DEVELOPMENT OF A PREDICTIVE MODEL FOR RESEARCH PARADIGMS AND PHILOSOPHIES

DISSERTATION (DFCOM92)

by

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DECLARATION

I Stanford Morore Mphahlele (Student No: 62231588), declare that "***Development of a Predictive Model for Research Paradigms and Philosophies***" is my own work and all the sources that I have consulted have been duly acknowledged throughout the text and by means of complete list of references.

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ABSTRACT

Although research paradigms and philosophies are highly regarded as frameworks and guides for choices of methods, application thereof is not evident. One of the reasons for the relatively limited application is the complexity and understanding surrounding paradigms and philosophies, making it hard for scholars to determine their stances and implications. This study describes a model for automatically predicting peoples' paradigm and philosophical stance, including meaning, and their impact on research by helping the user determine the paradigm and philosophical stance closest to their beliefs. Paradigm and philosophical attributes are automatically derived from a set of structured questions that use information matching techniques. The development of a model for Research Paradigm and Philosophy Index (RPPI) follows a two-phase approach. The first phase involves automatic extraction of key indicators from a composed database that utilises an indexing scheme with different philosophies and associated implications. The second phase applies a matchmaking technique that automatically draws information reflecting the user's attribute. This type of technology exists, but mainly in the dating and career matching fields. None exists for research paradigm and philosophical stances. The prototype system was designed and implemented to serve as a proof of concept, and was developed in Angular, using the Visual Studio Code, and Java, using Eclipse. The database was created using MySQL. The prototype system was designed and implemented to serve as a proof of concept due to the Intellectual Property nature of the product. Usability testing was conducted and results show that the participants agreed the system was simple, straight-forward to use, quite user-friendly and easy to learn, with easy navigation through menu items.

Keywords: Predictive index, Predictive modelling, Research paradigm, Ontology, Epistemology, Research philosophy

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GLOSSARY OF ACRONYMS

RPPI	Research Paradigm and Philosophy Index
ERD	Entity Relationship Diagram
API	Application Programming Interface
JEE	Java Enterprise Edition
MVC	Model View Controller
MySQL	My Structured Query Language
HTTPD	Hypertext Transfer Protocol Daemon
IDE	Integrated Development Editor
OS	Operating System
URL	Uniform Resource Locator
AI	Artificial Intelligence
NLP	Natural Language Processing
SDT	Signal Detection Theory

CHAPTER 1: INTRODUCTION

This chapter provides an overview of the literature reviewed in predictive models and the status of predictive models application. The chapter also outlines the problem statement, research goals and questions. Following the outline is a value added by the research, scope and limitations, definition of fundamental concepts and a preview of the research methodology. The chapter ends with the outline of the chapters and summary or conclusion.

1.1 BRIEF OVERVIEW OF PREDICTIVE MODELS

Predictive modelling refers to the process of using mathematical and statistical techniques to interrogate current and historic data to determine relationships and correlations in predicting future outcomes (Waller & Fawcett, 2013). Waller and Fawcett (2013) further state that it results from the area of data mining forecasting probabilities and trends. Often, the event one needs to predict is in the future. However, predictive modelling can be used for any unfamiliar occasion, regardless of when it happened (Finlay, 2014).

According to Finlay (2014), contingent upon definitional limits, predictive modelling is identical to, or to a great extent covers, the field of machine learning, as it is more regularly alluded to in scholarly or innovative work settings. At the point when sent commercially, predictive modelling is regularly alluded to as predictive analytics. Kim, Kim and Kim (2016) define the term predictive modelling as predicting future behaviour or trends based on information available at present.

Davenport (2014) indicates that no-one can capture and analyse data from the future. However, predictive analytics provides the opportunity to understand future behaviour through predictive indexes and historical data. Techniques such as machine learning, data mining, statistics and algorithms are the key components necessary for predictive

analytics (Davenport, 2014). Examples of predictive models developed from the later techniques include linear models, decision trees (classification and regression trees), neural networks, support vector machines, cluster models and naïve Bayes. These predictive models are discussed in-depth in Chapter 2, and all stress different, but similar prediction patterns.

Finlay (2014) identified benefits of using predictive models. These are:

- Many clients can be assessed and managed in only a couple of moments when using predictive models as a component of the automated decision-making system.
- Predictive models make more consistent predictions than individuals.
- A particular predictive model, when given similar information, will continuously make a similar prediction.

1.2 CURRENT STATUS OF PREDICTIVE MODELS APPLICATION

The concept of predictive modelling has exponentially increased in usage in recent times due to the developments in data and technology (Taylor, 2013). It is imperative to note that the technological trend has begun to facilitate business decision-making. Hence a vast majority of industries or organisations have adapted, and are developing, software to fast-track business performance (Davenport, 2014). It is noted that in the business market predictive tools are used for intelligence in decision-making. However, not much has been done in the field of research – the source of knowledge. The financial and retail industries apply predictive models for numerous reasons (Ala'raj & Abbod, 2015; Waller & Fawcett, 2013), including application risk scoring, solicitation response modelling, behavioural risk management, retention management, revenue ranking, fraud prevention, and many others.

According to Davenport (2014), an ever-increasing number of businesses are shifting to predictive analytics to improve their operations, increment income and to maintain the upper hand. Here are some instances that are discussed in-depth in Chapter 2:

- The public sector. Identifies and stops scams, improves service and performance, recurrent expenditures, the abuse of assets and citizen money and to distinguish criminal exercises and precedents (Finlay, 2014).
- Health care providers. Predict the medical tests and medications, and effectiveness of new procedures (Hiller, 2016).
- Health insurers. Identify patients that are most in danger of chronic illnesses of which mediations make the most remedial and commercial sense, detect and handle insurance claims fraud (Hiller, 2016).
- Insurance companies. Detect claims fraud, and decide protection costs, optimise claims procedures, maintain clients, enhance productivity and improve advertising efforts (Finlay, 2014).
- Production companies. Recognize aspects which might compromise the quality of products, decreased value of products, and optimise parts, service resources and distribution (Lee, Jun, Lee, & Lee, 2013)
- Gas, oil and service organisations. Utilize predictive maintenance technologies to detect assets deterioration, assets repairs and to alleviate unplanned health and safety matters (Taylor, 2013).
- Telecommunication companies. Lower client agitations, section clients, maintain commercial clients and create a robust business strategy (Dalvi, Khandge, Deomore, Bankar, & Kanade, 2016).

Although there are many studies on the nature and dimensions of predictive analytics in general, little is done about prediction in the area of research and knowledge production. Therefore, this study is aimed at developing a model for a research paradigm and philosophical index that will automatically predict and assist the user in determining the peoples' paradigm and philosophical stance closest to their beliefs.

1.3 CONTEXT OF RESEARCH: PARADIGMS AND PHILOSOPHIES (IMPORTANCE AND IMPLICATIONS)

This section highlights the importance and implications of misunderstanding research paradigm and philosophies.

1.3.1 Importance of research paradigms

According to Makombe (2017), it is critical to think about various research paradigms and philosophical issues of ontology and epistemology when undertaking research. The manner in which the research is undertaken can be impacted by these parameters - from outline through to conclusions - since they illustrate perceptions, values, presumptions, and the idea of reality and truth. It is accordingly critical to know and debate about these aspects so that methodologies harmonious to the kind and intentions of the specific investigation are implemented, and to guarantee that researcher predispositions are known, revealed, and reduced. According to Levers (2013), there are a few reasons why one has to consider philosophical issues prior to researching a specific field.

Easterby-Smith, Thorpe and Jackson (2012), identifies four significant reasons for understanding philosophies about research methodology:

- Empowers the researcher to improve and support the research technique to be utilised as a part of their investigation and accordingly assist the researchers to collect data and respond to research questions.
- The understanding of research philosophy will empower and help researchers with various sorts of methods and accordingly prevent improper and irrelevant works.
- Understanding the essential significance of research philosophy, its points of interest and advantages, assists the researcher to be more innovative and analytical in their technique of research.
- It can assist researchers to distinguish between, and even make, plans that might be outside their knowledge. It might likewise propose how to adjust research strategies as per the limitations of various topic or information structures.

Based on the given reasons above Table 1.1 outlined the importance of these underlying philosophical foundations.

Table 1.1: Importance of research paradigms

Quote on Relevance	Reference
"Allows researchers to identify knowledge gaps upon which to base research and the method with which the gaps are filled."	(Baldwin, 2014, p. 2)
"Once you understand the paradigm, it makes it easy to choose the research design and research methods."	(Makombe, 2017, p. 3372)
"It becomes more of an imperative as a researcher to espouse a research philosophy to guide a dissertation or a thesis and 'make explicit what is implicit' in order to illuminate research."	(Pring, 2012, p. 28)
"Knowledge of research philosophy will enable and assist the researcher to evaluate different methodologies and avoid inappropriate use and unnecessary work by identifying the limitations of particular approaches at an early stage."	(Easterby-Smith et al., 2012, p. 17)
"In essence, research paradigms address the philosophical dimensions of social sciences as phenomena to be studied."	(Wahyuni, 2012, p. 69).
"Each researcher follows important views on how they perceived the world. Furthermore, this views and assumptions will greatly affect the research strategy and methodology a researcher chooses as part of its approach."	(Saunders, Lewis, & Thornhill, 2012, p. 107)
"Provides better understanding of the research process and aligns critical aspects of the dissertations and theses, addressing various dilemmas researchers might encounter."	(Oftedal, 2014, p. 5)
"A paradigm is paramount to how people form belief systems and develop theories as well as how others form belief systems about the theories preceding their metatheories. A paradigm can be seen as the main philosophical frame of reference that guides the researcher."	(Tuli, 2010, p. 97)
"When researchers choose to follow a particular paradigm, they must do so conscious that they are aligning themselves to the precepts, principles and methodologies of that particular paradigm. This also helps the researcher to be congruent and consistent throughout the study."	(Sefotho, 2015, p. 26)
"The practical implications are that, through a deeper awareness of the ontological substructures informing studies, researchers will be more clearly positioned to iteratively reflect upon, and define how best to engage with their research projects."	(Bracken, 2010, p. 1)

1.3.2 Implications for misunderstanding research paradigms and philosophies

It is evident from the literature that research paradigms and philosophies are the most important part of research. These concepts are also regarded as the frameworks to guide researchers from the beginning through to the conclusion of a project.

However, it is important to note that when these concepts are misunderstood, it may fail to make relevant decisions for the research or adopt research methods that are incompatible with the researcher's stance. Table 1.2 outlined the implications for misunderstanding research paradigm and philosophies.

Table 1.2: Implications for misunderstanding research paradigms and philosophies

Quote	Reference
"When these concepts are misunderstood, then it is difficult to understand their interconnectedness, which may lead to failure to make the appropriate decisions for the research."	(Makombe, 2017, p. 3380)
"Without nominating a paradigm as the first step, there is no basis for subsequent choices regarding methodology, methods, literature or research design."	(Macheng, 2014, p. 80)
"It is impossible to engage in any form of research without committing (often implicitly) to ontological and epistemological positions."	(Scotland, 2012, p. 10)
"If one fails to think on philosophical issues in his/ her research it can seriously affect the quality of research itself."	(Easterby-Smith et al., 2012, p. 27)
"In fact, some doctoral theses make no reference at all to philosophy, yet philosophy must be the driving force that guides theses. This is because philosophy is like a roadmap for research without which ones' investigation lacks illuminated direction."	(Sefotho, 2015, p. 23)
"When these aspects are misunderstood, methods incompatible with the researcher's stance may be adopted, with the result that the final work will be undermined through lack of coherence."	(Flower, 2009, p. 1)
"For various reasons such as past training and skills, researchers may have unthinkingly slotted themselves into an objectivist or subjectivist position, not realising that the methods of an alternative philosophy may suit their research problem better."	(Sefotho, 2015, p. 27)

1.4 PROBLEM STATEMENT

It is vital to note that research is a fundamental activity that involves scientific processes to determine the reality derived from the assumptions on issues that relate to problem solving, both in social and business life (Kothari, 2012). Research paradigms and philosophies are mentioned in most research textbooks as the most crucial part of research and as the frameworks to guide researchers from the beginning through to the conclusion of a project. The problem is that limited application of research paradigms and philosophies exist in a broad range of scholarly fields (Mkansi, 2018; Killam, 2013; Wahyuni, 2012). The findings by Mkansi and Acheampong (2012) show related precedents of misunderstanding in the grouping and identifying of research philosophies. The majority of scholars and students do not know which paradigm and philosophical stance is closest to their belief, and what its role is in research. It is due to the complexity and misunderstanding surrounding paradigms and philosophies that many scholars would rather ignore a concept that they do not fully understand (Killam, 2013; Wahyuni, 2012). When these concepts are misunderstood it can lead to the adoption of methods contrary to the researcher's position with work being questioned by the absence of soundness (Blaikie & Priest, 2017). Makombe (2017) also adds that it will be difficult to understand their interconnectedness, which may lead to failure to make the appropriate decisions for the research. It is, therefore, worthwhile to unburden this dilemma of misunderstanding and to develop a predictive model that will help scholars and students to understand the paradigms and philosophies involved in research, for ease of depicting the cultural beliefs and attitudes from the demonstrated behaviours.

1.5 RESEARCH PURPOSE AND OBJECTIVES

The goal of this study is to develop a model for a research Paradigm and Philosophical Index that will automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs. To achieve this goal, the objectives are to:

- Compile a training database of paradigm and philosophical stance.
- Critically analyse the meaning, and interpret, the philosophical stance and paradigms into queries on the training database.
- Extract key data indicators to link and determine the predicted paradigm and philosophy through the SQL queries.

1.6 RESEARCH QUESTIONS

- What keywords and themes constitute the meaning of different paradigms and philosophies towards a relational database?
- How is the nature of the relationship and themes between a researcher and a philosophical stance?
- What are the key system indicators for each philosophy, and what underlying principles of the research philosophy predictive index outline in-depth explanations, report, and graphs of a researcher’s philosophical stance?

1.7 SIGNIFICANCE OF THE STUDY

From a theory perspective, the study will pave the way for future scholars and students to consider, and to help them to determine a paradigm and philosophical stance closest to their beliefs as a framework for research.

In practice, this study will serve as a pivotal point in that local and international academic institutions can enhance teaching and learning in the relevant area of research, and to simulate future outcomes.

Furthermore, it will display the importance of specific issues that had never been opened and realised before about the predictive models explored and their interpretations.

1.8 SCOPE AND LIMITATIONS OF THE STUDY

The scope of research refers to all areas that will be covered regarding the population and the field of study. The focus will be on the development of a predictive model for research paradigms and philosophies. The areas derived from the set objectives are to be covered.

1.9 DEFINITIONS OF KEY TERMS

It is vital that the various critical concepts utilised be appropriately defined before proceeding with any further discussion.

- Predictive Modelling

  Predictive modelling refers to the concepts of anticipating and predicting future behaviour based on statistics and algorithms (Waller & Fawcett, 2013; Finlay, 2014).

- Research Paradigm

  A research paradigm is a founded belief in a way matters function, as suggested by Thanh, Thi and Thanh (2015). Paradigms are referred to as beliefs and values utilised to direct, manage the study of a specific direction by giving boundaries, procedures and focal points utilised to complete the study (Bunniss & Kelly, 2010).

- Ontology

Mack (2010) defines ontology as the study of nature or truth, and how it responds to matters of the meaning of truth and its nature. Ontological philosophies are related to what signifies truth, as such, what is. The researcher's perspective of the truth is the foundation of every single other belief. That is, what is expected here establishes the researcher's different presumptions.

- Epistemology

According to Mack (2010), epistemology is related to nature, types of knowledge and its foundation. Willig (2013) adds that it is also related to how knowledge can be made, gained and shared, as such, what it implies to know.

1.10 PREVIEW OF RESEARCH METHODS

In this section, the research method and strategy, which are thoroughly discussed in Chapter 3, are introduced. The study used a quantitative approach as an appropriate research methodology, Creswell (2013), indicates that the quantitative approach utilises statistical information, predetermined techniques, closed-ended questions, and can include quantifying and might be systematised. The main benefit of the quantitative study is that data can be calculated and summarised by numerical interpretations.

According to Creswell and Clark (2011), the consideration of a quantitative approach in this study led to the adoption of a positivist paradigm as the research philosophy to conduct this research, because it relies on the fact that reality is objective and cannot be influenced by scientists.

1.11 OUTLINE OF THE CHAPTERS

The Figure 1.1 aids in facilitating understanding of the outline of the chapters.

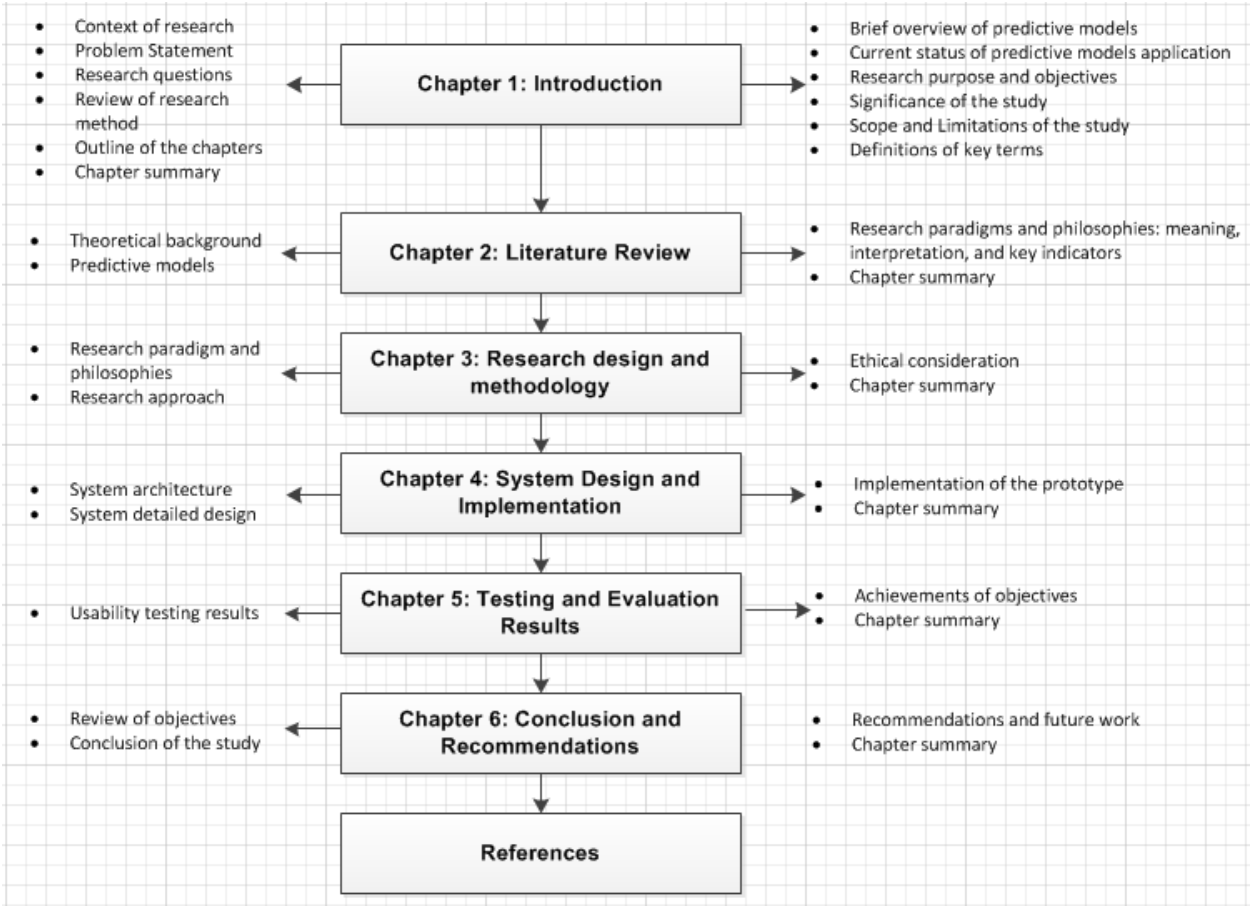

Figure 1.1: Outline of the chapters

1.12 CHAPTER SUMMARY

This chapter served as an introduction and orientation in which the reader was introduced to the phenomenon under investigation. It has revealed the underlying principle of the study, briefly highlighting the overview of predictive models, the status of predictive models application, and contextualises the study by highlighting the importance and implications of research paradigm and philosophies. It also portrays the research problem that directed this study, and the related research questions that are utilised to answer the problem of the study.

In further explaining how the study would unfold, a preview of the research method adopted was introduced by highlighting quantitative research as its approach. Additionally, the scope and limitations of this study are stated. Lastly, a diagram presenting the outline of the chapters was given. In the next chapter, the theoretical background and theories used, are discussed in-depth.

CHAPTER 2: LITERATURE REVIEW

This chapter presents the background of signal detection theory and a discussion of predictive models. It demonstrates the relationship between the beliefs, culture and attitudes of people in research (research paradigms and philosophies). Finally, we summarise the chapter.

2.1 THEORETICAL BACKGROUND

According to Waller and Fawcett (2013), the predictive model selected is dependent on experimenting, validation and assessment utilising Signal Detection Theory (SDT) to predict the likelihood of a result in a given set of data. SDT is followed from its starting point in design and statistical theories in making decisions through to its adjustment in psychology research, health analysis, and somewhere else (Swets, 2014). Swets (2014) further indicates that SDT was initially developed during World War II to optimise the detection of radio signals in environments perturbed with background interference. According to Martin (2017), SDT has a lengthy and intense history and in some cases is considered one of the foundations of psychological brain science. The model framework within the space of airport regulation was first presented by Radar researchers in the 1950s (Swets, 2014; Wilmshurst, 2017) and required that the aircraft that need to be monitored should be identified by the Air Traffic Controllers based on radar pictures on their screen. This subsequent section provides an overview of the detection theory and its parameters.

2.1.1 Signal Detection theory

SDT is a way to gauge the capacity to separate data between signal and noise related patterns. Within the area of electronic engineering, signal recovery is considered as the partition of these patterns from a concealing establishment (Wilmshurst, 2017).

Fisher (2014) indicates that in this theory exists numerous determiners of how a recognizing system can recognise the signal, and limit levels. Lynn and Barrett (2014) indicate that at the point when a detecting system is a person, for example, attributes, experience, desires, physical state and different elements can influence the applied approach. Witt, Taylor, Sugovic and Wixted (2015) suggest that parameters are viewed as the inability to find optimal detectors of the signal and noise, while Lynn and Barrett (2014) reiterated that a parameter actually is a unique variable factor utilised in a subprogram to allude to one of the bits of information presented as contribution to the subprogram.

The fact that signal detection theory is closely related to prediction is further elaborated in the work of Waller and Fawcett (2013). Taking this fact into account, it seems to have a clear interface with the objective of this research because we want to automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs. It is common sense that one should identify as many of the main predictive variables as possible. In the case of this study Table 2.3 distinguish these variables as a data used as input to make the predictions.

2.2 PREDICTIVE MODELS

Predictive modelling is rooted in data science, which extracts historical data using technologies such as machine learning and algorithms in order to anticipate future events (Taylor, 2013). (Thomas, 2015) adds that a predictive model consists of predictors, which are factors that influence future results. Nonetheless, with considerable developments and influence in the use of computers accessible to model inventors, the usage for predictive modelling extended exponentially and have many areas of application today (Davenport, 2014; Dalvi et al., 2016).

The financial and retail industries apply predictive models for numerous reasons (Ala’Raj & Abbod, 2015; Waller & Fawcett, 2013), including application risk scoring, solicitation

response modelling, behavioural risk management, retention management, revenue ranking, fraud prevention, and many others. Hiller (2016) further indicates that sales markets develop what they call a customer-lifetime value measure to design products and services tailored to specific segments and markets. According to Lee et al. (2013), predictive analytics decides how much a client will purchase from the business after some time. In other words, the sales market will be able to plan the best offer or most likely product/service a customer can be interested in buying should the present product lose value, or to retain business. Similarly, this study aims to have a predictive tool that might assist the local and international universities in teaching and learning of research, to determine the paradigms and philosophical stances.

It is imperative to note that the technological trend has begun to facilitate business decision-making today. Hence a vast majority of industries or organisations have adapted to the development of software to fast-track business performance (Davenport, 2014). It is noted from the business market that predictive tools are used for intelligence in decision-making. However, not much is done in the field of research, yet research is the source of knowledge. Although there are many studies on the nature and dimensions of predictive analytics in general, little is done about predicting research paradigms and philosophies. Therefore, this study aims at developing a model for a research paradigm and philosophical index that will automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs. To understand the main concept of this research, we have to refer to the literature. The concept can be broken down to understand it. In the subsequent section, we demonstrate types of predictive models and applications of predictive models from the literature.

2.2.1 Types of predictive models

Predictive modelling refers to the concepts of anticipating and predicting future behaviour based on statistics and algorithms (Shmueli & Koppius, 2010). Finlay (2014) adds that there are dozens, if not hundreds, of various strategies that can be utilised to make a model, and more are being continuously produced. In any case, there are few sorts of

predictive models (Kim et al., 2016). The most common ones are outlined in Table 2.1 detailing its strengths and weakness.

Table 2.1: Different types of predictive models

Model	Purposes/Uses	Methodology	Strength of the methodology	Weakness of the methodology	Reference
Linear models	Describe a continuous response variable as a function of one or more predictor variables. They can help you understand and predict the behaviour of complex systems or analyse experimental, financial, and biological data	Linear regression, Exponential regression, and Geometric regression	• Very easy and intuitive to use and understand • Even when it doesn't fit the data exactly, we can use it to find the nature of the relationship between the two variables.	• Only models relationships between dependent and independent variables that are linear. It assumes there is a straight-line relationship between them which is incorrect sometimes • Very sensitive to the anomalies in the data (or outliers).	Agresti (2015), Taylor (2014), Costanzo, Chacón, Conoscenti, Irigaray, & Rotigliano, (2014), Felicísimo, Cuartero, Remondo, & Quirós, (2013), Hilbe (2017)
Decision trees	Classify and predict one or more discrete variables based on other variables in the dataset.	CART, CHAID, ID5 and MARS	• Simple to understand and interpret • Little data preparation and little computation • Indicates which attributes are most important for classification • Nonlinear relationships between parameters do not affect tree performance	• Perform poorly with many classes and small data • Computationally expensive to train • Over-complex trees do not generalise well from the training data (overfitting)	Kaminski, Jiang, Piller, & Hopp, (2017), Pradhan (2012), Tien, Pradhan, Lofman, & Revhaug, (2012)
Neural networks	It is used in many areas of science and engineering as a promising tool because of its simplicity in simulation, prediction and modelling of process performance. It can also be used for better prediction of the process performance owing to their high accuracy, adequacy and quite promising applications in engineering.	NNet Neural Network and MONMLP Neural Network	• Relatively easy to use • Can approximate any function, regardless of its linearity • Great for complex/abstract problems like image recognition • Mimics the brain (but there is some controversy over the degree of this)	• Often abused in cases where simpler solutions like linear regression would be best • Requires a load of training and cases • Black box that not much can be gleaned from • Increasing accuracy by a few percent can bump up the scale by several magnitudes	Schmidhuber (2015), Tien et al. (2012)
Support vector machines	It can be used for either classification or regression challenges. However, it is mostly used in classification problems. A SVM maps input information vectors into a higher dimensional space, where an "ideal hyper plane" that isolates the information is built.	Supervised machine learning algorithm	• It works really well with clear margin of separation • It is effective in high dimensional spaces. • It is effective in cases where number of dimensions is greater than the number of samples. • It uses a subset of training points in the decision function (called support vectors), so it is also memory efficient.	• It doesn't perform well, when we have large data set because the required training time is higher • It also doesn't perform very well, when the data set has more noise i.e. target classes are overlapping • SVM doesn't directly provide probability estimates, these are calculated using an expensive five-fold cross-validation.	Nejatian, Kanani, Arabloo, Bahadori, & Zendehboudi, (2014), Kremer, Steenstrup, & Igel, (2014), Tien et al. (2012), Kavzoglu, Sahin, & Colkesen, (2014)
Cluster models	It is used to find groups which have not been explicitly labeled in the data. This can be used to confirm business assumptions about what types of groups exist or to identify unknown groups in complex data sets.	K-Means and TwoStep	• Easy to implement • With a large number of variables, K-Means may be computationally faster than hierarchical clustering (if K is small). • k-Means may produce tighter clusters than hierarchical clustering • An instance can change cluster (move to another cluster) when the centroids are recomputed.	• Difficult to predict the number of clusters (K-Value) • Initial seeds have a strong impact on the final results • The order of the data has an impact on the final results • Sensitive to scale: rescaling your datasets (normalization or standardization) will completely change results.	Pettet, Nannapaneni, Stadnick, Dubey, & Biswas, (2018), Taylor (2014), Sharma, Frontiera, Henry, Ringe, & Van Duyne, (2012)
Naive Byes	Naive Bayes classifiers assume strong, or naive, independence between attributes of data points. Popular uses of naive Bayes classifiers include spam filters, text analysis and medical diagnosis. Easy to build, with no complicated iterative parameter estimation which makes it particularly useful for very large datasets.	Bayes' Theorem	• It is easy and fast to predict class of test data set. It also perform well in multi class prediction • When assumption of independence holds, a Naive Bayes classifier performs better compare to other models like logistic regression and you need less training data. • It perform well in case of categorical input variables compared to numerical variable(s).	• On the other side naive Bayes is also known as a bad estimator, so the probability outputs from predict probability are not to be taken too seriously. • Another limitation of Naive Bayes is the assumption of independent predictors. In real life, it is almost impossible that we get a set of predictors which are completely independent.	Patil and Sherekar (2013), Korde (2012), Jadhav & Channe (2016)

There are two common sorts of categories of learning, namely supervised and unsupervised (Thomas, 2015; Srivastava, Mansimov, & Salakhudinov, 2015).

Nejatian et al. (2014) indicate that SVMs, decision trees, Neural Networks and regression models use a supervised type of learning to make the mapping limit between an arrangement of data fields and a target variable. The outcomes use an instructor who administers the understudy learning. At whatever point the student submits a mistake, the instructor outlines the correct answer in the hope that the understudy will over some time get it right. For instance, when given a specific arrangement of data sources, the yield will coordinate the objective (Taylor, 2013).

There is no need for an instructor or objective in unsupervised learning. Grouping methods fall into this classification. Data points are primarily assembled in light of their similarity. In an e-commerce website analysis, online shoppers might be grouped into window shoppers or power buyers. In case there should be client stir, a grouping method could allot particular bunches to churners and non-churners despite the result not being accessible during model training (Davenport, 2014).

There are several algorithms available for use in the predictive analysis model, including statistical, data mining, and machine-learning algorithms. These algorithms are frequently available in enterprise analytics or open-source software. Once one has defined the objectives of the desired model and selected the data, it is then possible to choose which algorithms might be applied best to the desired model.

Below are a few general rules to decide which algorithms can address various business concerns (Witten, Frank, Hall, & Pal, 2016, Srivastava et al., 2015):

- For customer division and community detection in the social circle, clustering algorithms are required.
- For customer retention, or to develop a recommender system, a classification algorithm applies.

- Decision trees can be used in cases where a linear decision boundary exists i.e. classifying people by their IQ.
- For credit scoring or anticipating the result of time-driven occasions, a regression algorithm is preferred. Regression is used to predict continuous values, instead of classifying. Regression can be used for traffic prediction, for instance.
- The Naive Bayes classifier is best utilised when the features are conditionally independent. For example, it has been used for simple object recognition in RGB where the three channels were assumed uncorrelated.
- Machine Learning (ML) is not an answer for each sort of issue. There are certain situations where robust solutions can be created without utilising ML techniques. For instance, ML is not required if one can determine a target value by using simple rules, calculations, or predetermined steps that can be programmed without needing any data-driven learning. Machine learning can be used in the following situations:
    - When it is hard to code the rules, or there are many rule factors: Several human tasks, (for example, perceiving whether an email is spam or not spam) cannot be satisfactorily resolved to utilise a basic (deterministic), rule-based solution.
    - When the solution cannot scale and may have the capacity to physically perceive a couple of hundred emails and choose, regardless of whether they are spam or not. In any case, this task ends up dull for millions of emails. ML solutions are successful for taking care of widespread scale problems.

Similarly, this study aims to have a predictive tool that might assist the local and international universities in teaching and learning of research, to determine the paradigms and philosophical stances of scholars and students.

In any case, this takes us to the next critical factor in predictive models. As alluded by Taylor (2013), each model has underlying assumptions, and it is essential to realise what they are and to figure out how to check whether they are still valid. In predictive analytics,

sometimes the assumption implies that the future will keep on resembling the past, though it is not. Duhigg (2012) describes that frequently individuals keep and build up solid precedents of behaviours over time. Nonetheless, the author opines that people tend to change or vary in the behaviour that they usually keep up. The predictive models utilised to anticipate these may be illegitimate and require modification. The proposed predictive model is, therefore, aimed at coming up with such variables or changes that result to help people to determine a paradigm and philosophical stance closest to their beliefs.

2.2.2 Applications of predictive models

Duhigg (2012), indicates that some companies used human resources' predictive analytics to predict what employment decisions their employees could make so that they are not suddenly extremely surprised. The predictive models revealed that some employees were likely to get restless and think of leaving their companies. According to Waller and Fawcett (2013), this was meant for informed decision-making within companies, to see with whom they could negotiate to either retain or retrench to save the company from financial calamities and the like. Similarly, development of the predictive model may assist both universities and students to make proper research decisions. Thomas (2015) states that predictive analytics can empower a modified business incentive that increases shared advantage for companies and their ability. For instance, to lessen worker income expenses.

According to Taylor (2013), the idea behind the development of a predictive model is solely recognise the characteristics of people and what makes them behave differently later on. For example, what makes a few learners do well at school; why a few patients are terrible in taking their prescription medicine; and, what makes a few potential employees do well in employment. In the end, the model enabled the police to proactively devise a mitigation strategy to curb different kinds of crime.

The examples above denote that the predictive model that is aimed to be developed has a high possibility of being used to predict the future behaviour of scholars and students in

research given the nature of one situation to another (consistency). Taylor (2013) suggests that when big companies or organisations want to make huge, infrequent strategic business decisions, such as where to infuse and find a billions of rands fabricating source, certain modelling is required. Kremer et al. (2014) reiterate that organisations put into place analytic tools to assemble large data for well-defined and informed decisions. Hence, the proposal of developing a predictive model for ease of research paradigm and philosophical determination.

According to Kim et al. (2016) multinational insurance corporations specialising in property and casualty also use predictive models to settle on jeopardised evaluation choices. In this regard, the logic of decisions is critical for accuracy and higher quality. Hu, Wen, Chua, and Li (2014) add that, whether we like or not, operational analytics are part of our lives today. An example is automated algorithm bank operations continuously update content on their sites to distinguish possible scams. The author reiterated that airlines naturally decide how to recourse travellers when climate causes postponements, while mulling over bunch elements and limitations.

According to Venkatesan, Kumar and Reinartz (2011), a predictive model can be used to track customer attitudes and behaviour around fulfilment, states of mind towards trademarks, items, and selling workers and buying aims. They tested the approach in the pharmaceutical industry, which included the history of physicians for a leading cardiovascular drug. The point was to investigate how the pharmaceutical association's client lifetime value, maintenance and deals were influenced by the doctor's involvement in the medication.

This also confirms that attitudinal information can predict the future profit potential of any intended study to make future business decisions. Furthermore, in this regard, the incorporation of attitudes provides an advancing quantity that would help to figure out who between the clients would add benefit and those with likelihood to decline. The scholars, however, indicated that there was no guarantee that the predictive models would always

give positive results derived from the attitudinal information, given the culture and beliefs of people subjected to a study.

This is to say that it is of utmost importance to consider the use of technology, or the art of science, to predict the future situation. This needs to be proactive, particularly for research, because research helps individual people, institutions and companies make informed decisions. Hence, this study intends to develop a predictive model for research paradigms and philosophical stances.

Mills and McCarthy (2014) demonstrates that the predictive model is being used, or can be used, across industry verticals and business areas. A predictive model helps to identify target events using the set of attributes or variables. According to Finlay (2014), few examples of applications of predictive modelling across business verticals are outlined in Table 2.2.

Table 2.2: Applications of predictive models

Sector	Purposes/Uses	Reference
Banking or Financial Services	• Application Scorecard for approve loans/credit card. • Identifying fraudulent transaction.	Ramesh (2017), Ala'raj & Abbod (2015), Waller & Fawcett (2013)
Insurance	• Improve the fraud detection process, helping prevent claims payouts. • Enhance risk management and underwriting process	Kenyon & Eloff (2017), Yunos, Hamid, & Ahmad, (2016), Finlay (2014)
Retail	• To predict those customers who are more likely to respond to a specific campaign from a retailer. • Identifying next best product to be recommended to a customers.	García et al. (2017), Lee et al. (2013), Waller & Fawcett (2013)
Healthcare	• Analyze large numbers of claim requests to detect and reduce fraud, waste and abuse (repeat billing, fake prescriptions, fictitious claims etc) more quickly and efficiently. • Detecting diseases at earlier stages when they can be treated more easily and effectively.	Hiller (2016), Choi, Bahadori, Schuetz, Stewart, & Sun, (2016), Koh & Tan (2011)
Telecommunication	• To identify the customers who are likely to change to competitors • To identify customers who are likely to take up additional services • To identify customers are less likely to renew the mobile plan	Ramanujaiaha et al. (2017), Yousef, Fahmy, & Mohamed, (2017), Dalvi et al. (2016)
Government	• Improve service and performance. • Improve recurrent expenditures. • Improve the abuse of assets and citizen money.	Morabito (2015), Finlay (2014), Schillemans & Busuioc (2014)

Therefore the predictive model that the study intends to invent might have relative symptoms of a strong validity since it is intended to predict the research paradigms and philosophies of scholars and students respectively.

2.3 RESEARCH PARADIGM AND PHILOSOPHIES: MEANING, INTERPRETATION, AND KEY INDICATORS

Paradigm is a founded belief in a way matters function, as suggested by Thanh et al. (2015). Paradigms are referred to as beliefs and values utilised to direct and manage the study of a specific direction by providing boundaries, procedures and focal points utilised to complete the study (Bunniss & Kelly, 2010). Research philosophy is classified as ontology, epistemology and axiology (Saunders et al., 2012; Mkansi & Acheampong, 2012; Scotland, 2012). However, in the next section, these terms associated with the research paradigms and philosophies are outlined.

2.3.1 Meaning, interpretation and key indicators

There are different perspectives regarding research paradigms and philosophies. Research paradigms have now and again been alluded to as research philosophies (Kothari, 2012). Research philosophies go beyond methods and techniques as they reflect the researcher's personal beliefs, assumptions, and stance about knowledge (Scotland, 2012). However, there are philosophical and paradigm dilemmas regarding the terminology used by proponents of philosophies and paradigms.

This study takes the approach advocated by Scotland (2012): that ontology and epistemology are not themselves paradigms, but significant components of a paradigm, and in determining one’s paradigm, a researcher must take a standing answer to the ontological and epistemological questions. Various research paradigms and philosophies do exist. The most common ones are outlined in Table 2.3 to illustrate the ontology, epistemology, and axiology associated with research paradigms and philosophies.

It is important to distinguish dependent and independent variables, as well as correlations between variables that could skew model results. Additionally, taking the signal detection theory into account, it is good to find if there is an identifiable signal to noise ratio in the

data. For example, in this study, we are aiming to predict people's paradigm and philosophical stance closest to their beliefs and these variable's characteristics and meaning can be important predictors as shown in Table 2.3.

Table 2.3: Interpretation of research paradigms and philosophies

Variables	Construct		Definitions		Items	
Paradigm/Philosopy	**Component**	**Characteristics**	**Meaning**	**Options**	**Questions**	**References**
Positivism	Ontology	Single reality, External, Objective and Independent	One version of the truth, real existing substance, certainty and tangilbe matter, external and independent to the individual. There is one defined true situation that exists and is it fixed, measurable, and observable.	One version of the truth. Universal, independent truth.	How many versions of the truth can there be in a given situation?	Kawulich (2012); Saunders et al. (2012); Wahyuni (2012); De Vos, Strydom, Schulze, & Patel, (2011b); Kamil (2011); Strauss (2012); Sefotho(2015); Denzin & Lincoln (2018); Scotland (2012)
				External and independent to the individual	How can reality or truth be influenced?	
				Fixed, measurable, and observable	How can reality be known?	
	Epistemology	Scientific method, established through objectivity and quantification, empirical observation and experimentation	Observed through our external senses, by means of scientific experiments. All observers reach same conclusion. Fact finding research hypothesis and proofs. Theories can be tested and expanded using scientific methods. Fixed, stable, observable, and measurable.	By means of scientific experiments	How is knowledge acquired i.e., how do we know what we know?	
				Testing of theories using scientific methods	How can one's belief be justified?	
	Axiology	Value-free	Independent of individual opions, beliefs and influence, free from bias. The ability to not be influenced by personal feelings or opinions in considering and representing facts. Bias lead to error.	Independent of individual opions, beliefs and influence	What influences how research is conducted?	
Post-positivism	Ontology	Objective reality	One version of the truth, real existing substance, certainty and tangible matter, external and independent to the individual, not fully understandable, not hundred percent perfect	One version of the truth. Universal, independent truth.	How many versions of the truth can there be in a given situation?	Wahyuni (2012); Saunders et al. (2012); Collis & Hussey (2014); Denzin & Lincoln (2018); Scotland (2012)
				External and independent to the individual	How can reality or truth be influenced?	
				Not fully known with complete certainty	How can reality be known?	
	Epistemology	Only Observable phenomena	Probable findings or results, critical judgement of findings, true until proven otherwise, hypothesis are either rejected or not rejected but never proven	Critical judgement, by means of scientific experiments	How is knowledge acquired i.e., how do we know what we know?	
				Critical judgement of findings, true until proven otherwise	How can one's belief be justified?	
	Axiology	Value added	Critical evaluations and analysis, opinions based on critical skills and merits	Critical evaluations, analysis, skills and merits	What influences how research is conducted?	
Interpretivism	Ontology	Multiple socially constructed realities, subjective and may change	More than one meaning, or version of the truth. Every individual has a story to tell, concepts are and are ideas viewed from a community point of view. Existing situations are accessed through social constructions such as language, consciousness, shared meanings, and instruments	More than one meaning, or version of the truth.	How many versions of the truth can there be in a given situation?	Kawulich (2012); Myers (2013); Wahyuni (2012); Saunders et al. (2012)
				Situations are influenced by social constructs	How can reality or truth be influenced?	
				Community and social awareness	How can reality be known?	
	Epistemology	Subjective Meaning and social phenomena	Community ideas and views are the source of knowledge. Concepts and knowledge are historical and built by society over time. Beliefs and cultures shape current views about the world. Knowledge is gained through an empathic understanding of participants' lived social life's; the goal of science is to describe people's experiences and understandings. Gained through understanding the meaning of the process or experience	Historical based on community views, ideas and experiences	How is knowledge acquired i.e., how do we know what we know?	
				Beliefs and cultures shape current views about the world.	How can one's belief be justified?	
	Axiology	Value-bound or biased	The researcher is part of the community or society under study and their values and understanding influence the research and its findings. The researcher's input based on personal feelings, tastes, or opinions values, intuition, and biases are important—they play a role in the dialog of social construction and inform their interpretation of the data.	Researcher's values and understanding influences the research and its findings	What influences how research is conducted?	
Pragmatism	Ontology	Complex, rich, reality is practical based on ideas	Practical views, considerations and truths based on practical concepts. Experience influences research direction	Practical views, considerations and truths based on practical concepts.	How many versions of the truth can there be in a given situation?	Saunders et al. (2012); Wahyuni (2012); Myers (2013); Wilson (2010); Collis & Hussey (2014); Sefotho(2015)
				Experience influences research direction	How can reality or truth be influenced?	
				Considerations based on practical concepts	How can reality be known?	
	Epistemology	Focus on problems and practical solutions, true theories and knowledge must enable successful actions	Focus on problems and practical solutions, true theories and knowledge must enable successful actions	Focus on problems and practical solutions	How is knowledge acquired i.e., how do we know what we know?	
				True theories and knowledge	How can one's belief be justified?	
	Axiology	Value driven based on researchers beliefs and curiosity	Value driven based on researchers beliefs and curiosity, sensible rather than theoretical	Researchers sensible beliefs and curiosity	What influences how research is conducted?	
Realism	Ontology	Objective reality, external, independent	Objects and concepts exist whether we know it or not i.e. independent and external to individuals	One version of the truth. Universal, independent truth.	How many versions of the truth can there be in a given situation?	Saunders et al. (2012); Blumberg, Cooper, & Schindler, (2011); Novikov & Novikov (2013), Sefotho (2015)
				External and independent to the individual	How can reality or truth be influenced?	
				Independent and external to individuals	How can reality be known?	
	Epistemology	Facts are social constructions, Knowledge historically situated and transient	What is called facts is based on what the individual knows. Knowledge is rooted in historical and experienced information and skills acquired.	Rooted in historical and experienced information and skills acquired.	How is knowledge acquired i.e., how do we know what we know?	
				Fact is based on what the individual knows	How can one's belief be justified?	
	Axiology	Value-laden or biased	Our knowledge, ideas, concept and what we consider facts are all based on awareness and experience	Personal experience and awareness of concepts	What influences how research is conducted?	

(Adopted from Saunders et al., 2012; Kawulich, 2012; Wahyuni, 2012; Denzin & Lincoln, 2018)

2.4 CHAPTER SUMMARY

This chapter provided an in-depth discussion of the theories used in the study. In further explaining how the study would unfold, a thorough discussion of predictive models and its application was introduced. Additionally, the meaning, interpretation and key indicators of research paradigms and philosophies are stated. In the next chapter, the research design and methodology used are discussed in-depth.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

According to Kothari (2012), all studies are founded on individual beliefs and presumptions about what is considered suitable. Hence, it is essential to comprehend the fundamental philosophical presumptions of any study. The implication that the researcher connects to the study is affected mostly by the researcher's design and methods. Neuman (2016) defines research as a systematic study whereby the researcher collects and analyse data, explains and forecasts an undertaken event. Any study intends to decide the responses to the research questions through orderly analysis (Kothari, 2012). The research design is characterised by Leedy and Ormrod (2013), as a strategy for research, giving the general system to gather data. It is also defined as a strategy for picking subjects, gathering of information techniques, and study destinations, to respond to study problems (Glesne, 2011). According to Creswell (2013), it is defined as a crucial system for the activity that serves as an extension of research questions and the implementation of the research methods.

The procedure of how to continue with analysis refers to a methodology and includes presumptions, interpretations, standards and techniques to deal with research (Neuman, 2016). According to Kothari and Garg (2014), research methods analyse, develop and characterise in detail the sorts of issues that are worth researching. Research methods also comprise a research problem that is feasible, theories that can be proven, ways to outline issues to be explored utilising specific methods and techniques, and a way to create and choose proper methods for gathering information. Apart from an appropriate comprehension of the idea of methodology, additionally the researcher needs an insight of the associated research beliefs that support the different study standards. The philosophical research position is reflected in this research through various standards, as indicated in a subsequent paradigms section.

3.1 RESEARCH PARADIGM AND PHILOSOPHIES

Analysis, knowledge, and understanding of the research are affected by a hypothetical system or paradigm. Exchange amongst meta-hypothetical foundations, philosophical presumptions, research problems and techniques happen to be notable in characterising the researcher's paradigmatic point of view (Ingleby, 2012).

Paradigm is a founded belief in a way matters function, as suggested by Thanh et al. (2015). Paradigms are referred to as beliefs and values utilised to direct, manage the study of a specific direction by giving boundaries, procedures and focal points utilised to complete the study (Bunniss & Kelly, 2010). Thanh et al. (2015), also highlight that it is essential to choose a paradigm as the initial step while researching in order to have the reason for following choices regarding the literature, research design and strategy. The subsection will talk about the paradigm that was adopted for this study.

3.1.1 Positivist paradigm

The researcher's goal to fully explain an experience or examine a hypothesis in a scientific study is frequently referred to as the positivist paradigm. Positivist researchers frequently look for fundamental relationships and regulations to anticipate future occurrences or outcomes (Riyami, 2015). This study adopted the positivist paradigm as the research philosophy since the intention of the study is to predict the research paradigm and philosophy to assist the user in determining the peoples' paradigm and philosophical stance closest to their beliefs. According to Creswell (2013), positivists act on the presumption that the social world works similarly to the physical domain. Therefore, consider the study as quantitative and the researcher unable to change outcomes and limitless esteem. As a result, replication by different researchers happens, which prompts the objective of summing up from outcomes.

Riyami (2015), also indicates that positivist research is regularly utilised by statisticians and researchers and is not a leading method when conducting humanities studies.

Positivists start their study with a theory or sequence of theories. They, at that point, create a model that may affirm a current hypothesis or may produce another one.

3.2 RESEARCH APPROACH

The research technique is a general design, as defined by Lewis (2015), which decides how to achieve the study goals by responding to the research questions and problem. The strategy of getting, classifying and analysing data are alluded to as research methodology (Kothari, 2012). The subsection outlines the approach that was considered for this study.

3.2.1 Quantitative approach

Creswell (2013), indicates that a quantitative strategy is one in which the individual undertaking the study essentially utilises positivist cases to gather information and create learning on fixed instruments. According to Maxwell (2013), the quantitative research methodology includes the gathering and transformation of information to deliver measurable computations in a numeric frame using surveys, tests and predetermined instruments. The quantitative study goes for evaluating the information, summing up, the outcomes and quantifying the sample.

Creswell (2013) adds that this approach utilises statistical information, predetermined techniques, closed-ended questions, can include quantifying and might be systematised. The main benefit of the quantitative study is that data can be calculated and summarised by numerical interpretations. A quantitative approach was considered appropriate in this research because the research intended to develop a model for a research paradigm and philosophical index that would automatically predict and assist the user in determining the peoples' paradigm and philosophical stance closest to their beliefs.

3.3 ETHICAL CONSIDERATION

Connelly (2014) defines ethics as a moral terminology, which means nature or belief, and hints at a common procedure that passes on ethical reliability and steady beliefs. According to Sugiura, Wiles and Pope (2017), ethics concerns what isn't right and what is correct when undertaking the study. Gratton and Jones (2010), add that to achieve a particular aim, every researcher, irrespective of research plans, testing, strategies and selection of techniques, is exposed to good attention.

Research projects are conducted within the parameters of regulations, moral standards, and norms. Researchers are expected to behave in ways that will not compromise their participants or the integrity of the research and its findings. All clearances required to guarantee the ethical principles of this research have been obtained by the researcher.

3.4 CHAPTER SUMMARY

In this chapter, we have discussed the research design and methodology. We first discussed the research philosophy position adopted for the study. Secondly, we discussed the research approach adopted in the study. Lastly, we presented the ethical consideration of the study. In the next chapter, the system design and implementation of the prototype solution are presented and discussed in detail.

CHAPTER 4: SYSTEM DESIGN AND IMPLEMENTATION

In this chapter, we present the proposed Research Paradigms and Philosophies Index (RPPI) prototype system design and implementation. The chapter is organised as follows: the overview of the system architecture that illustrates the various components of the prototype system. We also present a detailed design, which includes object-oriented design models and processes, and describes the implementation of the prototype system. Finally, we summarise the chapter.

4.1 SYSTEM ARCHITECTURE

This section describes the system architecture of the RPPI proposed prototype system. Figure 4.1 shows the various components of the system architecture.

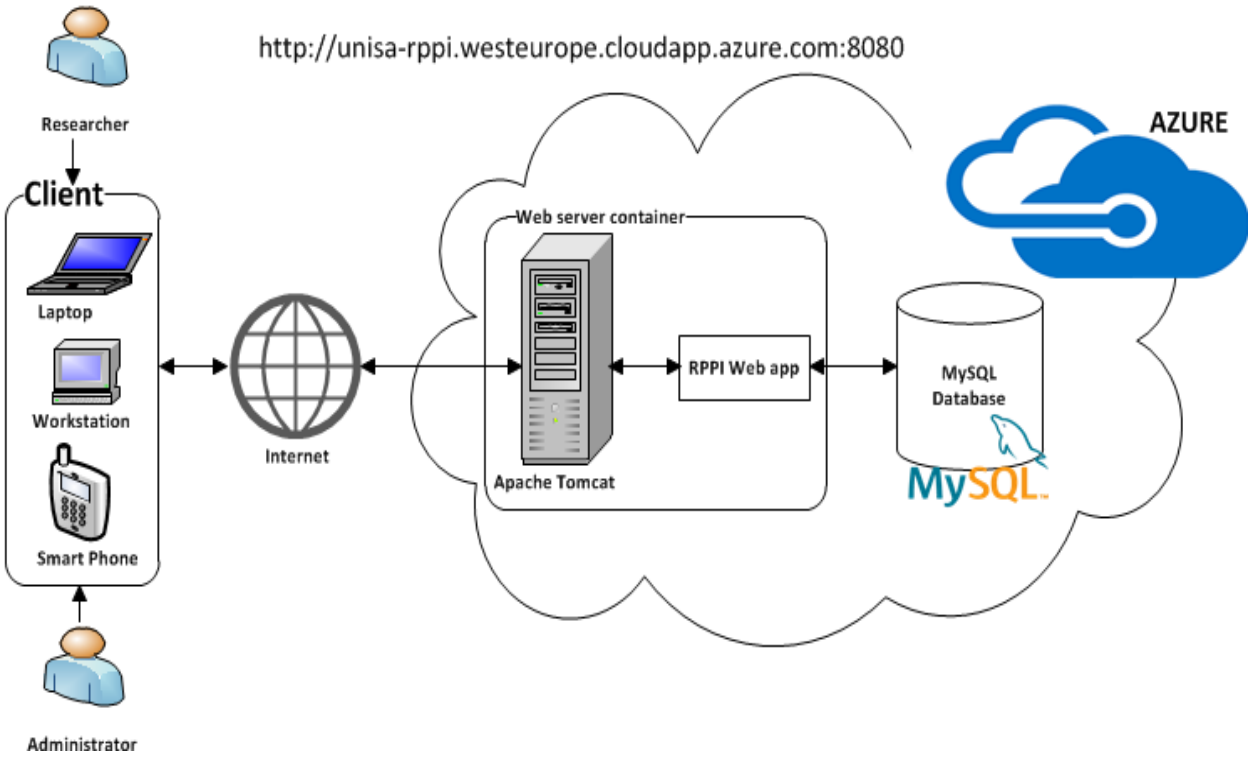

Figure 4.1: RPPI Prototype System Architecture

The RPPI prototype system was designed to be used by researchers to perform activities which mainly includes registering to use the system, login after registration, take a questionnaire and finally view a report. The architecture shows different role players and layers of the system. Apache Tomcat is a Java application server that is intended to execute Java code. It runs as an Apache http server module. We have the cloud that contains web application server, RPPI java web application and database. The web application server is connected to the RPPI java web application, which serves as the mediator between the web application server and MySQL database. Apache takes the request from the client, and handover to Tomcat. Tomcat handover the request to RPPI web application. RPPI web application process the request and provide a response and request back to Tomcat, then Tomcat handover request and response object to Apache server and Finally Apache give a response to the client. The RPPI prototype system is hosted on Azure – Microsoft's public cloud computing infrastructure. The solution is hosted on a Linux VMWare, using a MySQL database and Apache HTTPD web server. It has also used the Model View Controller (MVC) pattern using the Java Enterprise Edition (JEE) technologies suit. The RPPI prototype system followed the Restful Web Service – Client architecture. The Restful Web Service component was developed using Spring MVC back-end with the spring boot and MySQL technology stack. The client front-end design was implemented via Angular component.

4.2 SYSTEM DETAILED DESIGN

This section presents the detailed system design of the proposed prototype system by utilising use cases, class diagram and entity relationship diagram (ERD). There are two role players or actors in this system: the researcher, who interacts with the system by undertaking a questionnaire, and the administrator who is responsible for maintaining the system.

4.2.1 Use Case Diagrams

This section presents a diagram of the RPPI prototype system regarding players and their objectives. The players in the prototype system are administrators and researchers. The diagram in Figure 4.2 describes the user activities in the RPPI prototype system. Lastly, the diagram in Figure 4.3 shows all the activities an administrator can perform.

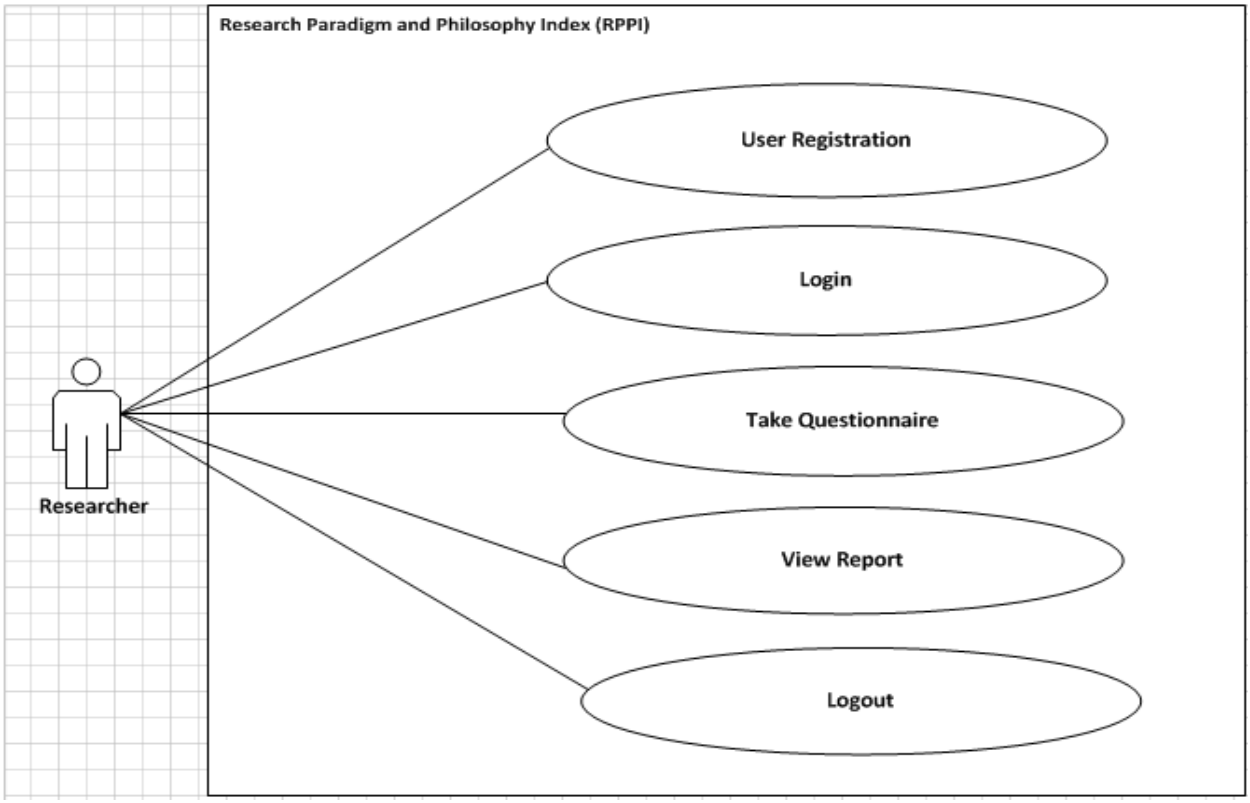

Figure 4.2: Researcher Use Case Diagram

The Researcher can register and log into the system, and once logged in will be able to take a questionnaire, view the report and finally log out of the system.

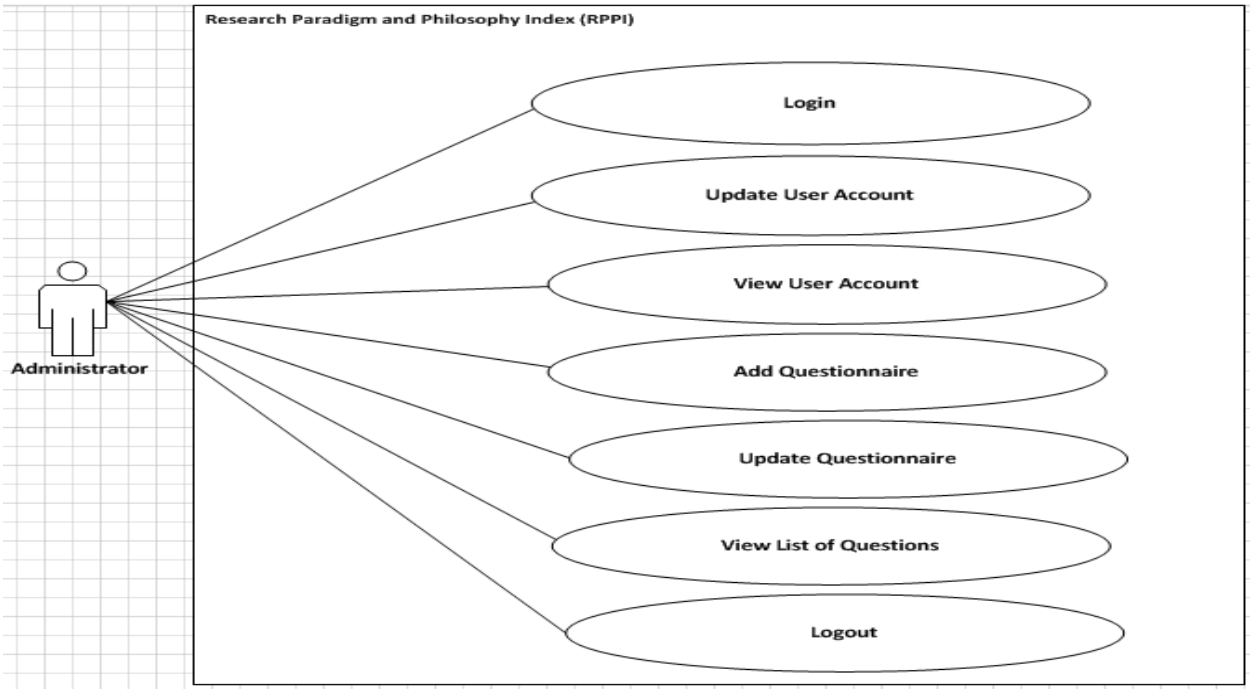

Figure 4.3: Administrator Use Case Diagram

The Administrator can log into the system and once log in, will be able to update, view user accounts, add and update the questionnaire, view the list of questions and finally log out of the system.

4.2.2 Class Diagram

This section presents a graphical diagram of the system that depicts the building blocks of the RPPI prototype system by demonstrating the system's objects, their elements, methods, and relations among objects as depicted in Figure 4.4.

Figure 4.4: RPPI Class Diagram

4.2.3 Entity Relationship Diagram

The RPPI prototype system database consists of 10 tables. Figure 4.5 describes the entity relationship diagram (ERD) and how the tables relate to each other.

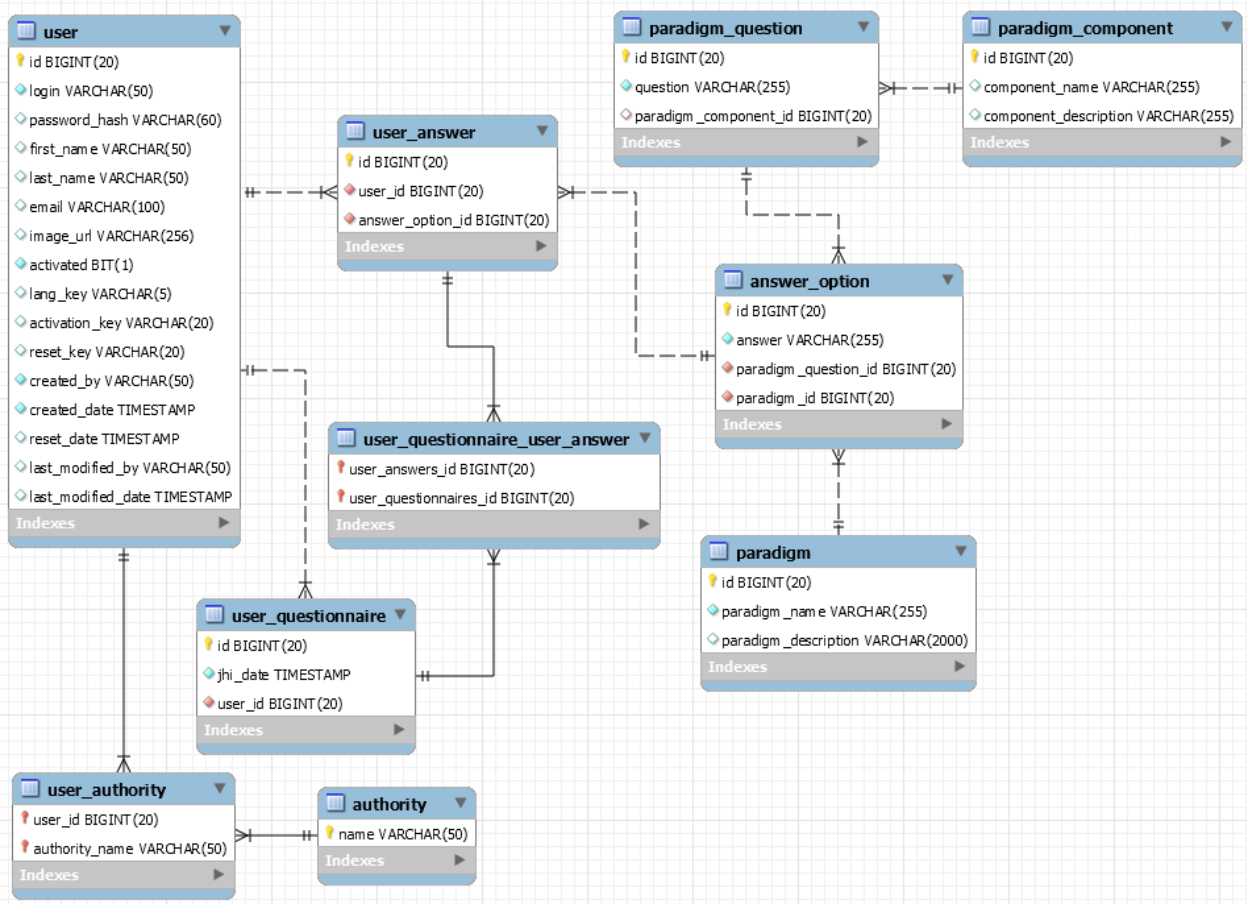

Figure 4.5: RPPI Entity Relationship Diagram

The user table contains credentials and information of the users of the system, which, in this case, are the researcher or administrator. A user table has an id field which is the primary key that is linked with user_authority, user_questionnaire and user_answer tables as shown in Figure 4.5. The user_authority table is linked to the user table through the user_id foreign key. The researcher and administrator have roles of role_user and role_admin respectively. These roles provide different privileges and access control to the system. The researcher has to provide login, password_hash, firt_name, last_name, and email during the registration process. The user_authority table is also linked to the authority table which contains all the roles in the system.

In the user_questionnaire table the id and user_id fields are the primary and foreign key respectively. The user_questionnaire table stores all user questionnaires and is related to user table by user_id field. The user_answer table has an id as the primary key, user_id and answer_option_id as the foreign keys. This table stores all the user answers to a specific question and is related to user table by user_id field. Once the user has taken a questionnaire, then we have user_questionnaire_user_answer table that stores all the answers provided by a user for a specific questionnaire.

The paradigm_question table stores all the questions that are in the questionnaire completed by the user. This table is linked to answer_option through paradigm_question_id which is the primary key and foreign key in the answer_option table. The paradigm_question table is also linked to a paradigm_component table which contains paradigm components data.

Lastly, the answer_option table stores all the possible answers for a specific question. This table is linked to user_answer through answer_option_id which is the primary key and foreign key in the user_answer table. The answer_option table is also linked to the paradigm table which contains all the paradigms and philosophies information.

4.3 IMPLEMENTATION OF THE PROTOTYPE SYSTEM

This section describes the implementation of the prototype as the proof of concept for the Research Paradigms and Philosophies Index (RPPI) system. There are two components of the prototype system: one that interacts with the end-users (front-end) and another that performs all the background functionalities (back-end).

4.3.1 Implementation Environment

This section demonstrates the system requirements and technologies used in the RPPI prototype system and more details are discussed in the subsequent sections.

4.3.1.1 System technical requirements

This section defines the minimum technical requirements for the development, running and deployment of the RPPI prototype system. RPPI prototype system is a responsive web application, and therefore runs on any browser. An internet connection is required for end-users to operate it. The implementation environment, system specification, functional testing, and lastly the prototype system are also discussed in the subsequent sections.

We have chosen these minimum technical requirements only because are the resources available to us. Table 4.1 presents these minimum technical requirements in details.

Table 4.1: Development and deployment specification

	Development Environment	Deployment Environment
OS	Windows 7	Ubuntu Linux 10.5
Memory	5GB RAM	5GB RAM
Instance Storage	500GB	500GB
64/32-bit platform	64-bit	Both
CPU Speed	3.00GHz	2 vCPU
Apache Tomcat	Tomcat Embedded v8	Tomcat v8

4.3.1.2 Technologies used

This section demonstrates the technologies used to implement the front-end or user interface and back-end solution of the RPPI prototype system. These technologies are adopted because they are open source and free of charge, as well as the resources available to us.

- Front-end or User Interface

The user interface or front-end of the prototype solution was developed in Angular as a typescript-based framework for front-end web application using the Visual Studio Code as the Integrated Development Editor (IDE). Figure 4.6 presents an overview of the RPPI system front-end code in the Visual Studio Code IDE.

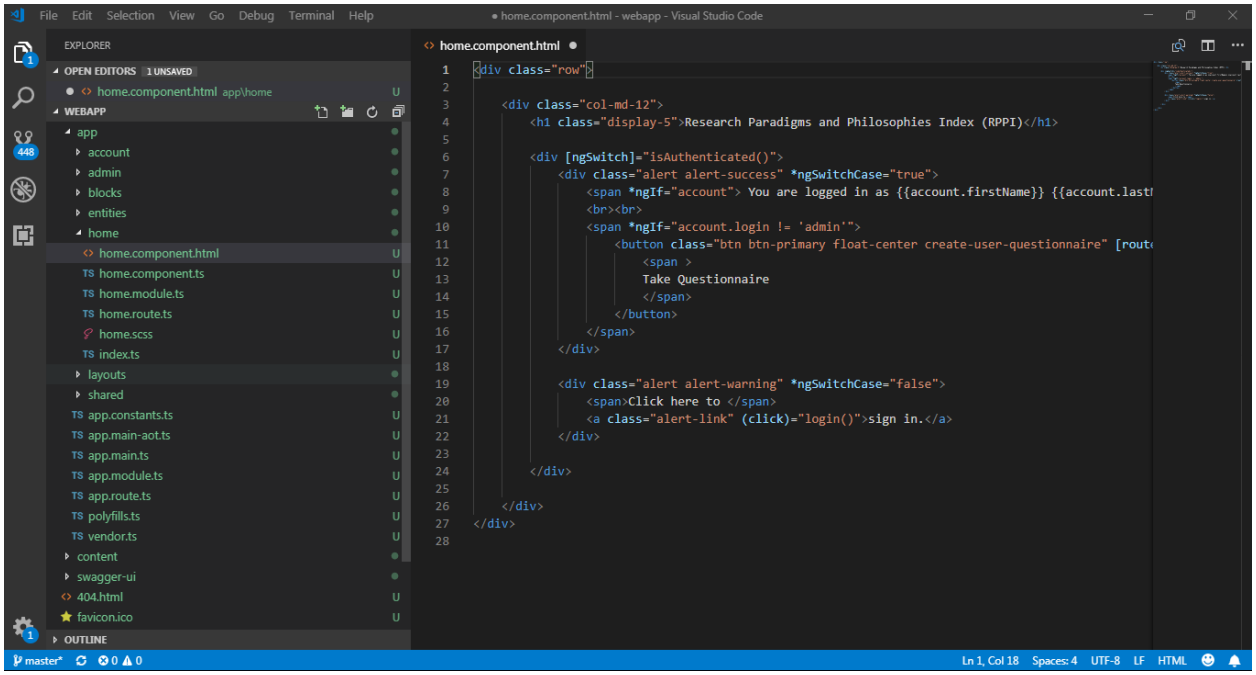

Figure 4.6: RPPI Frontend IDE Diagram

- Back-end

The back-end of the prototype solution was developed in Java programming language with Spring Boot using Eclipse as the IDE. Figure 4.7 presents an overview of the RPPI system back-end code in Eclipse IDE.

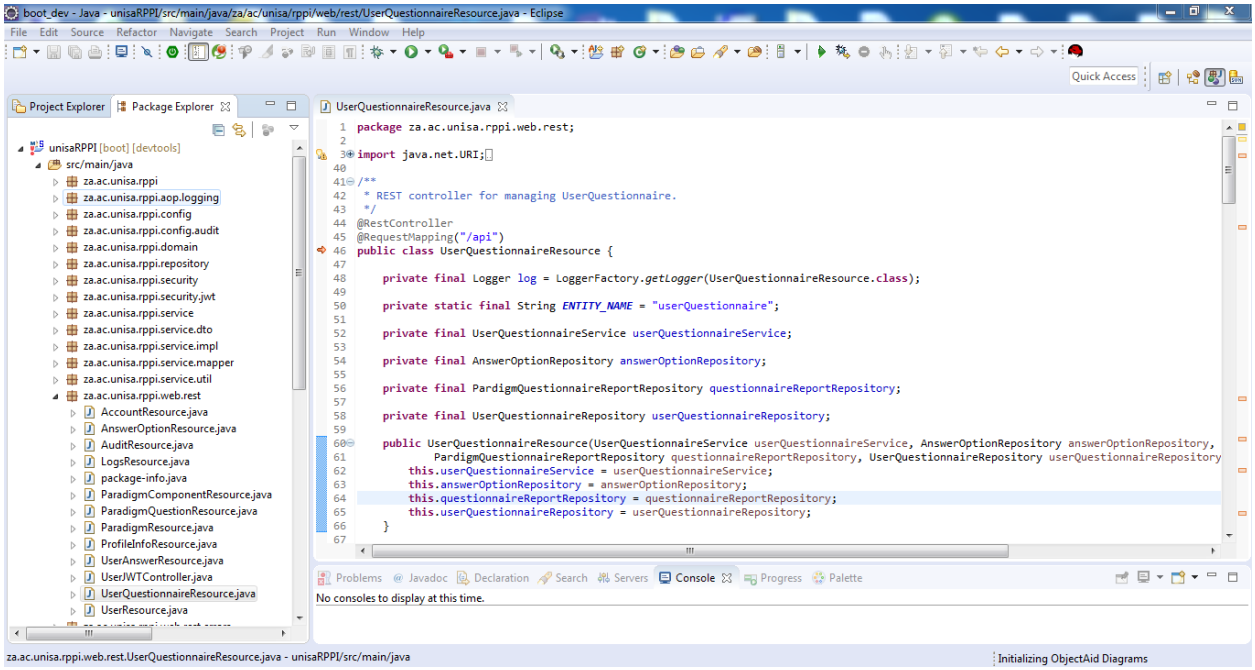

Figure 4.7: RPPI Backend IDE Diagram

The database was created using MySQL, which stores data including user profiles, user questionnaire and other entities shown in Figure 4.5. MySQL is also an open source, free of charge and provides the ultimate scalability and flexibility.

4.3.2 System Specification

There are key requirements to be met to effectively implement Research Paradigms and Philosophies Index (RPPI) prototype system. Table 4.2 presents these requirements in details.

Table 4.2: RPPI prototype system specification

Requirement	Details
Simplicity	The system should be easy to use or navigate.
Accessibility	Easy to access as long as you have a laptop, computer or mobile device.
Internet Connection	Internet connection is required so that user can operate and access the system
Verifiability	Once the user registered and activated account should be able to login successfully.
View/Edit/Delete Question	A system should be able to retrieve, edit or delete question when the admin click to view, edit or delete question respectively.
Authenticity	Only eligible users can have access and perform activities on the system.
Register/Create/View/Edit/Delete Account	The system should allow user to register account and admin to create, view, edit and delete accounts.
View/Edit/Delete Answer Options	A system should be able to retrieve, edit or delete answer option when the admin click to view, edit or delete answer option respectively.
View Report	A system should be able to retrieve paradigm report when the user click to view report
Confidentiality	User personal information on the system should not be disclosed to anyone.

4.3.3 Usability Testing

This section involves the goals of usability testing to evaluate the overall effectiveness of the RPPI prototype system and whether the functionality is working according to the

system design. The post-usability testing questionnaire was used to discover possible design flaws to enhance the RPPI prototype system where required, and to identify system features accepted by the users.

4.3.3.1 Approach

We have created a list of tasks to be completed by the participants which were assessed according to whether a user completed a task or experienced some difficulties. This approach consisted of two parts: the four tasks to be completed (see Appendix A) using the RPPI prototype system, and a post-usability testing questionnaire (see Appendix B). The tasks completed are described in Table 4.3 in details.

Table 4.3: List of user tasks

User Task
Register to use the system
Login after registration
Take a questionnaire
View report

This research is a project that involves three members of the team. The prototype system was designed and implemented to serve as a proof of concept due to the Intellectual Property nature of the product, hence we did not formally recruit participants. The participants involved in the usability testing were only two team members, one supervisor and two other participants chosen by the supervisor in accordance with the non-disclosure agreement of this project. The participants were sent the Uniform Resource Locator (URL) to access the system, tasks to be completed and post-testing questionnaire via the email. We also informed the participants that the main purpose of the usability testing was only focused on the RPPI prototype system and whether the system was serving the proposed purpose and functionality according to the design.

4.3.4 RPPI Prototype System

In this section, we present the data that was used as an input to the system. Following this is the demonstration of the system through various user interface screenshots. The actors in the system are the researcher who performs user activities and the administrator who is responsible for managing and maintaining the system.

4.3.4.1 Input data

Table 2.3 of Chapter 2 shows the input data that was used as a proof of concept for the RPPI prototype system.

4.3.4.2 User interface of the system

This section outlines the designs for the user interface screens to manipulate and execute the use cases for this prototype system. The RPPI prototype system has two roles, which are the researcher and the administrator, and are discussed in subsequent sections. The user needs internet access in order to use the system. Also, the user needs a proper email address for registration purposes and activation of the user account.

- **Researcher**

The researcher has to register first before utilising or performing any activities in the system. After the researcher has launched the system, he/she has to sign in or register by clicking the 'Register' option under the Account menu. Alternatively by clicking the 'Register a new account' link as shown in Figure 4.9. The user registration interface to capture the user or account information is depicted in Figure 4.8. The researcher has to fill the details to the text fields by entering a username, first name, last name, e-mail, new password and new password confirmation. All the fields are required and the only email

text field is validated. When all the text fields are filled then the researcher will have to click the 'Register' button to register the account.

Figure 4.8: User Registration

The user will receive an account activation email with a link to activate the account once the registration is successful. The activated account can log into the system. After successful activation of the account, the username and password created during registration need to be entered to gain access to the system as illustrated in Figure 4.9.

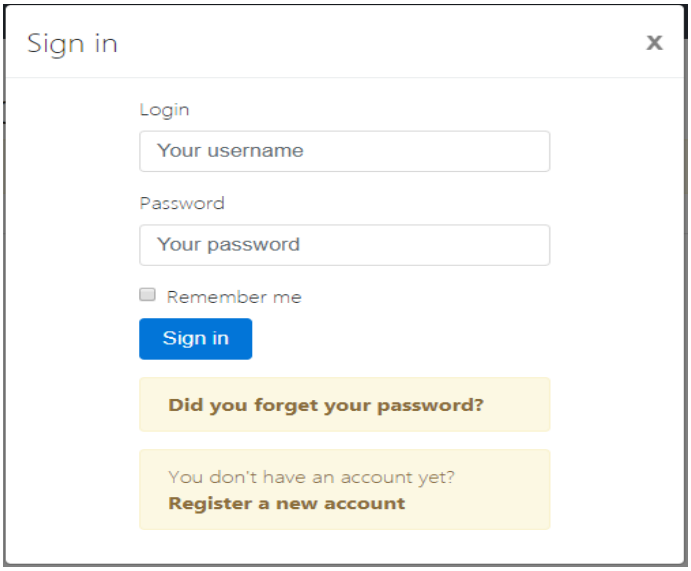

Figure 4.9: User Login

After a successful login to the system by clicking the ‘Sign in’ button, the user can be able to access the landing page and welcomed by his/her own full names with the option of taking a questionnaire as illustrated in Figure 4.10.

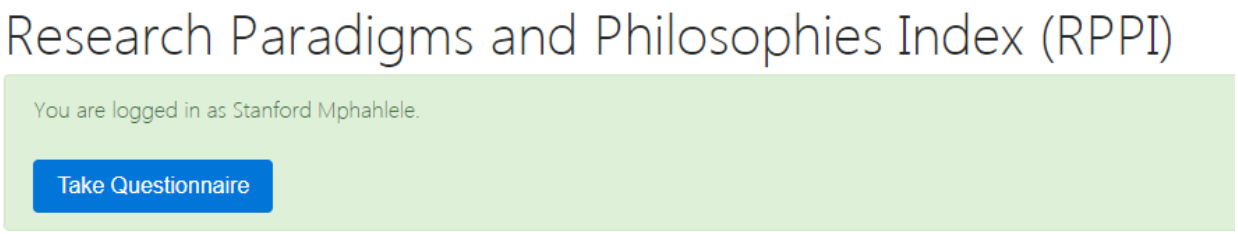

Figure 4.10: Successful Login Landing Page

When the user clicks the ‘Take Questionnaire’ button, at this stage, Figure 4.11 will be displayed to allow the user to provide responses from the questions.

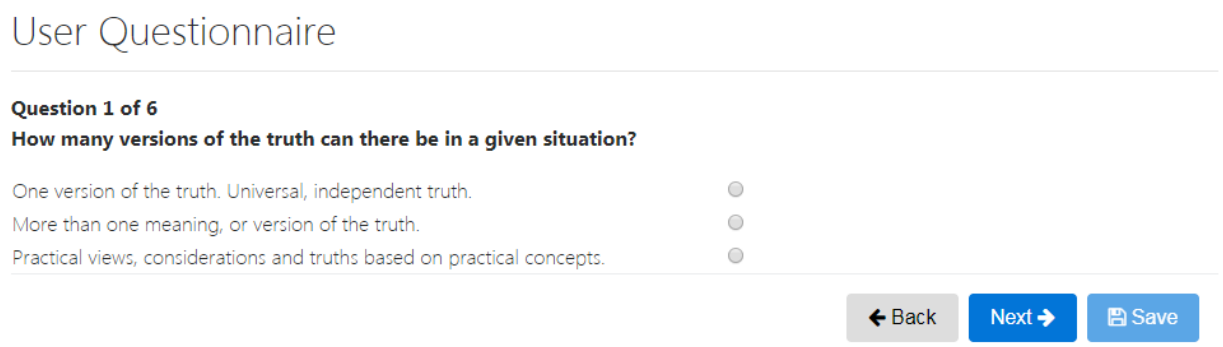

Figure 4.11: User Questionnaire

The user can provide the responses and click on the ‘Next’ button until the last question. When the user clicks on the ‘Save’ button, all the user responses will be saved and lastly, a user can be able to view the matched research paradigm and philosophy report as shown in Figure 4.12.

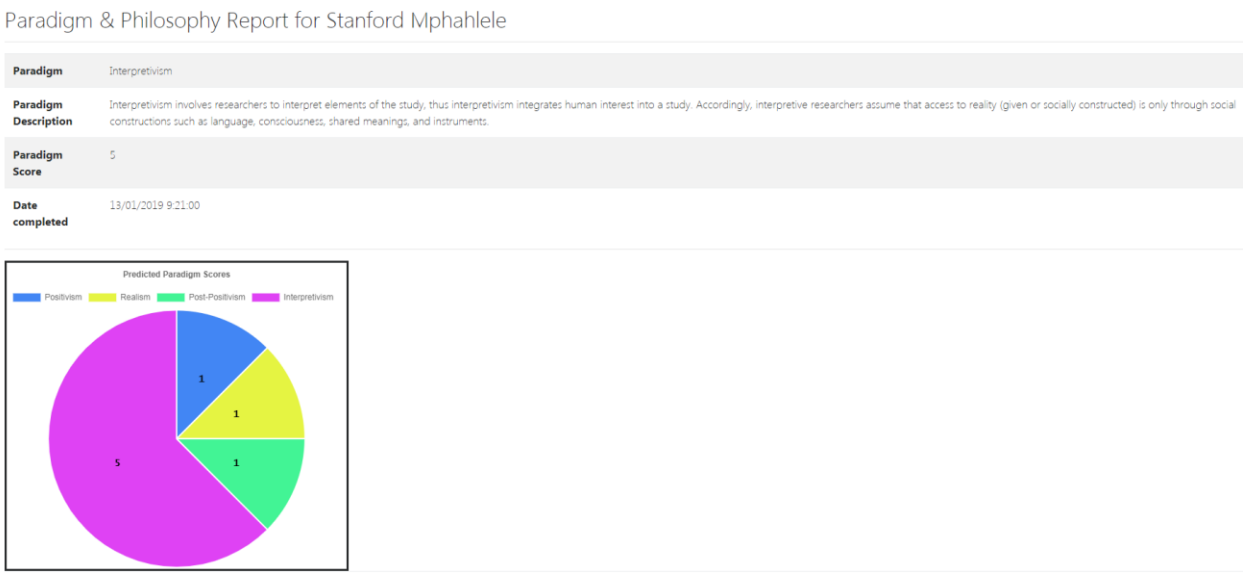

Figure 4.12: Paradigm and Philosophy User Report

- **Administrator**

When the users are registered successfully, the administrator can login into the system and manage users by directly activate/deactivate, view, edit, delete and create users as depicted in Figure 4.13.

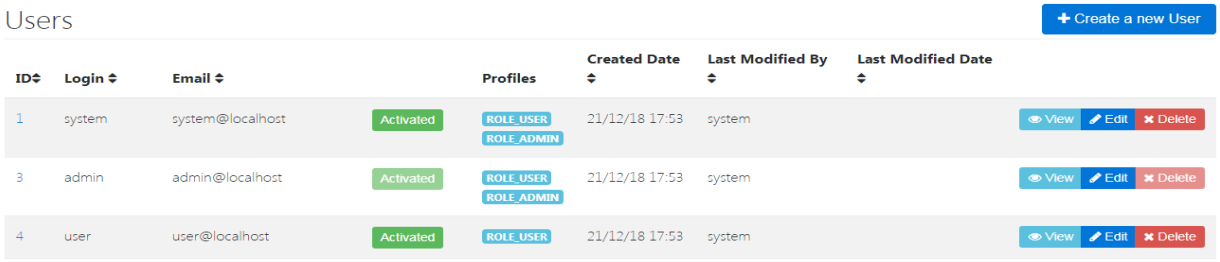

Figure 4.13: Users Screenshot

The administrator can also view, edit, delete existing questions and create new questions in the system as shown in Figure 4.14.

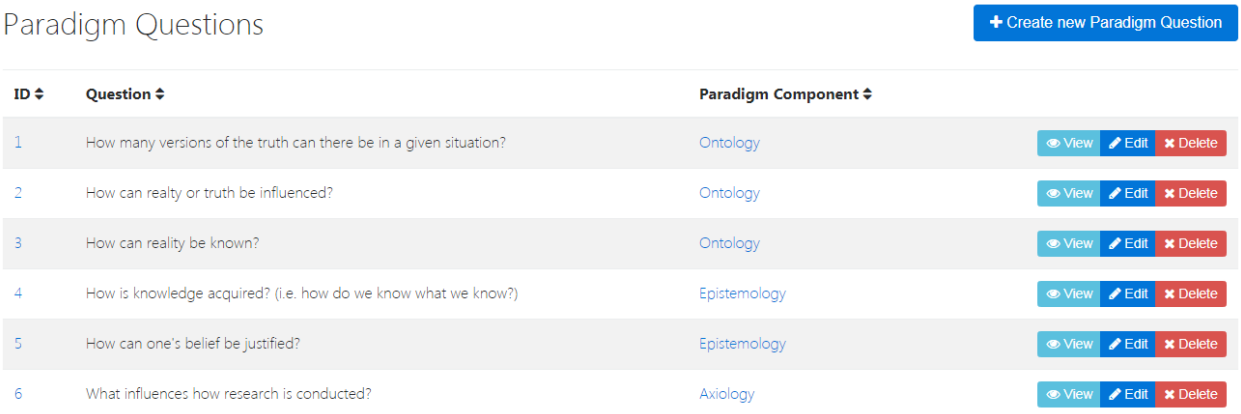

Figure 4.14: Questions Screenshot

Each and every question has the answer option and paradigm associated with it. The administrator can also view, edit, delete and create answer options for each question in the system as shown in Figure 4.15.

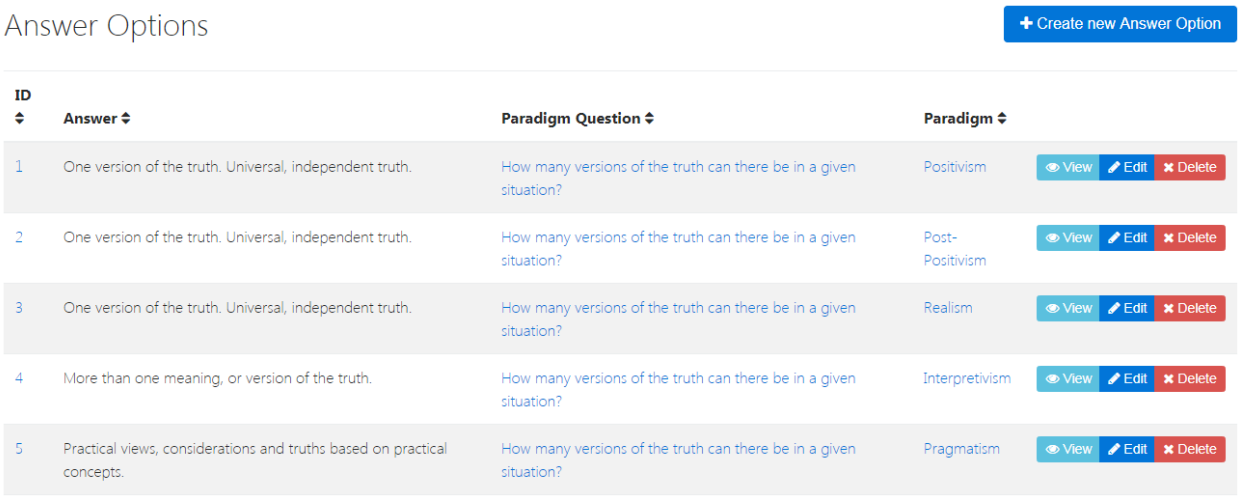

Figure 4.15: Answer Options Screenshot

4.4 CHAPTER SUMMARY

This chapter provided an in-depth discussion of the architecture, detailed and implementation design of the prototype system solution. The system architecture was presented to illustrate the various components of the RPPI prototype system. The system design was demonstrated which includes object-oriented design models and processes. Lastly, we presented how the prototype system was implemented. In the next chapter, the general effectiveness and the results of the usability testing of the RPPI prototype system are discussed in-depth.

CHAPTER 5: TESTING AND EVALUATION RESULTS

In this chapter, we evaluate our proposed Research Paradigms and Philosophies Index (RPPI) prototype system general effectiveness. The chapter is organised as follows, presentation of the usability testing results and the achievements of the study objectives. Finally, we summarise the chapter.

5.1 USABILITY TESTING RESULTS

This section presents the RPPI prototype system's usability testing results. Subsequent to developing the system, it is vital to assess and guarantee that the system is doing what is proposed to do, and according to the design. Therefore, the tasks were completed to get comments and feedback from the participants. The participants involved were only three team members, our supervisor and the other two participants that were chosen by the supervisor due to non-disclosure agreement of this project.

The participants were sent an URL to access the system, tasks to be completed and post-testing questionnaire via the email. We also informed the participants that the primary purpose of the usability testing was only focused on the RPPI prototype system and whether the system was serving the proposed purpose and functionality, and was performing according to the design.

5.1.1 Completed Tasks Results

We have created a list of tasks to be completed by the participants who were evaluated as to whether the user was able to complete that task or not. In this study, we evaluated the effectiveness based on the successful completion of a task, such as to register to use the system, take a questionnaire and view the report. To evaluate user satisfaction, we considered participant comments as they completed tasks and collected data via a post-usability testing questionnaire (see Appendix B), together with general comments. Also considered was the number of participants who could finish each task. The effectiveness

of the RPPI prototype system showed us how well participants can accomplish specific tasks. Table 5.1 reflect the tasks that participants had to accomplish and their status.

Table 5.1 Tasks participants completed

Task	Completed	
	Assisted	Without Assistance
Register to use the system	0%	100%
Login after registration	0%	100%
Take a questionnaire	0%	100%
View report	0%	100%

The participants were expected to provide their general feeling about the RPPI prototype system, and we received a similar response from all of them. 100% of the participants completed all the tasks efficiently and without any assistance. The participants were able to complete the tasks with ease and without difficulties.

The user satisfaction was captured through the post-usability testing questionnaire (see Appendix B) as shown in Figure 5.1.

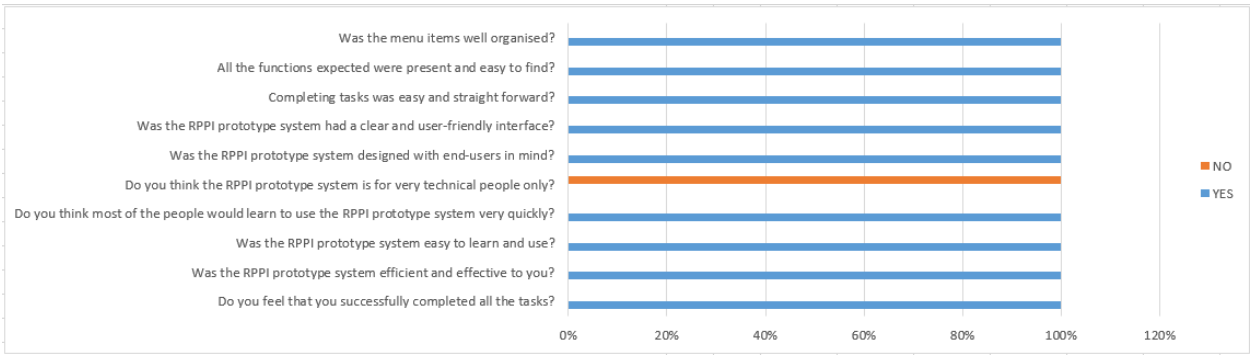

Figure 5.1: Post-Usability Testing Questionnaire Analysis

Participants' response shows that the system was simple and straight forward to use, quite user-friendly, with navigation through menu items easy to learn, use and that the

system is well organised. All the functions expected were present and easy to find and execute.

One participant highlighted that at the end of the questionnaire the Next button still shows even though that button does nothing at that stage. There was also comment that the output of the report would look much better when the pie chart shows percentages instead of the actual paradigm scores. Another participant commented that the Save button should be enabled throughout the questionnaire in case one cannot complete the questionnaire in one session. This would enable them to save the questionnaire and return to complete it later. There was also comment that the report should display and reflect when more than one paradigm and philosophy was linked to or predicted for, a user. The possibility of being able to choose more than one answer was also suggested.

There was a general feeling of satisfaction, and pleasure, in regards to the RPPI prototype system. The usability testing results indicate that all participants agree that the RPPI prototype system achieved what it was intended for, and is effective.

5.2 ACHIEVEMENTS OF OBJECTIVES

The goal of this study was to develop a model for a Research Paradigm and Philosophical Index that will automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs.

Therefore, to achieve this goal, the following objectives were accomplished:

5.2.1 Objective 1: Compile a database of paradigm and philosophical stance.

Through a thorough literature review of research paradigms and philosophies, this objective was achieved in section 2.3.1 of Chapter 2. We outlined those terms associated with the research paradigms and philosophies. As proof of concept, we only outlined the most common research paradigms and philosophies.

5.2.2 Objective 2: Critically analyse the meaning and interpret the philosophical stance and paradigms into queries.

This objective of critically analysing the meaning and interpreting the philosophical stance and paradigms into queries was achieved in section 2.3.1 of Chapter 2. We conducted a thorough literature review to critically analyse and interpret the meaning of research paradigms and philosophies, and the results were presented as variables, construct, definitions and items in Table 2.3 of Chapter 2.

5.2.3 Objective 3: Extract key data indicators to link and determine predicted paradigm and philosophy through the SQL queries.

Once the design of the RPPI prototype system was completed, this objective was achieved by compiling a complex SQL query in the relational database. These SQL queries will generate the user report to automatically predict and assist in determining the user's paradigm and philosophical stance closest to their beliefs. Figure 4.12 of Chapter 4 demonstrates the generated user report for the completed questionnaire.

5.3 CHAPTER SUMMARY

In this chapter, the results of the usability testing were presented and evaluated. The RPPI prototype system gained a remarkable response from the participants regarding the usability testing, and the general impression is that the system is simple and straight-forward to use, is quite user-friendly, has easy navigation through menu items, and is easy to learn and use, and is well organised. The RPPI prototype system would automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs. Also, the achievements of the objectives were discussed and how they were accomplished. In the next Chapter, we present future recommendations and conclude the dissertation.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

In this chapter, we present the conclusion and recommendations of the study. The study objectives are reviewed, followed by a discussion of the general study conclusion and the recommendations and future areas to explore. Finally, we summarise the chapter.

6.1 REVIEW OF OBJECTIVES

The goal of this study was to develop a model for a Research Paradigm and Philosophical Index that will automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs. Therefore, to achieve this goal, the following objectives were accomplished as discussed in details in section 5.2 of Chapter 5:

- Compile a database of paradigm and philosophical stance.
- Critically analyse the meaning and interpret the philosophical stance and paradigms into queries.
- Extract key data indicators to link and determine predicted paradigm and philosophy through the SQL queries.

6.2 CONCLUSION OF THE STUDY

In this study, we have proposed to develop a model for a research paradigms and philosophies that will automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs. The prototype was designed and implemented to serve as a proof of concept. The development of the prototype was separated into front-end and back-end components. The front-end or user interface was developed in Angular using the Visual Studio Code as an IDE. The back-end of the prototype solution was developed in Java programming language with Spring Boot using Eclipse as an IDE. The database was created using MySQL. Further details of the prototype design and implementation were discussed and presented in Chapter 4,

including the system architecture that shows all the various components of the prototype system.

We conducted usability testing to evaluate the effectiveness based on the successful completion of tasks (see Appendix A). We also evaluated user satisfaction with the post-usability testing questionnaire (see Appendix B). The results reflected that 100% of the participants completed all the tasks efficiently, without any assistance, and that all participants agree that the RPPI prototype system is effective. The further details of the prototype's usability testing and evaluation results were discussed and presented in Chapter 5.

The researcher's perspective and the general conclusion is that the research objectives were achieved and the functionality of the prototype system as proof of concept was also working according to the design. It achieved what it was intended for.

6.3 RECOMMENDATIONS AND FUTURE WORK

This study is a project that involved three members of the team. The other members of the team will address the remaining, and other required functionalities as part of their studies. Also, they will address specific issues that were encountered during the usability testing and suggestions made post-usability testing of the RPPI prototype system. The following abilities or functionalities could be added to the system or software:

- Artificial Intelligence (AI) through the application of machine learning algorithms and natural language processing (NLP). Types of predictive models and algorithms were discussed and elaborated on in Chapter 2: This will be addressed by clustering the philosophies based on the agreed framework. Depending on the user answers, a cluster will be predicted using Machine learning algorithms. Also for the NLP part, the bag of words model will be used to classify a user's input by comparing the input words against the philosophies corpus words, checking the similarities of input words against each philosophy in Table 2.3 of Chapter 2.

- Implementation of a mobile application.
- The ability to provide a research document as input to the system and predict the research paradigms and philosophies of the study: This will be addressed by using the crawling mechanism.
- The ability to be able to reflect the prediction report when multiple paradigms and philosophies are linked to a user.
- The possibility of being able to choose more than one answer from the questionnaire: This will be addressed by using the checkboxes instead of radio buttons to allow multiple selections of responses.
- Removal of the 'Next' button at the end of the questionnaire: This will be addressed by disabling the button instead of removing it completely.
- Enable 'Save' button throughout the questionnaire: This would be very useful in case one cannot complete the questionnaire in one session and would enable users to save the questionnaire and return to complete it later.
- A pie chart on the report to show percentages instead of the actual paradigm scores: This will allow users to be able to read and understand the report in the percentages format. It will be addressed by calculating and converting the paradigm scores to percentages. eight

Moreover, when the mentioned recommendations and future work can be achieved, it may be a beneficial tool to assist the local and international universities in teaching and learning of research, to determine the student's paradigms and philosophical stances closest to their beliefs before they can embark on a specific topic of research.

6.4 CHAPTER SUMMARY

This chapter served as a conclusion and recommendations of the study in which the objectives for this research was reviewed to determine if this study has fulfilled its objective. The general study conclusion was discussed and concluded that this research has fulfilled and accomplished its objective. Lastly, we discussed and made the recommendations with a specific focus on future abilities or functionalities to explore.

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APPENDICES

Appendix A: List of Tasks completed

Research Paradigm and Philosophical Index (RPPI) prototype system is a straight-forward system that will automatically predict and assist in determining the peoples' paradigm and philosophical stance closest to their beliefs. When the participants launch the system, they should expect to perform the tasks that are related to research paradigms and philosophies prototype system only. Internet access and registration of an account are required before utilising or performing any activities in the system. Also, a proper email address is required for registration purpose and activation of the user account. The usability testing activities to be completed by participants are as follows:

1. Register to use the system

The participants click on the register link or option to get the registration page. Fill in their details to register the account; once the registration is successful, the user will receive an email with a link to activate the account.

2. Login after registration

Once the registration is successful, the user can login using the username and password provided during registration. The system will open the home page with the option to take a questionnaire once the login is successful. The system will not allow the user to login until the account is activated.

3. Take a questionnaire

The participants are expected to take the questionnaire. At the end of the questionnaire, they click the Save button to store all the responses in the system and the completed questionnaire with the option to view the report displays.

4. View report

Once the questionnaire is completed and saved, participants upon clicking View Report button, the system will automatically predict and determine the paradigm and philosophical stance closest to their beliefs.

Appendix B: Post-Usability Testing Questionnaire

Please indicate the answers with the mark (X) in Yes or No column:

Question	YES	NO
Do you feel that you successfully completed all the tasks?		
Was the RPPI prototype system efficient and effective to you?		
Was the RPPI prototype system easy to learn and use?		
Do you think most of the people would learn to use the RPPI prototype system very quickly?		
Do you think the RPPI prototype system is for very technical people only?		
Was the RPPI prototype system designed with end-users in mind?		
Was the RPPI prototype system had a clear and user-friendly interface?		
Completing tasks was easy and straight forward?		
All the functions expected were present and easy to find?		
Was the menu items well organised?		

General comments,

_____

_____

_____

The RPPI team would like to thank you for taking part in this usability testing and for completing the questionnaire.

Appendix C: Ethical Document

UNISA university of south africa

COLLEGE OF ECONOMIC AND MANAGEMENT SCIENCES
RESEARCH ETHICS REVIEW COMMITTEE

10 May 2016

Ref #: 2016_CRERC_009(FA)

Name of applicant: Prof Marcia Mkansi

Student number #: 90215028

Dear Prof Mkansi

Decision: Ethics Approval

Name: Prof Marcia Mkansi, mkansm@unisa.ac.za, 012 429-2339 or 084 901 0362

Proposal: Knowledge product for knowledge development: a theory of constraints perspective

Qualification: n.a.

Thank you for the application for research ethics clearance by the College of Economic and Management Sciences Research Ethics Review Committee for the above mentioned research. Final approval is granted from 10 May **2016 to 11 May 2018.**

For full approval: *The application was expedited reviewed in compliance with the Unisa Policy on Research Ethics by members the CRERC.*

The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that*

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is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the CRERC.

3) *An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*
4) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*

Note:

The reference number **2016_CRERC_009(FA)** should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the CRERC.

Kind regards,

Prof JS Wessels
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