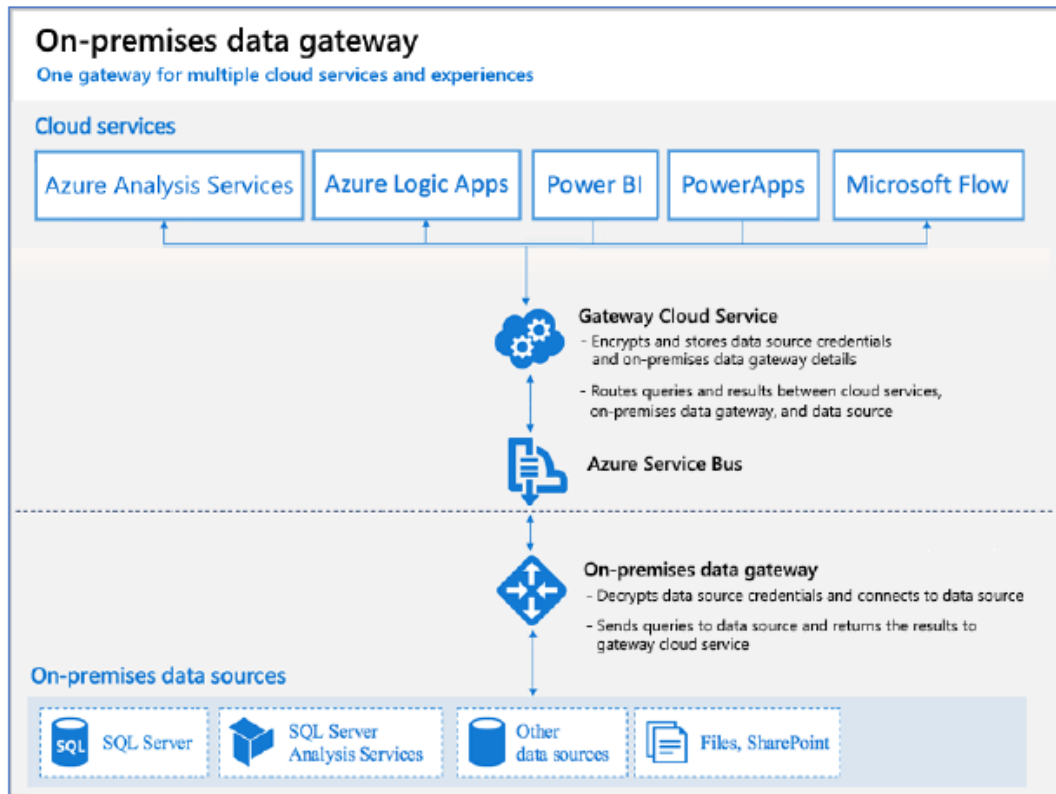
All these processes are used while collecting and extracting data, making the life

easier for the customers and organizations while building outstanding business applications.

#### 4.4 Connection between database and PowerApps

Microsoft PowerApps has risen as one of the quickest application improvement stages. It is undoubtedly trivial and efficient to make a local application which can run on any gadget, similar to Android/iOS/Windows cell phones or any work area program. (Shinde 2019). Additionally, a senior program manager from Microsoft publicized, there will be open on-premises information for the ones who are applying all the sources that are attainable from the on-premises information gateway. This addition to the new feature has been a demand by the users for a long period of time, it made the life easier for all the PowerApps developers. Now, interfacing data to PowerApps is secured enabling to manipulate data with proper secure connection, loss of data and without changing any forms of data beforehand. A single gateway is now accessible by PowerApps, PowerBI and Microsoft Flow. (Microsoft 2016). An overview of the system architecture will make it clearer.

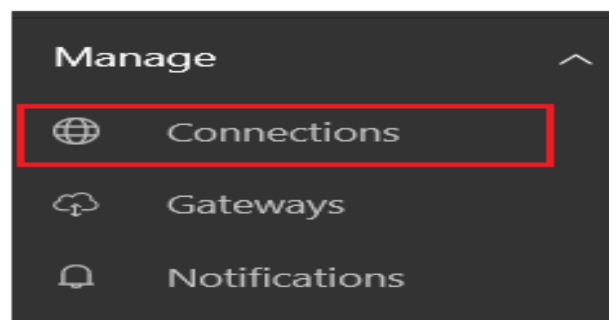


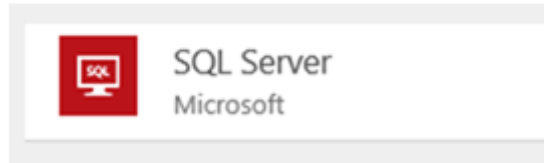


**Figure 12.** General architecture of on-premises data gateway. (Yack 2018: 26)

PowerApps empowers to use on-premises data gateway to connect to a data source as it is very much achievable, systematic and efficient.

There are tons of ways a database connection can be created in PowerApps. The first way is to open PowerApps with a valid work Microsoft account.





**Figure 13.** Connections from PowerApps (Nair 2016)

There is a connections options which leads to a new connection and then the SQL server is clicked (see Figure 12.)

The dialog box is titled "SQL Server" with the Microsoft logo. It contains the following text and controls:

Microsoft SQL Server is a relational database management system developed by Microsoft. Connect to SQL Server to manage data. You can perform various actions such as create, update, get, and delete on rows in a table.

How do you want to connect to your data?

- Connect directly (cloud-services)
- Connect using on-premises data gateway (?)

SQL server name \*

SQL database name \*

Authentication Type

Username \*

Password \*

Choose a gateway \*

If you don't see a gateway, or want a new one, you can install one now. To see recently installed gateways, refresh this list.

[Install a gateway](#)

Cancel Add connection

**Figure 13.** View of the Database connection page (Nair 2016)

In order to have the alternative association with on-premises data the “Connect using on-premises data gateway” is selected. Over here all the necessary fields are provided and filled by the organization IT specialist who then gives the permission for others to use the database information to PowerApps. However, once the connection is made the admin can grant verification for others to use the App. More in details in the practical part of the thesis.

#### 4.5 Experimental Analysis

This part of the chapter focuses on the practical implementation carried out for the company. The project was mainly focused on PowerApps application from scratch, that is making a field testing mobile application for the company users as excel was very much time consuming and not a very efficient process to maintain. The challenging part was to learn PowerApps and Microsoft SQL and then implement the requirements which were updated by the customer on everyday basis. It took about three and a half months to complete the whole mobile application.

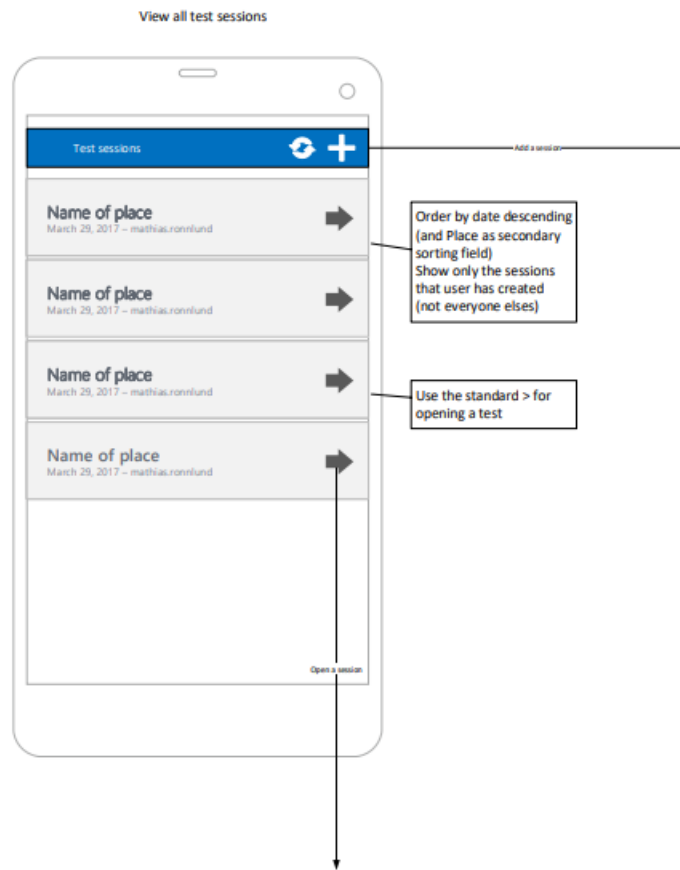
##### 4.5.1 Process

Tasks included was to distinguish results from the company’s sanding papers that included abrasive sanding sheet paper and polishing method. Abrasive sand paper is basically a lead-footed paper laminated with sand, used by big organizations to accomplish a glassy surface (Abrasive paper n.d.). On the other hand, polishing determines the furnace made after using the abrasive sand sheet. A field test will be carried out using the mobile application comparing the company’s tested product and a random reference product listing all the good and bad things about the sanding sheet.

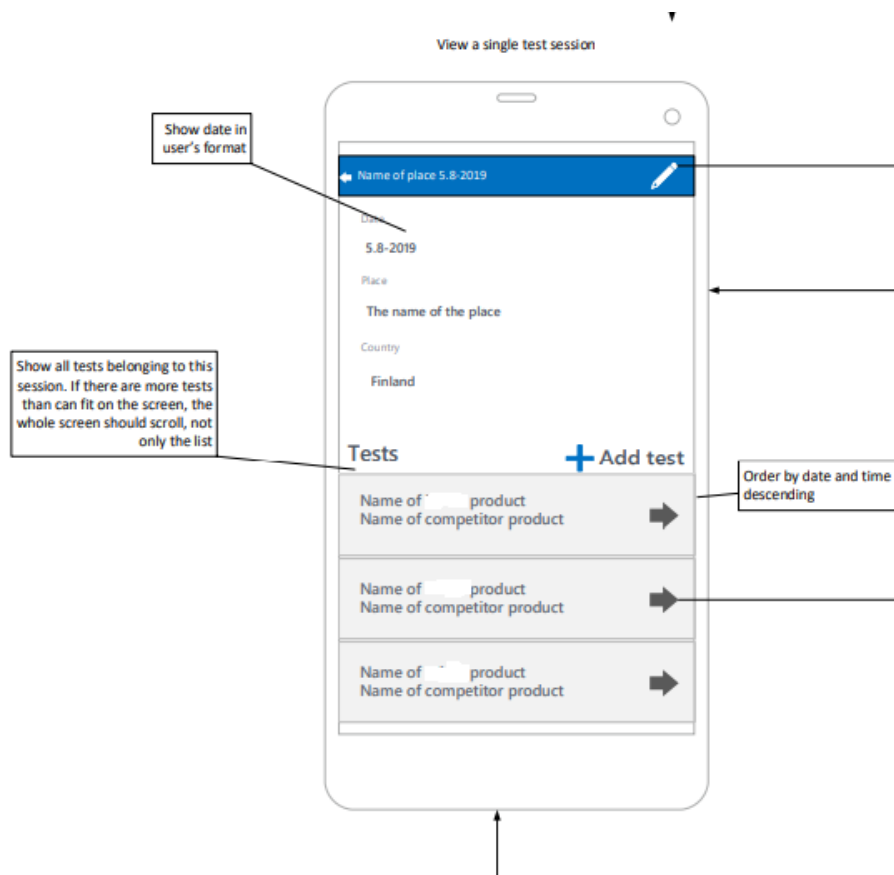
##### 4.5.2 Blueprint of the system

The company designed a UI for me to follow and listed all the criteria’s which needs

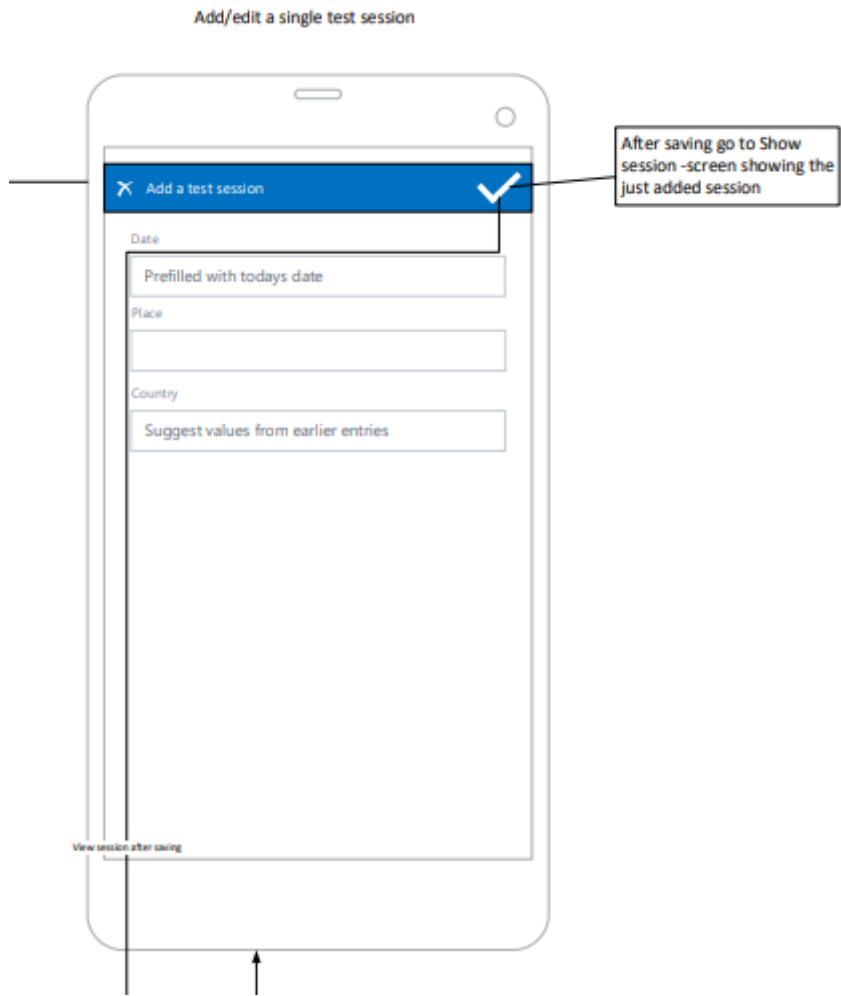
to follow in order to get the same overall UI and functionalities.



**Figure 14.** Test Session Screen UI design provided by the company

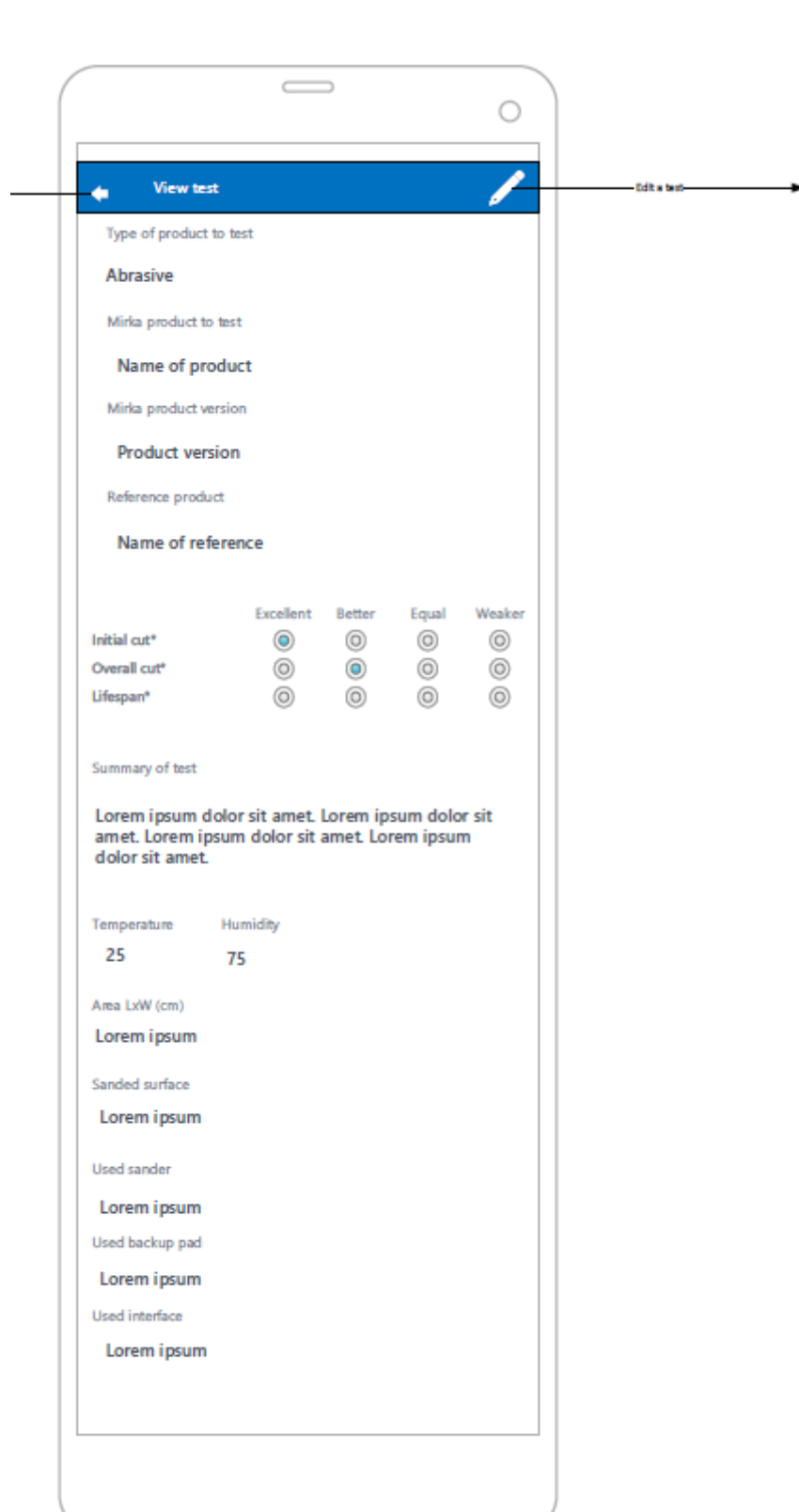


**Figure 15.** View Session screen UI design provided by the company



**Figure 16.** Add/Edit screen UI provided by the company





**Figure 18.** View test screen UI provided by the company

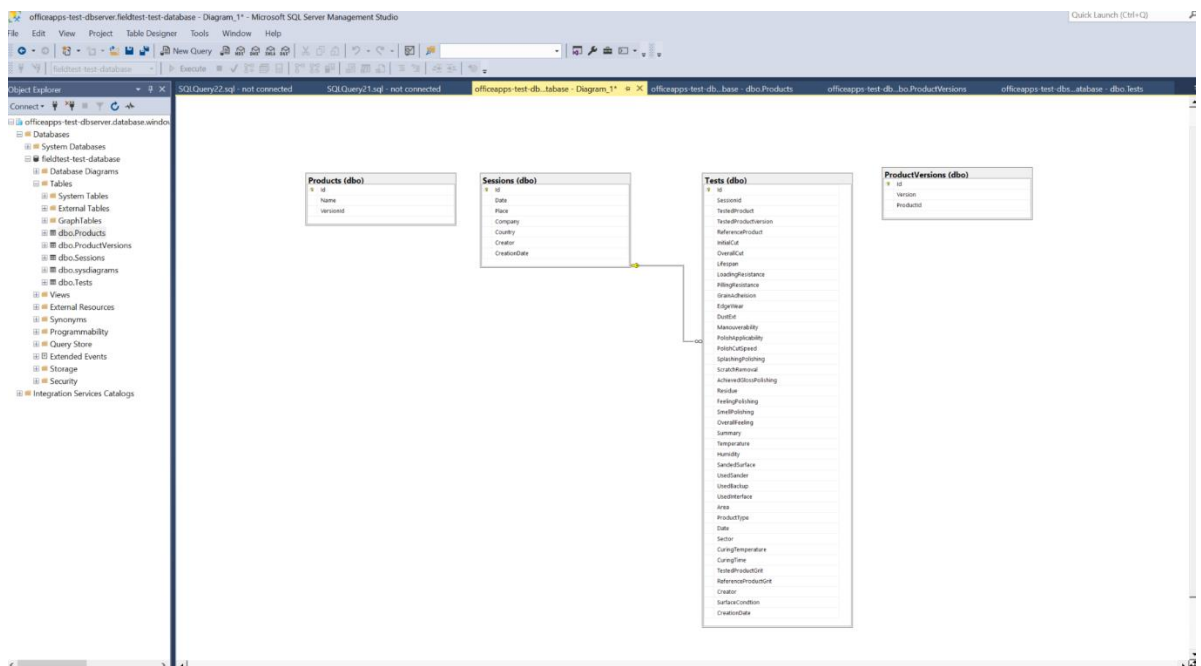
All of the screenshots provided is how the mobile application should look and



operate.

#### 4.5.3 Overall application structure

The first step was to make a database connection which was initiated from the server of the company credentials, need to hide the procedure because of company policy. However, after getting all the log in confirmation and credentials the responsibility was to make tables according to the criteria.



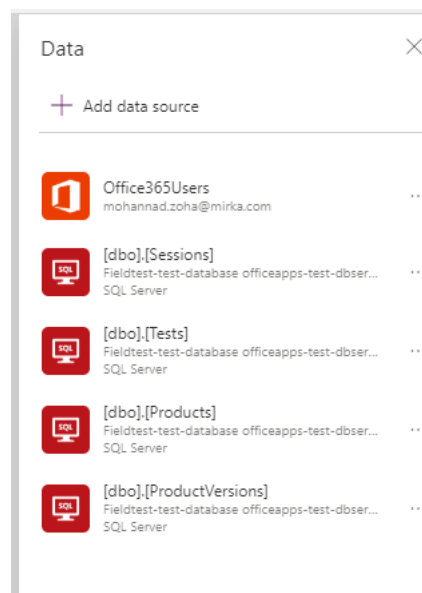
**Figure 19.** Database tables used in project

For instance, in the figure (see Figure 19) under the field-test-database there are tables named `dbo.Products`, `dbo.ProductVersions`, `dboSessions`, `dboTests` and `dbo.sysdiagrams`. `Dbosysdiagrams` shows the diagram of the tables that are initiated. Every table has a similar field `Id` that is the primary key which determines that all the records are exclusive and not empty.

However, after successful completion of the database tables and connections the focus goes to PowerApps. Logged in as a Microsoft user a new empty project is done and

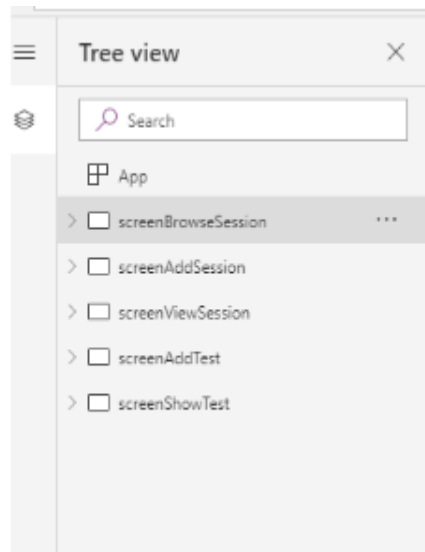
then all the screens are carried out according to the workflow diagram.

The first task was to connect the database server to the PowerApps application to execute all the information needed to put in the app accordingly to the database values.



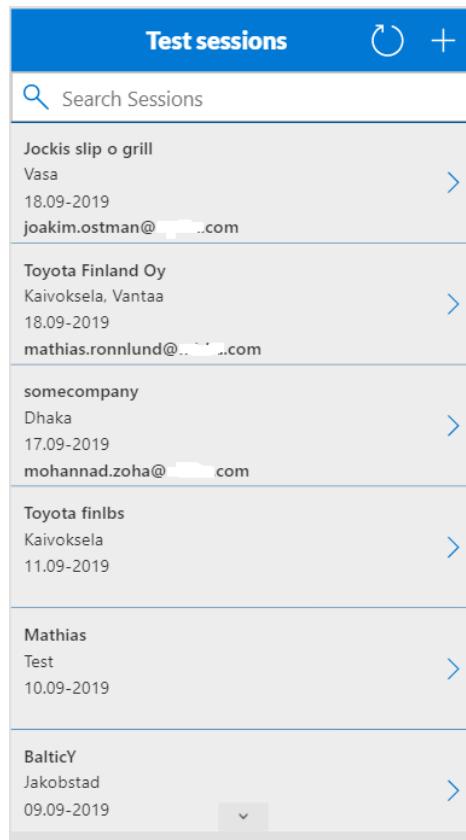
**Figure 20.** Database connections

All the database connections needed are connected successfully (see Figure 20) and after that all the screens are named based on the database names to make it easier for the customer to easily understand which screen belongs to which database information and with all the properties included on each screen.

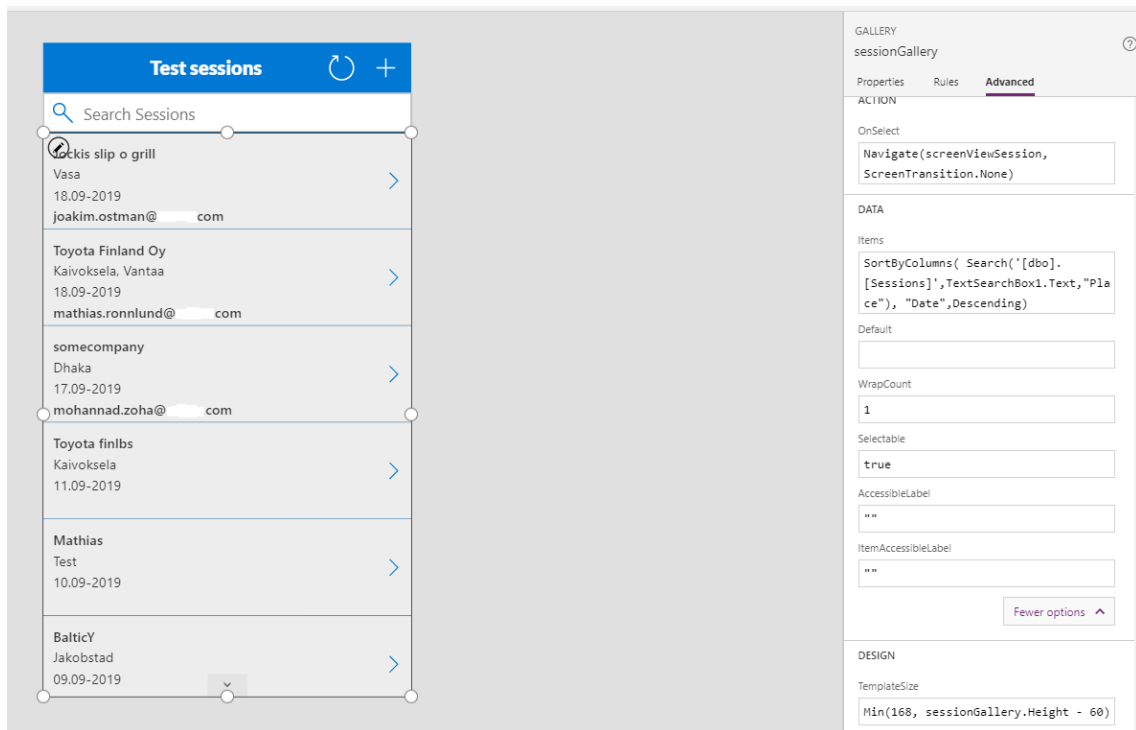


**Figure 21.** Screens executed for the App

Screen brown session has the view of all the sessions listed according to the figure below.



**Figure 22.** Test Session view for the app



**Figure 23.** Test Session advanced options View

The database table Sessions included Id, Date, Place, Company, Country, Creator and CreationDate where the Id and CreationDate is hidden from the app view but the information is stored in the database automatically. As shown in the figure (see Figure 19) there is “Search Session” box which is a PowerApps UI and needs to be hard coded to make the search function work. However, the gallery is the whole page which has items connected with the database server below the Data option (see Figure 22).

**Items:**

```
SortByColumns(Search ('[dbo].Sessions',TextSearchBox1.Text,
“Place”),”Date”,Descending)
```

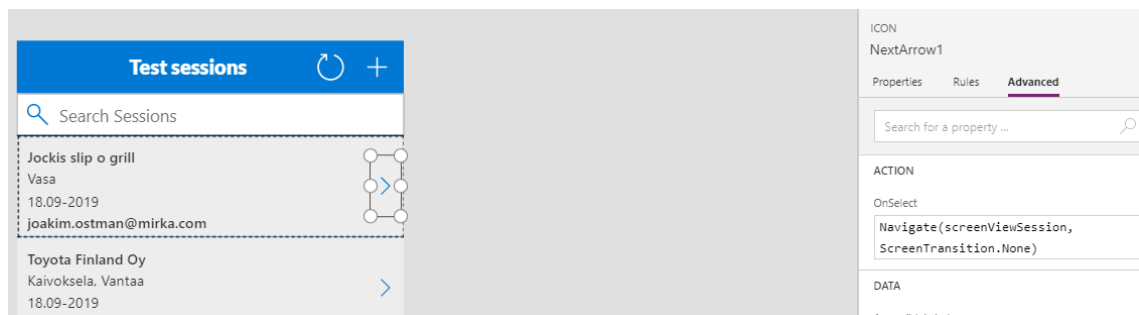
Basically, what this code does makes the Search box work by searching all the values that are determined in the Sessions database table. Also, listing the new sessions made by the user. The company, place, date and creator are shown in the screen and saved to the database when the user saves the session which will be shown in the addSessions screen.

	Id	Date	Place	Company	Country	Creator	CreationDate
1	12	2019-07-28 21:00:00.0000000	Yritys A	COM3	FIN	NULL	NULL
2	15	2019-08-14 21:00:00.0000000	Company qwe444	ggfhtyhn	FIN	NULL	NULL
3	27	2019-08-20 21:00:00.0000000	newone	ry	SWE	NULL	NULL
4	29	2019-08-18 21:00:00.0000000	TestSessionNew	USCOMPANY	US	NULL	NULL
5	36	2019-08-25 21:00:00.0000000	mathias place	Some compa	SWE	NULL	NULL
6	37	2019-08-26 21:00:00.0000000	NewMohannadDev	MohannadZ	FIN	NULL	NULL
7	38	2019-08-27 21:00:00.0000000	wer	NULL	NULL	NULL	NULL
8	40	2019-09-01 21:00:00.0000000	Today'sNewStuff	InDevatus	FIN	NULL	NULL
9	41	2019-09-03 21:00:00.0000000	kaivoksela Vantaa	toyota fin	FIN	NULL	NULL
10	42	2019-09-05 21:00:00.0000000	Mathias test place1	Mathias te	FIN	NULL	NULL
11	49	2019-09-08 21:00:00.0000000	Jakobstad	BalticY	FIN	NULL	NULL
12	53	2019-09-09 21:00:00.0000000	Test	Mathias	FIN	NULL	NULL
13	57	2019-09-10 21:00:00.0000000	Kaivoksela	Toyota finibs	FIN	NULL	NULL
14	66	2019-09-16 21:00:00.0000000	Dhaka	somecompany	Bangladesh	mohannad.zoha@...com	2019-09-17 07:34:02.2666667
15	78	2019-09-17 21:00:00.0000000	Kaivoksela, Vantaa	Toyota Finland Oy	Finland	mathias.ronnlund@...com	2019-09-18 12:29:00.0000000
16	79	2019-09-17 21:00:00.0000000	Vasa	Jockis slip o grill	Finland	joakim.ostman@...com	2019-09-18 13:35:09.4366667

**Figure 24.** Database view of the information saved

The above ones were just for testing purpose. The last three in the table show the information which are listed in the PowerApps session screen which are being saved in the Microsoft SQL server (see Figure 19).

Then, after doing so there is an arrow function which navigates to a page showing the information being saved in View Session screen, making it easier for the user to see whenever it needs to be edited or viewed for some purpose.



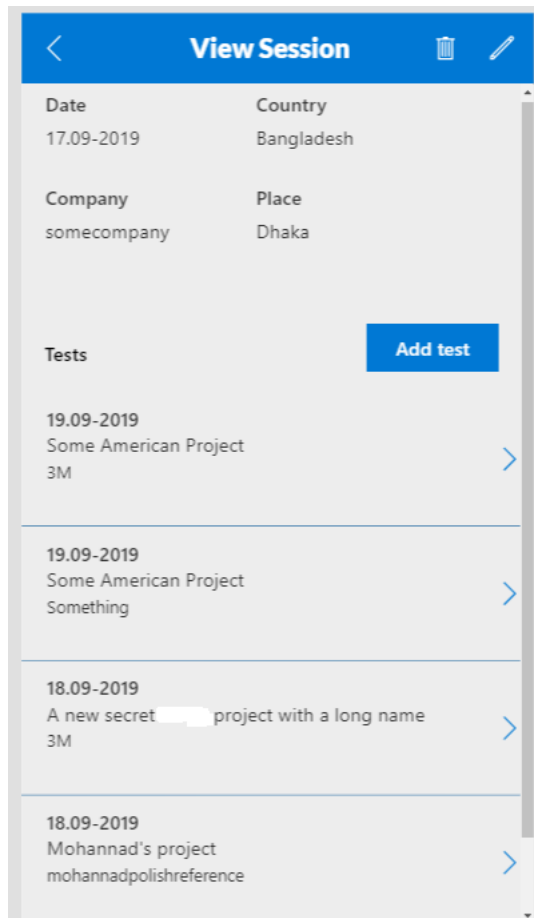
**Figure 25.** Navigation to another screen

When the arrow is clicked it will lead to another page which needs to put in the Navigate function to initiate which page it should lead to. All this is related to actions so it is below the actions toolbar.

onSelect:

Navigate(screenViewSession,ScreenTransition.None)

This function directs the display screen to View Session as shown in the code without any visual adaptation. (see Figure 26)



**Figure 26.** View Session screen

First, the Add session page should be explained properly before continuing with view session screen. So, the add session is basically where all the sessions are added and listed in the test session page which was demanded by the customer to be the first page for the system.

The screenshot shows a mobile application screen titled "Add a test session". The screen features a blue header bar with a close button (X) on the left, the title "Add a test session" in the center, and a checkmark button on the right. Below the header, there are four required fields, each marked with an asterisk (\*):

- Date:** A text input field containing "19.09-2019" and a calendar icon on the right.
- Country:** A dropdown menu with "Bangladesh" selected and a downward arrow on the right.
- Company:** A text input field containing "somecompany".
- Place:** A text input field containing "Dhaka".

The form is enclosed in a light gray border with white circular handles at the corners.

**Figure 27.** Add session screen

The data source used is the same in this screen that is `dbo.Sessions`. All the fields are added accordingly. PowerApps has the options to view, add value, and edit the value and store it to the database. Once all the information is added the tick button is clicked which leads to the main page. In this page the challenge was to make the combo box for the Country field (see Figure 27 & Figure 28), the logic was to use combo box as it allows to search for countries and add country easily making it user friendly and easy to use.

DATA

DataField

DisplayName

Required

Default

Update

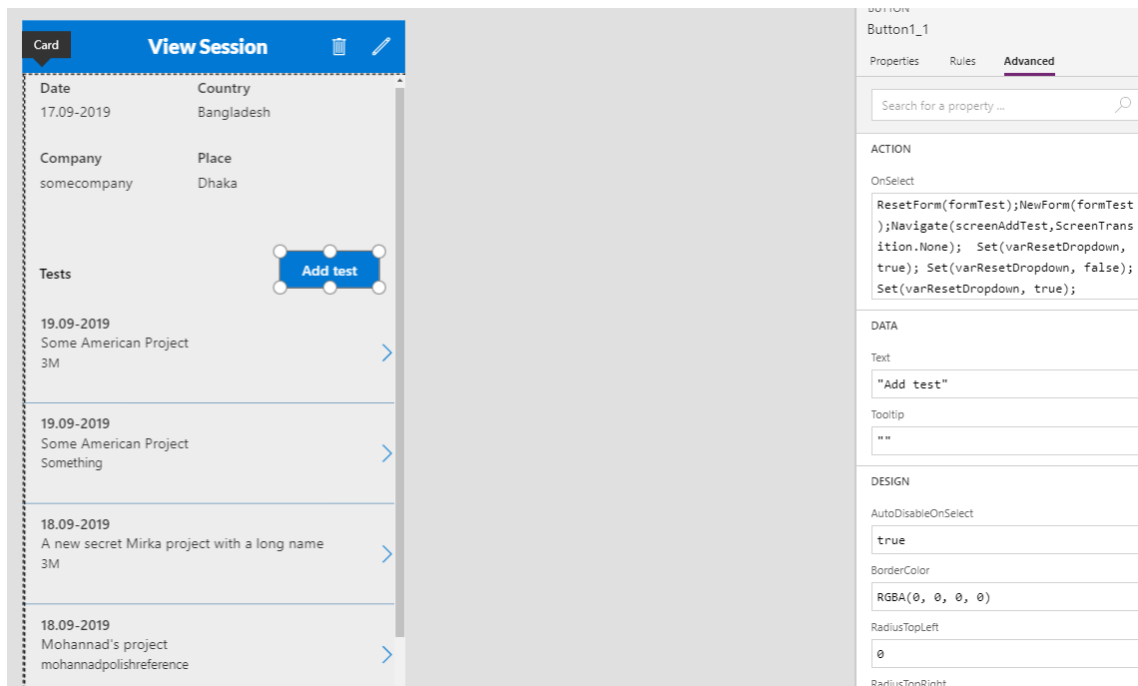
AllowedValues

**Figure 28.** Combo box and allowed values for country field

All the countries are listed accordingly, and the sort function allows to list it alphabetically. Also, as mentioned the combo box selected value allows the user to search for countries when the dropdown is opened.

Now, discussing about the viewing session saving the details of the selected session. In a session a user can add a test which can be either abrasive or polish. Abrasive and polish information are loaded when the “Add test” is clicked. (see Figure 29)



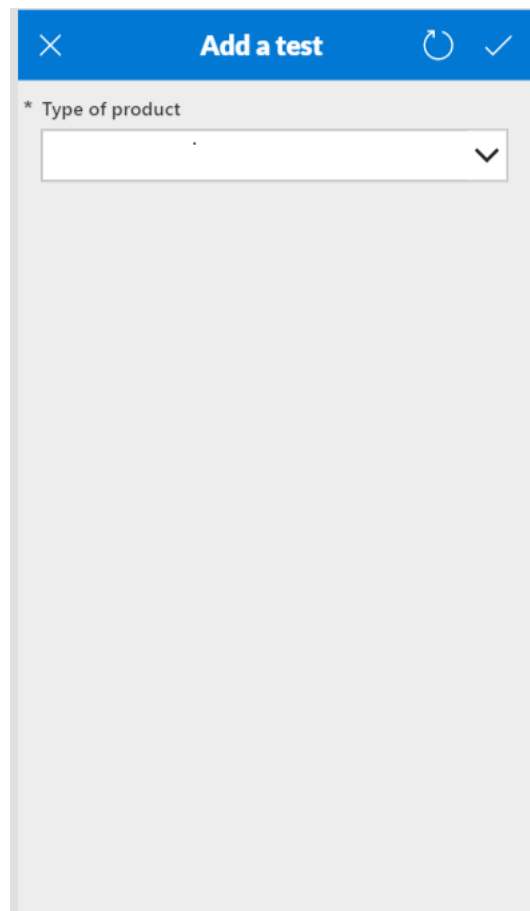


**Figure 29.** Add test functionality in view session screen

As add a test falls under an action. The code determines what should be viewed when the screen is steered to Add a test screen.

OnSelect:

```
ResetForm(formTest);      NewForm(formTest);      Navigate(screenAddTest,
ScreenTransition.None); Set(varResetDropdown, true); Set(varResetDropdown,
false); Set(varResetDropdown, true);
```



The image shows a mobile application screen titled "Add a test". At the top, there is a blue header bar containing a close button (X), the text "Add a test", a refresh button (circular arrow), and a checkmark. Below the header, the screen displays a form with a label "\* Type of product" and a dropdown menu with a downward arrow icon.

**Figure 30.** Add a test screen

According to the code mentioned, formTest is actually a list of records from the add test page. Reset Form function allows to reset the form every time a user wants to add a test, creating a new form hence the NewForm functionality is required for that. Next, it navigates to the add test page (see Figure 30) and the dropdown has values abrasive and polish, but it will show a blank product when it is first loaded to the page that is when varResetDropdown comes into play, resetting every time the user goes back and comes to add test screen.

	Excellent	Better	Equal	Weaker
* Overall Cut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Initial Cut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Lifespan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Loading Resistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Pilling Resistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Grain Adhesion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Edge Wear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Dust extraction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Manouverability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Summary	<input type="text"/>			

**Figure 31.** Add a test view for Abrasive product

	Excellent	Better	Equal	Weaker
* Scratch Removal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Polish Cut Speed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Polish Applicability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Residue	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Smell Polishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Feeling Polishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Splashing Polishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Achieved Gloss Polishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Overall Feeling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
* Summary				

**Figure 32.** Add test screen for Polish product

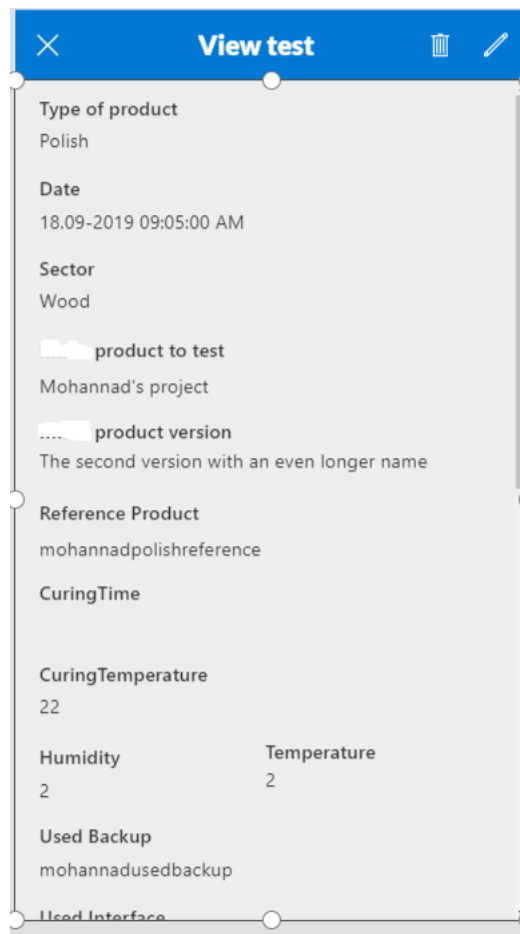
All the fields are mandatory hence the asterisk signs. All the fields are from the database tables which is available in the database server. However, the view differs from abrasive and polish products. The changes will be clearer when seen in the figures. (see Figure 31 & Figure 32).

The screenshot displays a SQL Server Enterprise Manager window with a query result grid. The grid has 30 columns and approximately 50 rows of data. The columns include: Sessid, TestedProduct, TestedProductVersion, ReferenceProduct, InitOut, Overcut, LhsPan, LeadingResistance, RflbResistance, GainAdhesion, EdgeWear, DuctExt, Moisturability, PubsApplicability, PubsCutSpeed, SplashingRating, ScratchRemoval, AcheatClassPobling, Residue, FeewingPobling, and SoilPobling. The data is organized into several groups, with some rows highlighted in yellow. The interface also shows a message pane at the top and a status bar at the bottom.

Figure 33. Database server with all the test data.

All the test data information is saved in the database. (see Figure 33)

After all the fields are filled out and it is saved leading to the last screen of the application that is the view test screen.



**Figure 34.** View test screen

After all, completed it will store the information about the products either abrasive or polish based on the user demands and then the company will be able distinguish between the tested products and reference products based on the information saved.

## 5. Conclusion and Future Work

Developing an application from scratch can be challenging yet very informative. Technology will always keep on growing and it is the utmost responsibility for developers to learn new aspects every day. For this thesis, the extensive focus was on the field testing and database development. Field testing is not so broad but yet a very powerful and efficient technique carried out by industries to come up with the best possible business solution or updated materials. In the same way, the database plays a fundamental aspect in storing and updating information using Microsoft SQL Server. Eventually, PowerApps was a crucial element too for the thesis and it leads to the successful completion of the thesis.

First, field testing is discussed with all the previous work that has been done with the help of field testing. Then, the perspective of field testing techniques is also mentioned in the paper that allows us to carry out a good field testing approach so that a good business is carried out in the organization. Then, all the demanding methods of field testing is also said to fulfill the best performance of a business product.

Second, the crucial part of the thesis was to understand how the database is connected to a field testing mobile application. Luckily, the database concept is comprehensive making it is easy to gather data from different resources and store them. Various types of database management system including how data can be manipulated, inserted, and deleted is mentioned in the paper. The database used for the project is Microsoft SQL, it is secured, easy and beneficial software for company premises.

Third, the overall application implementation was to accomplish a PowerApps application. PowerApps is a tool provided by Microsoft which is very powerful and mostly used in different organizations to make a web-based or mobile-based application for their own beneficial needs. It is very less time consuming yet very efficient. Different aspects of PowerApps infrastructure is mentioned in the paper.

In the new modern era, it is important to develop a fast-growing process of applications that is easy to use and understand. Every automation has ways to improve and there is definitely a bright future with PowerApps applications. For this purpose, the development of field testing applications in PowerApps can be improved using machine learning algorithms, there is an option in the application where a developer can use AI model to execute operations like detection of objects, classification of texts and most importantly predicting. However, there is still not enough documentation on how to use it and once there are more study and research based on it, the application can be developed even further with powerful machine learning hi-tech automation enhancing field tests.



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