Requirements Analysis and Physical Data Model of e-Suripreneur Database

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Abstract – **E-commerce appears to be a promising solution to resolve poverty in Malaysia. Consequently, a novel platform to assist the B40 in e-commerce called e-Suripreneur is being developed to prepare and assist B40s in starting their own online business. This paper presents the database design aspect of the project: from design considerations and data mapping into the MySQL database. The Requirement Analysis (RA) and Physical Data Model (PDM) was presented, and key design considerations have been deliberated in this paper. The findings of this research will be used for the development of the e-Suripreneur system.**

Keywords – **E-commerce, software engineering, database design, database visualization.**

1. Introduction

The emergence of the global CoVID-19 pandemic has forced humanity to rely on technology for its survival [1]. E-commerce (the purchase of goods through online medium [2]) appears to be a promising solution to resolve poverty in Malaysia as it provides a viable long-term solution for self-reliance, especially for the (B40, Bottom 40%) hardcore poor. E-commerce also appears to be resistant to the challenges of global pandemics, as demonstrated by increased use of e-commerce, Amazon's record profits and increased revenues of Malaysian e-commerce companies during the current CoVID-19 pandemic [3]–[6].

The COVID-19 outbreak has had a significantly positive impact on e-commerce. as consumers have been forced to stay home due to social distancing measures. This has led to a rapid shift from physical stores to online stores, resulting in a dramatic increase in online sales and a surge in demand for e-commerce services. The increased safety, availability of products, convenience, and competition that have resulted from the pandemic have all contributed to its growth. Among the reasons identified are:

- Increased safety: COVID-19 has made people more conscious of safety and hygiene. This has led to an increased preference for online shopping, as it allows purchases without physical visits to the store.
- Availability of products: The closure of many physical stores has led to a decrease in availability of products. As physical stores are closed, e-commerce had become the only way for consumers to access certain products. This has made e-commerce more appealing and has helped to boost sales.
- More convenience: E-commerce provides more convenience as it allows customers to shop from the comfort of their own home, thus increasing sales.
- Increased competition: With more people turning to e-commerce, there has been an increase in competition among e-commerce companies to provide better services and prices. This has made e-commerce more competitive and has helped to drive down prices.

On the other hand, the hardcore poor are particularly vulnerable to the impacts of COVID-19. They are more likely to experience food insecurity, loss of income, job insecurity, and lack of access to health care. Due to limited resources, they are less able to afford protective equipment and adhere to social distancing measures, leaving them more vulnerable to infection. They are also more likely to be in occupations deemed essential, such as grocery store clerks, healthcare workers, and delivery drivers, putting them at risk of exposure. This is especially worse for women, as the female hardcore poor are more likely to be in insecure and low-paid jobs,

meaning they are more vulnerable to job insecurity and income loss.

In Malaysia, the acronym B40 is an acronym for Bottom 40 percent, which is a term used to refer to the bottom 40 percent of households in Malaysia based on income. This group of households generally earns an income of MYR 2,500 or less per month and faces greater economic and social challenges than the rest of the population. The government of Malaysia has identified the B40 households as a priority group in terms of providing assistance and support to help them increase their income, improve their quality of life, and break the cycle of poverty. This includes providing access to education, healthcare, housing, and employment opportunities. The government also provides direct assistance through cash transfers, such as the *Bantuan Sara Hidup (BSH)* program, and through subsidies and loans.

Realizing that e-commerce can bring a positive impact to the hardcore poor, this research aims to alleviate the socioeconomic status of the B40 group by providing tools and training towards self-reliance and targeted and precise business decisions. A novel platform called e-Suripreneur to ease the B40 into e-commerce is being developed to achieve this. The dual-language one-stop center platform doesn't aim to recreate but to assimilate and interface with various successful e-commerce, social networking, payment, logistics, training, and financing websites. Similar integrated online platforms are currently unavailable, mainly focusing on B40.

The aims of the research are three-fold: 1) to investigate, model and represent the data organization and structure to interface a portal integrating various identified popular e-Commerce, payment, training, financing and logistics provider platforms targeted for B40 women entrepreneurs, 2) to determine a suitable framework for integrating various popular platforms targeted for B40 women entrepreneurs, and 3) to devise a~ an e-Entrepreneurship Readiness Model along with index rating to measure the target audience's readiness to enter e-Commerce.

The scope of this paper is to analyze and describe the database design to represent the necessary data for the system for database implementation. Special attention was given proposing a structure that caters to the audience's requirements while being flexible to sustain its future relevance.

1.1. Database Fundamentals and Design Process

A database is a framework that organizes data into a form that allows a simplified and efficient ways to locate, explore and organize them [7]. A database is organized in multiple tables, which are interlinked through a set of relationships. The software used to manage the database is known as Database Management System (DBMS). This software provides functionalities for management and analysis of data, as well as end user and application interactions [8]. The most adopted database type is Relational DBMS that represents the data based on the relational model [9]. The Structured Query Language (SQL) is the programming language used to interact with the database [10].

In a relational database, the entities are organized into relationships. The entities are translated into a tabular form where the rows are the records, and the columns are the attributes. Each record has a uniquely identifiable key known as the Primary Key (PK). The relationships between tables are enforced using Foreign Keys (FK) [10].

Database design is the process of planning, design, and organization of data according to specific domain requirements. A well-designed database organizes the data such that there is minimal redundancy, logical organization that is easily understandable, and seamless and timely execution of queries [10]. To achieve this, databases are developed using formal design and modelling techniques, which are a series of steps to design, create and implement them [8]. Design principles involve structuring the data for accuracy and comprehensiveness, as well minimization of redundant data to optimize computational resources and reduce errors.

A proper database schema is critical to any information system. The process is challenging as it requires deep insight into the business processes throughout [11]. One of the most common high-level conceptual models to design a relational database is the Entity Relationship Diagram (ERD). The ERD describes information requirements and / or the types of information to be stored. Data is classified and relationships are identified and represented and can then be converted into logical and physical models.

Among the advantages of ERD are [12]:
- The ERD is expressive. It translates the simple structure to understand concepts, even for non-domain professionals.
- Facilitates discussions between the developer and user leading to new ideas and refinements of the database design.

- The model is software independent. It is consistent across different DBMS platforms.

Good database design principles are condensed into several fundamental rules [9]:

- A relation is defined as a set of records that possess the exact attributes. A record typically represents an object and information about that object. These objects can be physical or concepts. A relationship is described as a table, which is organized into rows and columns.
- Each data in the table should be uniquely identified and modified independently. In an RDBMS, each row represents entity instances and is uniquely identified by a Primary Key (PK). When a new record is written, a new unique value for it is generated and this would be the key that the RDBMS uses primarily to access the table. Alternative unique keys may also be defined (Alternate Key (AK)). They may combine several attributes to make them unique.
- A row in a table can be linked to other rows by including a special attribute known as the Foreign Key (FK). FKs are not required to have unique values in the referencing relation. When a PK migrates to another table, it becomes a FK in the other table. The FK is added to the referring table and linked to the referred table's PK.
- As each cell consists of a singular value, and the PK migrates to an entity table the design pattern can be represented as a one-to-one or one-to-many relationship. Most RDBMS designs resolve complex many-to-many relationships by decomposing the relationship into an additional table that contains PKs from both the tables. The relationship itself becomes an entity and the resolution table combines the two FKs to become a unique Composite Key (CK).
- Because of the rules listed above, the data type for PKs and FKs are usually system-assigned integers for efficiency and clarity.
- Normalization is a procedure to minimize non-atomic and duplicate data. During design it must be performed to prevent data manipulation anomalies and preserve data integrity.

1.2. Recent Works on Database Design

In Joshy et al. [13], a Microsoft Access-based database was developed for students, researchers, academicians, and policymakers to monitor Indian fish import data. The researchers described the design and implementation of various database objects to store, retrieve and manage the data.

Research by Siddiq et al. [14] designed and developed an online Customer Relationship Management (CRM) system aimed to increase efficiency in managing customer service. Among the problems faced by the traditional customer management approach is data redundancy. Furthermore, minimal data integration caused an inability to tailor customers to suitable loyalty and promotion programs. Data was collected for RA. Next, the database was designed, actor identification. A functional analysis was performed to identify data structure, users and usage scope and functionalities required. The system was implemented using Laravel PHP and MySQL. User acceptance tests suggest that the system was favorable with an 85.71% acceptance rate.

In Renaudie et al. [15], the Neptune Sandbox Berlin (NSB), a database storing marine plankton fossil data was upgraded to improve the data management efficiency of the ageing database. Additional fields were added and / or updated considering new requirements. The researchers also integrated outlier detection algorithms to ensure data integrity. Development was done using Django Python (for the web interface) and PostgreSQL (database).

Soukup and Sykora [16] designed a database structure of a web application to display information about the development of Czech Republic's 19th and the 20th century rural architecture. Citing the importance of effectively designed database structure to store historical data, among the considerations for database design is a variety of data types. The research begins with a use case study to determine the system's functional requirements and the roles of specific users. The database was designed to store various types of data (pictures, plans and text) to store the various maps, floor plans and orthophoto images. Development was done using PostgreSQL and PHP Nette as the database and web interface, respectively.

In Putra and Ranggadara [17], database design for work order application was presented. Work Order systems are used to manage repair orders in a company. Traditional methods are prone to data duplication and misuse leading to the need of organized and centralized data storage. The design and development process were guided by Unified Modeling Language (UML). UML provides a detailed and structure methodology for designing systems, creating functional, user and data models.

Reznikova [18] designed a database to monitor recycled household appliances' reliability. The database schema was proposed based on the product

life cycle and processing stages of malfunctioning equipment.

Researchers in the municipality of Eilat, Israel designed a database to organize and display smart city data to attract technology investments into the city [19]. A study on similar platforms suggests that web-based systems generally incorporated search, informational reporting and statistics to users. The researchers then analyzed the user base and their use cases for the system.

In Nurhadryani et al. [20], a database design to monitor and provide early warning for food insecurity was presented. The database was constructed by designing, implementing, and optimizing a NoSQL database. The preliminary database's cohesiveness analysis indicates five entities with strong, 16 with moderate, and three with low cohesiveness, respectively. Refactoring managed to reduce the number of low-cohesion entities boosted the average cohesiveness from 0.62 to 0.67 after refactoring. To compare the pre- and post-refactoring performance, the authors analyzed the response time and discovered an improvement in access time by a factor of 1.38. The findings of the experiment enhancing the coherence had a significant positive effect on the performance of the NoSQL database.

Salim et al. [21] developed a database to organize and store Water Quality Index (WQI) based on Geographical Information System (GIS). GIS location and WQI information (Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solid (SS), Ammonia Nitrogen (AN), and pH were collected and stored in a database. These findings suggested that GIS can provide interactive visual analysis to improve large-scale water quality management systems.

Alseelawi et al. [22] designed a database to store medical treasury information. The database contains information on medical supplies to estimate the annual demand for medications to fulfil the hospital's healthcare responsibilities. The system was designed using the UML, while development used ASP.NET (Active Server Pages) to build the base where drug data is stored, Next, steps to build the proposed system using the description language use cases were presented.

A database-driven Expert System (ES) for herbal medicine inference was presented by Melina et al. [23]. The inference of the ES was stored in the SQL database as a set of rules and the context in which it was applied. Several levels of designs were presented, such as Data Flow Diagram (DFD), Conceptual Design, Logical Design, and Physical Design. The SQL inference mechanism enables the ES to be dynamic, up-to-date, accurately, and accessible.

Inegbedion and Dickson [24] developed a database for cataloguing student projects using MySQL database. Information about students' thesis were previously stored in a time-consuming manual method. The project aims to digitize this process and make it more efficient. The system's usage flow, the structure of the database, and the user interface were deliberated in the paper.

1.3. Works in Business Readiness Modeling (BRM)

Business readiness is a key factor for budding entrepreneurs. It is essential for entrepreneurs to have a clear understanding of the various components of their business, such as the operational environment, financials, and legal considerations. They must also be aware of the risks and rewards associated with their venture and have the tools and resources in place to manage them. Additionally, entrepreneurs must be able to develop and implement a business plan that outlines their goals, objectives, and strategy. Having a sound business plan and a clear understanding of the risks and rewards of their venture will help entrepreneurs to make informed decisions and be successful in their venture.

This section describes recent relevant works in Business Readiness Modeling (BRM) for the adoption of new technology (like e-Commerce adoption among the B40 poor in this paper). Adopting new technologies poses some risks to the recipient individual / institution / nation. Therefore, business readiness studies help model the adoption process prior to implementation to help mitigate some of the risks [23]. Several recent studies in business readiness were found. However, all of them primarily focus on the entity's readiness to accept new technology at an institution, state or national level, not at the individual level.

In Lubis et al. [25], the researchers attempted to measure the e-commerce readiness of MSEs in North Sumatra, Indonesia to support tourism. The study examined several factors, namely business entity's readiness, and technology readiness of its population. Their studies found that businesses may benefit from the technology by incorporating e-commerce business activities in their business, and actively engaging the technologically savvy youth to assist.

A study conducted by Kamanghad et al. [26] attempted to measure the business readiness to integrate new technology called Mobile Customer Relationship Management (MCRM) into their business process. MCRM is used to manage business relationships with its customers using mobile technology. From the business perspective, MCRM is a complicated project that requires a huge investment and is prone to failure. Therefore, the readiness model is vital to test the acceptance before implementation. The VERDICT model was selected to represent MCRM technological readiness. The model considered four main factors for readiness, namely management, information technology, people, and process. The authors claimed that the VERDICT model is suitable for modelling MCRM technology acceptance in business entities.

A model to gauge a nation's readiness to establish e-commerce is presented by al Natour [27]. The study identified several themes key to the success of e-commerce in a country – politics and economics, internet, logistics and shipment, payment method, legal regulations, movement time and cultural stability. The researchers discovered these factors for the success of e-commerce in a country, namely political stability, internet connectivity, logistics & finances support, laws & regulations, and sensitivity to cultural norms. The authors constructed a model using several established frameworks such as the Battery Charge Model, Spiral Model, and E-Commerce Tier Matrix based on these inputs.

In Ikumoro and Jawad [28], researchers explored the readiness of Malaysian SMEs to integrate Intelligent Conversation Agents (ICA) into their e-commerce systems to automatically manage customer inquiries and complaints by generating human-like responses to customer queries. The readiness model combined the Unified Theory of Technology Acceptance & Use of Technology (UTUAT) and Technology-Organization-Environment (TOE) models. The conceptual framework established 11 factors (i.e., employees technology know-how, performance expectancy, perceived relative advantage, perceived technology security, chief executive officer (CEO) and manager characteristics, perceived adoption cost, facilitating condition, social influence, hedonistic drives, and normative and mimetic pressures) to model SMEs readiness for ICA incorporation.

Recognizing that traditional forecasting models are unsuitable in predicting modern digital adoption trends, a model of business readiness towards digitization was created by Hamid et al. [29] using a neural network trained on various business monitoring, operation, and management data. The researchers adopted methods commonly used in statistical, financial, and marketing analysis to build the neural network model.

Research by Qiu and Yang [30] presented an e-Commerce readiness model for the Heilongjiang rural province in China. The researchers used the Entropy Weight Method (EWM) based on the established Organization for Economic Co-operation and Development (ODEC) and Confederation of Indian Industries (CII) reference models. The authors explained the choice of EWM as a method that reduces the effect of subjectivity by traditional main observation and evaluation methods. The EWM model considered readiness, application and impact factors on data spanning from 2010 to 2017. The research found that e-Commerce success factors are 1) readiness of connectivity and infrastructure to support e-Commerce, 2) how the technology is integrated and used by the people, and 3) positive results affecting the development, living and social standards of the residents. The model found that the implementation of e-Commerce was well managed in Heilongjiang, with support for economic growth in the area.

Salient points from the review in this section suggest that:
- BRM helps reduce risk by simulating readiness to adopt a new technology before committing funds and effort to perform.
- Works on BRM primarily focus on Institutional / State / National level, but there is minimum work focusing on individuals embarking on e-commerce.

2. Methodology

A Conceptual Model (CM) presents an overview of objects within the scope of the system as well as their relationships. The CM begins with a determination of high-level business objects in, and the scope of the system. This information is collected during the requirements gathering phase. This initial model is evolved into more detailed models as the design matured. In this paper, the ERD is used to represent the conceptual model. The entities are defined based on the scope of the e-Suripreneur system. There are three different relationship types in a relational database: namely one-to-one (1:1), one-to-many (1:M) and many to many (M:N).

The Logical Data Model (LDM) expands the conceptual model by defining the attributes for each entity. Additionally, operational and transactional entities (entities that are created to decompose and

simplify complex relationships between main entities) are also defined together with their attributes. Among the crucial step in the LDM is the methodical approach of normalization. Normalization is used to minimize redundancy and maintain consistency across database operations. The process should consider the balance between storage space, execution speed, computational cost, and data redundancy in performing this process. Like CM, LDMs are platform independent.

The Physical Data Model (PDM) represents the platform dependent design blueprint of the database. It expands the LDM by describing the technical parameters associated with the table attributes. As the PDM is platform dependent, the limitations and reserved keywords of the DBMS needs to be considered during design.

3. Results and Discussion

3.1. Requirements Analysis (RA)

RA studies the requirements and expectations of user to determine the functionalities and scope of the system. The RA was conducted by collaborating with an e-Commerce domain expert to understand her vision for the project.

The system is intended to assist the Bottom-40% (B40) and hardcore poor women to set up their own successful online business. The general age demographic is approximately 30 to 50 years old. The users generally have low Information Technology (IT)-literacy and low English literacy. Their access to computers is quite limited, however we expect the users to have reasonable access to low-specification Android-based gadgets, such as tablets and handphones.

3.2. Requirements Overview

The system must have a simple and easy to understand interface with relatively uncluttered and modern appearance and large, easy to distinguish fonts and background. The system is expected to be bilingual (English and Malay). A mechanism to switch between both languages should be available to the users of the system.

For ease and security of login, users should be able to register and log in using either Google or Facebook OAuth. They should be able to receive confirmation emails and verify their account using the email.

An administrator console needs to be provided to perform Create, Read, Update, and Delete (CRUD) operations for all tables in the system. Administrators should be able to perform CRUD operations on the personality test contents and videos as well.

On first login, the user must take and pass the personality test (more than 75% passing mark). If the user fails, the user will have to watch several videos to improve and retake the test until passed. These videos will be stored in YouTube but should be embedded and can be watched from inside the system.

Upon passing the personality test, the user will have access to training videos for Business Readiness Modeling (BRM). The training videos are organized into classes. The classes, in turn, are organized into modules. The administrator can add and organize the modules and classes. The videos for the classes will be stored in YouTube but should be embedded and can be watched from inside the system. After watching the training video in each class, the users are expected to answer a test. The passing mark of the test is 75%.

The passing marks for each module is 75% (the passing mark is calculated based on the average test scores of each class in the module). Users can attend as many modules as they want, and they can view their success and achievements from the system's dashboard. As the module, class and test contents are expected to change over time, administrators should be able to perform create, read, update and delete operations on the test, class, and module contents.

Additionally, the system should also support capabilities for online training using Google Meet. This includes support for setting up a meeting and conducting it online. Both the user and administrator should be able to view the results of the tests taken by the user. To financially support the system, there may be several modules or classes that can be marked as premium. These premium contents are available by paying some fee. The user should be able to pay for this type of content using Stripe integration.

For the Bricolage component of the system, users and the administrator can enter information about their business using a Google Maps pin drop and address search interface. Administrators can also enter information about businesses in a particular area using a similar interface. The Bricolage system is intended to show available businesses in a particular area that can either (i) support their

business (such as supply of raw materials, etc.), (ii) possible competition with their business, and (iii) existing businesses that can become consumers for the user's products. The end objective of this Bricolage system is to assist the users in selecting a suitable location to start their own business.

As marketing is a key part of any business, users of the system should be able to market their products in the form of Facebook Posts, Instagram Stories and Twitter Feeds automatically using one-click functionality. The idea is that the users enter the marketing advertisements and it should be posted to the three social media automatically using a single click.

For the e-commerce part, it is expected to be integrated with the system, with functionalities for buyers to view products, add them to their carts and make secure payments. Buyer orders should be recorded and informed to the seller to pack and ship to the buyer. After an order is received, the seller should be able to update the tracking number for the buyer's reference.

A common problem faced by the B40 sellers is keeping track of their business finances. The seller should be able to record their financial transactions using a simple ledger system. The ledger should have a two-column display that records the expenditure and income of a particular business owned by the user. Sellers should be able to perform create, read, update and delete operations on accounts belonging to their business.

3.3. Salient Points

The following salient points were discovered:
1. The system should have some contact information and different user levels. The user levels control which functions in e-Suripreneur a user can access. Users must be unique and verifiable using email address. Contact information is needed. The password must be encrypted for security.
2. Administration of e-Commerce businesses requires high management and technical skills, which the B40 hardcore poor lacks. They can benefit from targeted training customized to develop specific skillsets. Skill-based assessment needs to be performed to assess the knowledge and skills of users. Assessment questions should be organized into categories and linked to specific training classes. The user may retake the assessment until passed. The assessment results need to be stored. The results are used by the e-

Suripreneur Expert System (ES) to recommend suitable training modules.
3. Each user has a different level of readiness that needs to be assessed and evaluated. A low level of readiness needs specialized training is required to improve.
4. The e-Suripreneur system includes a Geographical Information System (GIS) to assist users in searching for ideal locations to start a business (strategic areas not saturated by competition). Location information of Malaysian companies (such as area, district, and state) and the goods produced by these businesses need to be stored. The companies need to be classified into business sectors and categories for classification.

3.4. Physical Data Model (PDM)

The PDM is shown in Fig. 1. PKs in all tables were set to unique auto-generated integers by MySQL. The number of bits to represent PKs depend on the estimated future records to be stored in each table. The integer size of PK is adjustable from 1-bit to a maximum of 255-bit. For example, the table state is represented by 4-bit integers with a maximum value of $2^4 = 16$. This would be sufficient to store all the states in Malaysia (13 states). On the other hand, the users' table is represented by 255-bit integers, as we expect a significant number of records to be stored in this table.

Tables state, district and area store location information stored in table users and business. Table areas are linked to district and state using FK state_id and district_id. Consequently, the table district is linked to the state using state_id field in the table. These FK are essential for designing the Graphical User Interface (GUI), which allows the district and area selection to be narrowed down as the user selects different states from the dropdown menu.

Tables roles and role_permissions control the accessibility of specific menus and functions for different user roles. Two types of users are defined: normal user and administrator. The access to certain pages can be modified by updating the records in role_permissions.

Table user stores the user's personal and account information. Apart from this information, the passwords are stored in hashed form for increased security.

Tables personality test and personality test question category store the questions for the business readiness test and the question category. When the

user logs in for the first time, they must take the business readiness test. The answers are stored in table personalityanswers. Based on the answers, the system then updates the score in table userptqc and recommends the customized training options for the user. The corresponding training links (URLs) for the personality test are stored in table personalitymodule.

Tables user business and business are used to store information about self-owned or general companies. The records here are linked to tables state, district, and area to organize them into locations. Additionally, the businesses were also classified into smaller categories by linking them to tables business sector and business category. Additionally, the products produced by these companies (table product) are also linked together with the product type (table product type).

Training classes (table class) contain the links to classes that the users can take. Several classes can be organized into modules by linking them to table module using FK module_id. The modules in the table module are further linked to different skills in table skill and user skill set. User competencies are assessed by asking them to answer a set of questions, the answer of which is stored in the table test.
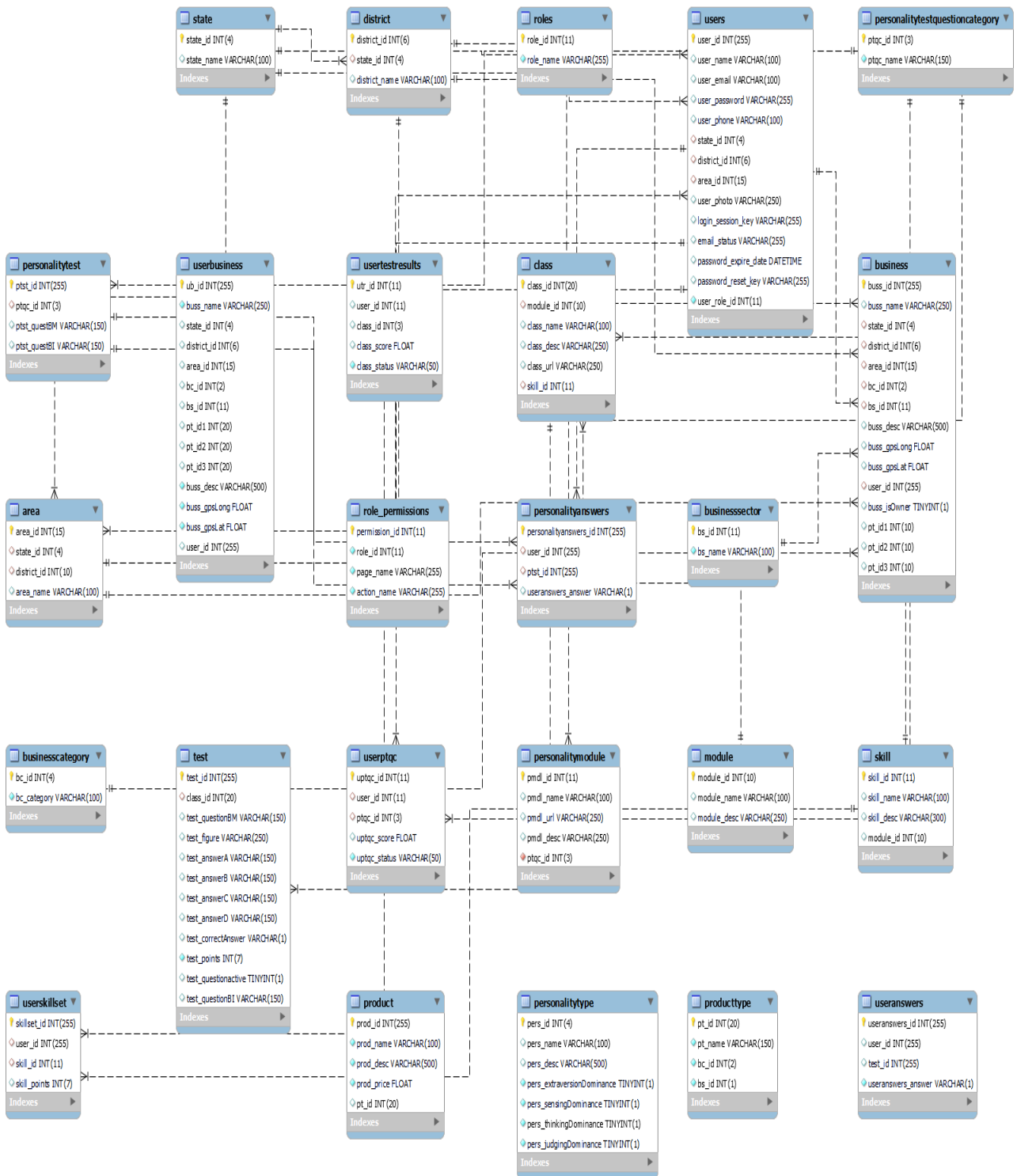
Figure 1. PDM of e-Suripreneur system

4. Conclusion

A novel platform to assist the B40 in e-commerce called e-Suripreneur is currently being developed to prepare and assist B40s in starting their own online business. The RA and PDM of the e-Suripreneur system have been presented. Fundamental considerations during design have been deliberated.

The Entity Relationship (ER) method used for the PDM provides a visual representation of the data, which is helpful for understanding complex databases and are well suited for representing the data requirements of many types of applications. This model uses tables to store data and allows for relationships between tables to be defined using SQL queries. This model is widely used in web-based applications.

Using the ER, relationships between entities can be easily identified and manipulated using ER models. This model type is flexible and can be quickly modified to reflect changes in the underlying data. Additionally, ER models are less prone to data anomalies, which can occur with other database models as they implement referential integrity constraints, which ensure that data is consistent and accurate. This model was chosen as the database of choice for this project is MySQL, which implements the relational model in its structure.

For our future work, we are also considering other database models, namely Object-Oriented Database Model (OODM), Hierarchical Database Model (HDM), and Network Database Model (NDM).

OODM uses objects (data items) as the basic unit of data storage and manipulation. It allows for objects to be arranged in a hierarchy for easier data management. Advantages of this model include faster query response times, better scalability and flexibility, and ability to store complex data. However, the drawbacks include the need for specialized software, the complexity of learning how to use the database, and the difficulty of data migration.

Another option, the HDM, arranges data in a tree-like structure, with each record having a single parent record and zero or more child records. This model is commonly used in database applications such as file systems. This model type facilitates navigation and query optimization, and its flexibility in adding and deleting records. However, there is the need to define relationships between records, and data consistency issues are common in this type of model.

Finally, the NDM uses a network of records to represent data. It allows for records to have multiple parents and children and is commonly used in database applications such as banking systems. This model is well-known Advantages of this model include its ability to represent complex relationships between records, scalability and flexibility. However, this type of model are known for its complexity and difficulty to maintain data integrity and consistency, especially when the number of records is high.

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