An Investigation into the adoption of technology among breeders in the Irish Thoroughbred Industry and the factors which affect their decision.

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Abstract

Digitalisation is spreading across most industries at a rapid pace and therefore it has never been more significant for an industry to understand the adoption process and the factors which affect it. The Irish thoroughbred industry (ITI) is an industry which has seen advancements in technology in recent years and this has enabled it to remain competitive with its national and international competitors. This industry generates a significant return to the rural economy with an annual contribution which has been independently valued at €1.84bn, supporting directly and indirectly almost 29,000 jobs (Horse Racing Ireland, 2019).

The purpose of this research is to gain a better understanding of the factors which affect technology adoption through analysing the views of Irish thoroughbred breeders. Understanding these factors will assist industry bodies when putting in place new structures, which will encourage technology adoption, with the aim of improving efficiency across the industry stakeholders.

A qualitative approach using semi structured interviews were chosen to achieve the research objectives. A conceptual model was developed from existing literature from which the interview questions were drafted. The four factors influencing technology adoption in the Irish thoroughbred industry were identified as (i) personality, (ii) social, (iii) digital inclusion, (iv) organisational. This research showed that personality and social factors are significant determinants in technology adoption while digital inclusion and organisational factors are only relevant in specific cases.

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1.0 Introduction

Business environments change; so too must a business's tactics and strategies to meet the new challenges brought about by the changing environment. The old business adage: "Adapt or Die". A key example of this is the increase in modern technology and the adoption of it. Digitalisation is spreading across most industries at a rapid pace and therefore it has never been more significant to understand the technology adoption process within the organisation along with the factors which influence it (Nambisan *et al*. 2019).

The agricultural industry has been subject to significant advancements in digitalisation and one of the main driving forces behind this research is the industry's role in which it plays in providing food and other resources to the global population. The worlds' population is expected to increase from 6.7 billion to 10 billion by 2050, an increase of 33%. (World Government Summit, 2018). This population growth will significantly increase demand for food requirements and research has indicated that it will be the implementation of modern advancements in technology in the agricultural sector which will play a vital role in meeting production levels. Agricultural operations will be run very differently primarily due to advancements in technology, a plan which has been labelled Agriculture 4.0.

The Irish Thoroughbred Industry (ITI) generates a very significant return to the rural economy in Ireland and a positive international profile for the country. The annual contribution from the ITI to the country has been independently valued at €1.84bn, supporting directly and indirectly, almost 29,000 jobs. (Horse Racing Ireland, 2019). The growth and success of the ITI would not have been achieved without the support provided by government through the Horse and Greyhound Fund which is allocated in the states annual budget.

There has been significant research into the adoption of technology within different segments of the agricultural industry but none with a focus on the thoroughbred industry. The ITI is a world leader in its sector and to maintain this position and in turn its contribution to the state, more research is required to understand attitudes towards technology adoption from the perspective of the stakeholders.

This research could create opportunities which would be vital to Ireland maintaining its success on a global scale which will help maintain its contribution to the state and therefore help secure government funding going forward. This research will address this gap through the adoption

of Roberts *et al*. (2020) P-TAF framework which had been designed to analyse the psychological factors influencing technology adoption in the oil and gas industry.

1.1 Structure of Dissertation

The next chapter, chapter two will categorise and critically evaluate the literature which has been published with regards to the adoption of technology in the agricultural industry. Using a theoretic framework, the evaluation of the main factors which have been found to influence technology will be examined. This chapter will also aim to display the significance of this literature to this study along with highlighting any gaps within the existing literature.

Chapter three will illustrate the methodology choice, the selected strategy, and the research method. The procedures involved in data analysis and ethical considerations will also be included in this chapter.

Chapter four will analyse and explore the findings which have been gathered and will aim to make a case in how it links back into the overall objectives of this research study.

Chapter five will include a critical evaluation of the findings considering the previous research conducted which includes Roberts *et al*. (2020) study on the psychological factors influencing technology adoption.

Chapter six will conclude this dissertation through reflecting on the key areas of the research. It will aim to provide realistic recommendations, recognise the limitations of the study, and propose possible areas for further research.

2.0 Literature Review

2.1 Introduction

Whilst economic, market and organisational factors are regularly discussed within innovation literature, psychological factors can also act as barriers to corporate and institutional technology adoption (Knobloch and Mercure, 2016). There is a vast amount of literature available which looks at the psychological factors which influence technological innovation adoption. Roberts *et al*. (2020) has looked at these psychological factors which influence technology adoption in a study from the oil and gas industry. This study found that technology advancement is vital for the future of not only the oil and gas industry but that innovations are only successful if they are taken off the proverbial shelf, adopted and used. Meanwhile, research by Mwangi and Kariuki (2015) looked at the factors which determine adoption of new technology by farmers in developing countries and found that farmers perception towards the new technology is the key precondition for adoption.

The ITI falls under the remit of the Department of Agriculture, Food and Marine. The agricultural and thoroughbred industries are very much intertwined with farmers income being supplemented by their investment in thoroughbred industry and vice versa. Both industries are primarily based rurally and provide significant employment in those rural areas. On this basis, previous research on agriculture and farming will be used as a literature support for this study. A considerable amount of research carried out on technology adoption in the agricultural industry has been carried out in developing countries. These industries are located in the rural part of these countries, and this is also the case for the agricultural practices in developed countries such as Ireland.

He and Veronesi (2017) conducted research on the effect personality traits had in the adoption of renewable energy technology and Bukchin and Kerret (2018) offer a new perspective referred to as Character Strengths which are personal variables, and it is these which prompts the adoption of technologies by farmers. The limitation of this research is that it has not been carried out on or tested against any members of the thoroughbred industry and this research will aim to address this gap by exploring the adoption barriers on participants of the ITI.

2.2 Research Justification

There have been numerous studies carried out over the past five decades on innovation adoption and the factors which influence it. With regards the psychological component, several key models exist which include Rogers (2002) five stage Diffusion of Innovation Theory (DOI) and the Technology Acceptance Model (TAM) to which another psychological model was later added to it to form the Theory of Planned Behaviour Model (Ajzen, 1991).

Another conceptual model which has been designed is the P-TAF framework which Roberts *et al.* (2020) devised to analyse the Psychological Factors Influencing Technology Adoption in the Oil and Gas Industry. This body of work will use the P-TAF framework as it fits well with the aim of this research and this framework is a contemporary model which further strengthens its suitability. Using this model as a basis and expanding it to include additional factors which have been examined in the literature below, this research will aim to analyse the factors which influence the adoption of technology by Irish thoroughbred breeders, essentially testing the model on the ITI.

Roberts *et al.* (2020) framework organised psychological factors into six categories which were identified as personality factors, motivation factors, attitude factors, cognitive factors, social factors, and organisational factors.

Figure 1 : Roberts et. al (2020) P-TAF framework

The researcher will be limiting this study to personality, social and organisational factors from the P-TAF framework as further examination suggested that these factors are significant in the context of the ITI.

Research carried out in 2019 on behalf of the Irish Farmers Association (IFA) on Irish farmers found that digital inclusion is a significant factor in Technology Adoption in the Irish agricultural industry and therefore it would be remiss not to adapt this model further and make the necessary addition. This study also addresses the call from Roberts to use this framework to develop interventions which support technology uptake in other sectors which are experiencing resistance to the introduction of new technology.

The following sections relate to and discuss the literature as it pertains to the barriers to technology adoption which is faced by the ITI. These barriers are presented in the conceptual model in Figure 2.

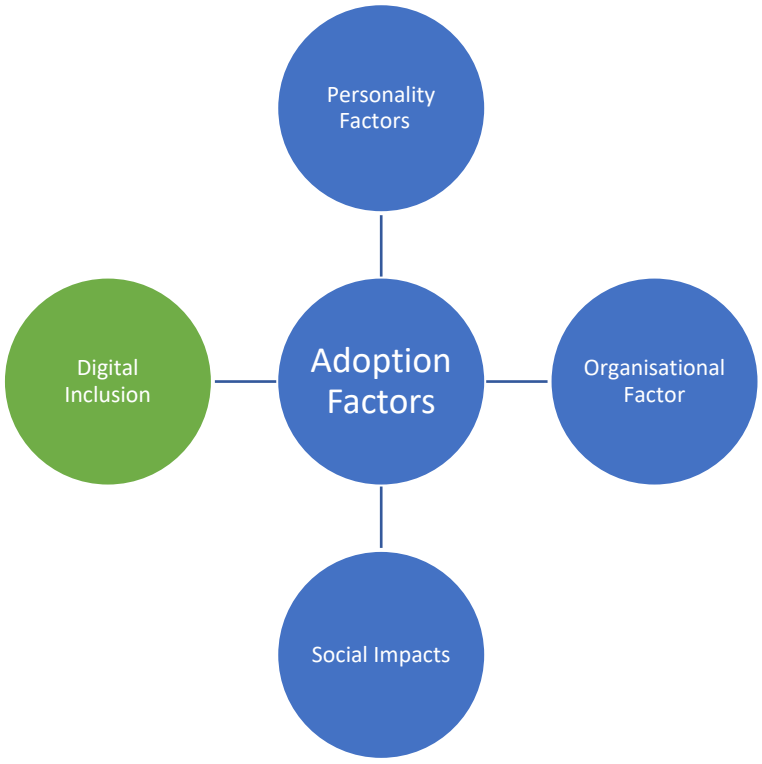


Figure 2: AOD Model 2021

2.3 Adoption Factors

Personality Factors

Research shows that personality factors play a key role in technology adoption. Funder (2015) defines personality as the individual differences in the patterns of behaviour, emotion and thought, while Rogers (1995) suggests that when it comes to technology adoption, personality is an important factor which affects the adoption of new technologies.

Roberts *et al.* (2020) describes personality factors as the differences in the makeup of an individual's behaviour and characteristics which comprise a person's adjustment to life such as their major traits, drives, interests, abilities, and emotional patterns.

He and Veronesi (2017) conducted research on the effect personality traits had in the adoption of renewable energy technology. This research showed that including personality traits in the adoption models of renewable energy technologies gave them a better understanding of individual differences in the adoption decision. This research provided the support for its use in this study. Among the many personality factors which have been identified when assessing technology adoption, the research carried out by Roberts *et al*. (2020) focussed on Innovativeness and Risk Aversion.

Innovativeness - Aldahdouh *et al*. (2019) refers to innovativeness as an individual's inclination towards novelty and change which in turn relates to that person's willingness to try out new technologies. Research carried out by Biagini *et al.* (2014) and Diagne and Cabral (2017) suggests that in many cases innovative technologies are anticipated to play a considerable role in the development of sustainable agricultural systems. Feist (1988) proposes that creative people possess a distinct set of traits and with regards farmers, creative farmers constantly seek innovative, sophisticated solutions and therefore are much more likely to grasp a new technology. On the topic of innovative solutions, Bukchin and Kerret (2018) found that creative farmers are continuously seeking to achieve this and that they view new technology as an improvement and a possible solution to overcoming challenges.

Risk Aversion - Roberts *et al*. (2020) describes risk aversion as choosing the less risky option during the decision-making process even if that risk is relatively small. Research carried out by Mukasa (2018) suggests that farmers are known to be more risk-adverse and as such reluctant to embrace new technologies.

Sinja *et al*. (2004) highlight the important benefits of making the farmer a part of the evaluation process prior to them adopting it. Doss (2003) believes that trialability is a significant factor in technology adoption as their research found that the potential adopter is more likely to adopt new technology if they are given the opportunity to try something out prior to adopting it completely. This is supported by research carried out by Sinja *et al*. (2004) who found that when introducing any new technology to farmers, it is important that they should be involved in its evaluation to ensure its suitability for their requirements.

Kratzer *et al.* (2017) emphasises the psychological barriers to the introduction of new technology from managers who are resistant to prototypes being trialled on their worksites. As a result of being the early adopter, there could be productivity risks, as well as a reluctance by staff to change from their familiar ways of working.

According to Kariyasa and Dewi (2013) age is another factor which contributes to the risk aversion element in the adoption process of new technology. Research found that older more experienced farmers who have gained more knowledge over time are better equipped to evaluate technology information in comparison to younger farmers. In contrast to this, Maurceri *et al.* (2005) and Adesina & Zinnah (1993) argue that age is found to have a negative relationship with adoption of technology. The thought process here is that as farmers get older their risk aversion increases which in turn brings about a decreased interest in committing to a long-term investment in the farm, in contrast to younger farmers who are typically less risk-averse and more willing to try new technologies.

Digital Inclusion

Digital technologies are being used to transform the global agricultural industry. Phillips *et al*. (2019) suggests that agricultural firms are adapting and adopting a range of new software, mobile apps, sensor technologies and big data applications which is disrupting established structures in the associated sectors. With the post-industrial world moving online, access to digital communication technologies have become increasingly important for rural economies.

Edwards (2009) argues that broadband access is now considered a core public utility but the access to these digital technologies, does not mean that people in rural communities are able to participate fully in the digital economy due to digital inclusion. Marshall *et al*. (2020) describes digital inclusion as the ability of people to access, afford and use online technologies effectively. This research looked at to what extent Australian farmers are digitally included and results showed that farmers score lower than others in similar circumstances. Bukchin and Kerret (2020) suggest that the primary barriers obstructing adoption are the lack of access to

sustainable technologies, an argument which is supported by Cafer and Rikoon, (2018) whose research also suggests that the main barriers impeding technology adoption in rural areas is the lack of access to sustainable technology and the information about them. Although Bukchin and Kerret (2020) suggest that these are the primary barriers, their research does argue that these barriers fail to explain in full the issue faced by farmers as their removal does not guarantee that a particular innovation would actually be adopted and perhaps it is more a combination of factors.

Social Impacts

Roberts *et al*. (2020) refers to social factors in relation to social cognition in that people perceive, consider, interpret, and judge their own social behaviours and those of others. This is primarily in relation to social influence which Roberts defines as any changes in a person's behaviours, feelings or thoughts caused by other people when introducing new ways of working.

According to Mwangi and Kariuki (2015) farmers who are part of a social group discover and learn of the benefits through using technology while Uaiene *et al*. (2009) believes that effects of a social group play an important role, particularly in the context of agricultural innovations as farmers share information and learn from each other.

Rose *et al*. (2021) identifies some concerns with regards the digitalisation of all farming systems when highlighting that a lack of attention has been given to the social impacts of new technologies. This is based on the thought process that while technologies may increase yields and reduce inputs, in many cases the requirement of labour will be reduced. This concern is echoed by Carolan (2008) whose research highlights the importance of physical work and traditional farm practices in order to maintain enjoyment of their role and work satisfaction.

The ITI would often receive criticism for its resistance to change and would be deemed archaic on many fronts. Prior to Covid-19, the industry would have been slow to embrace the digital and technologic systems that would have been readily available for quite a while. Makkonen *et al*. (2016) highlights that a reluctance of organisations to adopt new technology can result in significant costs through the loss of competitive advantage and potential revenue. The global thoroughbred industry is extremely competitive, and constant change is required to stay ahead of the competition. Marshall Goldsmith's famous quote of 'What gets you here, won't get you there' is very applicable in this instance.

Organisational Factors

Mwangi and Kariuki (2015) found that the size of the farm or organisation plays a critical role in the process of adopting new technology. Lavison (2013) supports this when suggesting that the size of the farm affects and can be affected by other factors influencing technology adoption.

Research indicates that there is a corelation between larger farm sizes and the adoption of agricultural technology. Uaiene *et al*. 2009 suggests that farmers with large farm sizes are likely to adopt a new technology as they can afford to devote part of their land to try out new technology unlike those with a smaller farm size. In contrast to this research, Mwangi and Kariuki (2015) showed a negative influence of farm size on adoption of new agricultural technology in that the smaller farm size may provide an enticement to adopt a technology especially in the case of an input-intensive innovation.

2.4 Conclusion

The literature examined shows that there has been adequate research carried out in the area of technology adoption in the agricultural industry but with very little focus on the thoroughbred industry. The conceptual model which was derived from this research will be used as a framework and ensure legitimacy in this study. This study will explore the gap which exists and add a new dimension to existing research.

In the next chapter, the research question and research objectives will be outlined.

3.0 Research Question

3.1 Research Objective

The research objective for this dissertation is to investigate technology adoption among Irish Thoroughbred Breeders and the factors which affect its implementation.

There have been previous studies on the impact of technology in the agricultural industries by Bukchin and Kerret (2020) and Rose et. al. (2021), however, there has been no such work with a focus on the Irish Thoroughbred Industry (ITI).

Given the demonstrated increase in the advancement in technology and the importance of the ITI to the economy, this research aims to answer the following research question.

What factors affect the adoption of technology in the Irish Thoroughbred Industry from the perspective of Irish breeders.

3.2 Research Questions

To achieve the research objective, the research questions to be answered in this dissertation are:

1. Analyse the awareness of Irish breeders of the availability of technology to them in their role in the thoroughbred industry.

2. What are the main barriers facing breeders to introducing these new technological advances in the ITI?

3. Which additions have proved to be the most significant in terms of effect and successful impact?

4.0 Methodology Introduction

4.1 Introduction

Kumar (2015) defines research methodology as the scientific or systematic way in which a researcher performs their research to accomplish their desired goals and objectives. The aim of this chapter is to lay out the methodology which the researcher has elected to use while providing a justification for these choices. The techniques used to carry out sampling, data collection and analysis will also be explained in this chapter along with ethical considerations and validity of the research.

Saunders *et al*. (2009) research onion model outlines the various stages to be undertaken by a researcher when preparing a methodology, so this will be used to ensure validity and creditability at these different stages. This chapter discusses the full process and numerous elements of how the research is carried out for this study. A high level of critical evaluation of all available methods and research strategies is required when completing the methodology process (Blaikie, 2000). This assessment was carried out and the chosen methodology along with its justification will be outlined along with limitations of the research and ethical considerations.

4.2 Research Philosophy

Research philosophy is the first layer of the ‘‘onion’’ that is to be addressed and Saunders *et al.* (2009) refers to it as a system of assumptions and beliefs about the expansion of knowledge. The research philosophy sets the groundwork for all future aspects of the research process which includes the creation of the research question and the selection of research methods. Given the high level of detail required in the section, Mkansi and Acheampong (2012) emphasise the necessity of the researcher possessing an in-dept knowledge of their investigations. This clear understanding of the study will enable the researcher to select the most effective and suitable methodology in order to achieve the research objective. The two main concepts when discussing research philosophy are ontology and epistemology and it will be the latter which will be used in this dissertation.

4.3 Epistemology

Epistemology is defined by Saunders et. al (2009) as an acceptable knowledge in a particular area of research which enables the researcher to know how best to go about delving into this area further. Lewis and Thornhill (2007) split the type of researchers in epistemology into two types, the Resources Orientated researcher and the Feelings Orientated researcher. While the

former tends to be in a positivist position, the latter tends to participate from an interpretive perspective.

It is the belief of Fisher (2007) that interpretivism is research based on the understanding that reality is socially constructed and therefore that knowledge and truth are subjective. This study will have an interpretive element as it will be based on the views of thoroughbred breeders who will have a considerable emotional aspect to it so therefore a feelings-orientated research role will be undertaken. Saunders and Tosey (2012) believe that interpretivism has a close association with the study of social phenomena when in their natural environment. Saunders et. al. (2009) points to the use of qualitative methods when undertaking the interpretive approach with this qualitative data being collected from small sample sizes via in-depth interviews.

4.4 Approach and Design

Cresswell (2007) implies that an inductive approach is shaped by the researchers experience in collecting and analysing data, suggesting that it essentially emerges from the ground up. This approach will be used for this dissertation as it supports the interpretivism method which considers the human and emotion aspects associated with the qualitative data collection techniques. The emotions of the thoroughbred breeders play a noticeable role in the input and results of the research. Yin (2016) also recommends that an inductive approach is mainly associated with qualitative research.

This dissertation will concentrate on qualitative methodologies as the majority of data used will require interpretation due to its nature e.g. online discussions, opinions and perspectives. Qualitive research is described by Kennedy (2019) as the study of a research topic which is not suitable to statistical analysis as the focus needs to be on interpreting meaning from the participants along with their experience and views. The research shows that embracing these new technologies is a personal choice and to get accurate and detailed perspectives from them, qualitative research is the most suitable methodology. The ITI is commonly referred to as a people business which is built on strong relationships so it is felt that a survey would not be as effective as it could miss out on some of the nuisances that are in existence. This qualitative methodology was used by Bukchin and Kerret (2016) when carrying out research on smallholder farmers. Although Roberts *et al*. (2020) used a multi-pronged approach which was possible given their large pool of resources, qualitative methods also played a significant role in their study as they were deemed appropriate as they helped form a connection with the participant. One of the main differences between qualitative and quantitative research which

Chloy (2014) highlighted is that qualitative research through its semi structured nature can account for emotions, ideas and opinions which will be important as participants can provide information and answers in their own words. This level of flexibility should prove beneficial here when trying to delve deeper to coax out essential insights.

4.5 Research Method

Research methods are the techniques, procedures and tools used when gathering and analysing data (Kennedy 2017). When deciding on a research method in which to collect data, Saunders *et al*. (2009) advises that the researcher has the option to choose a single research method or go with using a combination of methods. When making this decision the primary objective of the researcher is to select the method or methods which will best help answer the research questions and achieve the objectives of the study.

Qualitative semi-structured interviews will be used as the research method for this study and Clifford, French and Valentine (2010) describe these as a type of interview in which the questions are open ended. This will allow participants go into further detail on the adoption factors which they feel are the most significant to them. Saunders *et al.* (2009) supports the earlier research when referring to semi-structured interviews as a qualitative interview which will develop based on the themes and questions that have been set, but there will be the opportunity for the participants to elaborate further on the areas which they feel justify further detail. Yin (2016) highlights two-way interaction as an advantage of semi-structured interviews as it plays a positive role in relationship building and the clarification of questions because such issues would negatively affect the accuracy of the findings. The importance of building a relationship with the participants and avoiding any misunderstandings will encourage them to open-up and speak freely during this process which is likely to be a new experience for some of them. This is supported by Uaiene *et al*. (2009) who found that in the context of agricultural innovations, communication and information sharing among farmers played an important role.

The themes will be primarily based around Roberts *et al*. (2020) P-TAF model which was examined in detail in the literature review and through adopting this approach here it adds further rigour to this study. The revised model is again illustrated in Figure 3 on the following page.

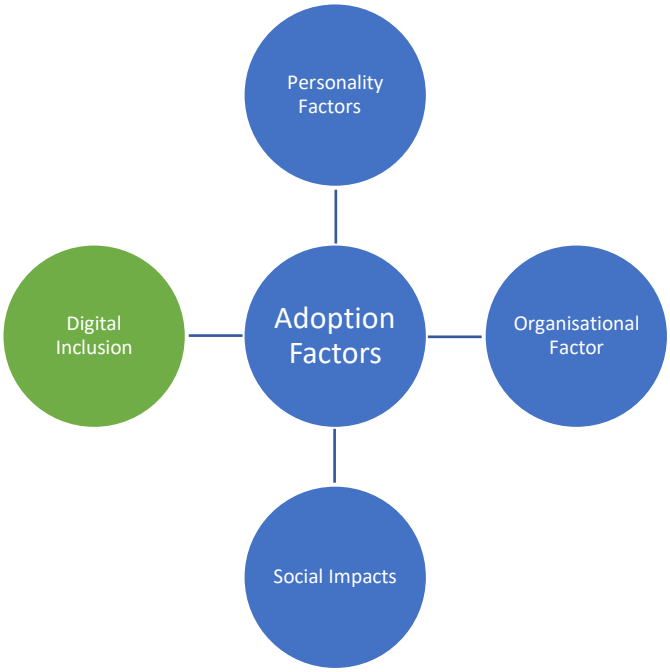


Figure 3: AOD Model 2021

Technology Adoption Factors

The table below outlines the four primary technology adoption factors along with the literature sources which support them. This research played a significant role in the further development of Roberts *et al*. P-TAF framework to create the AOD Model 2021.

Technology Adoption Factors			
Personality Factors			
Study Author	**Context/Setting**	**Variables/Focus**	**Outcome**
Roberts et al. (2020)	Large farms Australia	Innovativeness	Generational differences with regards views towards technology.
Biagini et al. (2014)	Senegal Farming	Innovativeness	Innovative technologies are predicted to play a significant role in the development of sustainable agricultural systems
Diagne & Cabral (2017)	Senegal Farming	Innovativeness	Innovative technologies are predicted to play a significant role in the development of sustainable agricultural systems
Roberts et al. (2020)	Large farms Australia	Risk Aversion	Tendency to avoid options that entail risk even if that risk is relatively small
Mukasa (2018)	Farming sector more generally	Risk Aversion	Farmers are known to be more risk adverse and as such reluctant to embrace new technologies

Maurceri et al. (2015)	Age of person	Risk Adverse	Age is found to have a negative relationship with technology adoption.
Digital Inclusion			
Study Author	**Context/Setting**	**Variable/Focus**	**Outcome**
Bukchin & Kerret, (2020)	Farming	Barriers to adoption	Barriers obstructing adoption are the lack of access to sustainable technologies
Edwards, (2009)	General	Broadband Access	Broadband access is now considered a core public utility
Marshall et al. (2020)	Australian Farmers	Broadband	Australian farmers are not digitally included
Cafer & Rikoon, 2018	Developing countries – no digital	Lack of access	Main barriers hindering adoption are lack of access to sustainable technology and to information about them
Phillips et al. (2019)	Agricultural	Adoption of new services	Adapting and adopting new technology which is disrupting established structures in the associated sectors.
Social Impacts			
Study Author	**Context/Setting**	**Variables/Focus**	**Outcome**
Roberts et al. (2020)	Large Farm Australia	Social Reasoning	People perceive, consider, interpret, and judge their own social behaviours and those of others.
Mwangi & Kariuki (2015)	Developing Countries	Social group	Farmers who are part of a social group discover and learn of the benefits through using technology
Rose et al. (2021)	Digital transformation of rural areas	Lack of attention given to social impacts	The digitalisation of all farming systems identifies a lack of attention which has been given to the social impacts of new technologies.
Carolan (2008)	Rural Areas	Enjoyment and job fulfilment	Importance of physical work and traditional farm practices to maintain enjoyment of their role and work satisfaction.
Organisational Factors			
Lavison (2013)	Rural Areas	Farm Size	Farm size affects and can be affected by other factors influencing technology adoption.

Mwangi & Kariuki (2015)	Developing Countries	Farm Size	Size of farm or organisation plays a critical role in the process of technology adoption.
Uaiene et al. (2009)	Determinants of Agricultural Technology Adoption in Mozambique	Farm size	Farmers with large farms are likely to adopt a new technology as they can afford to devote part of their land to try out new technology

Figure 4: Model Development Table

4.6 Sampling

Researchers use sampling to identify a sub-group of the population that can act as a representative of the population. Quinlan (2011) suggests that there are two key sampling techniques in probability and non-probability sampling. Purposive sampling is a practice of non-probability sampling, and it is this technique which has been selected for this dissertation.

Neuman (2005) highlights how purposive sampling allows the researcher to work with particularly small sample sizes that are relevant to the project. In the current climate this is important, as access to people is not as easy as in previous years prior to Covid-19 so it is essential that the right people are targeted to increase data accuracy and quality. Purposive sampling will be adopted in this study as it allows the researcher to use their judgement when selecting who they believe the most appropriate sample to be to answer the research question and meet the overall objectives of the dissertation. Baker (2001) suggests that non-probability sampling is less time consuming and less complicated for those with a smaller pool of resources and limited resources are a factor which had to be considered for this dissertation.

To qualify as a participant for this study, the following criteria must be met:

- Working within the thoroughbred industry based in Ireland.
- Owner of a stud farm who breeds thoroughbred horses on a commercial basis or a senior manager of a commercial thoroughbred breeding operation with responsibility for strategic decision.

Based on the criteria, the researcher contacted eight possible participants from a broad range of locations within the ITI. These participants were contacts which the researcher dealt with through their industry network. This population was narrowed down to six participants who the researcher felt could best contribute to the achievement of the research objectives.

The selected candidates are listed below.

Unique ID	Job Title	Business Size	Age & Location
Participant one	Stud farm owner	20 mares	62 years - Kildare
Participant two	Stud farm owner	6 mares	33 years – Tipperary
Participant three	Stud farm owner	15 mares	38 years - Offaly
Participant four	Stud farm owner	10 mares	65 years - Limerick
Participant five	Stud farm manager	12 mares	42 years - Down

Figure 5: Table of participants for this research

4.7 Data Collection Analysis

This process commenced with an initial email being sent to the six participants which included the research topic, a summary of the objectives of the study and a consent form. A request for a one-hour meeting through Microsoft teams was also included. On acceptance of this request, interviews were scheduled, and invites sent to participants. These invites included the theoretical framework which outlined the themes which would be discussed. A set of open-ended questions were developed based on each factor which made up the conceptual model. A pilot study was considered but given current restrictions, the researcher did not have access to the required participants. The technology used to carry out the interview was tested with a work colleague prior to the first scheduled interview.

Six semi-structured interviews were carried out with Irish thoroughbred breeders. Ideally these interviews would have been carried out face to face but this was not possible due to Covid-19 but the use of video meant that body language and expressions could be shared and captured. Saunders et al. (2009) highlights the importance that these expressions are to the researcher as it allows them to gauge the sincerity and truthfulness of the interviewee's response. The framework which was sent to the participant helped to put their mind at ease about what was required while also allowing them the opportunity to give the subject some thought in advance. Using the Microsoft Teams method also resulted in getting access to certain participates who would not have had time to travel to meet the researcher in person. Each of the meetings were recorded and this assisted in giving the interviewer a relaxed conversational nature as notes did not have to be taken. All interviews were recorded which provided the significant benefit of listening back to the conversation and extracting the required data. This was a significant time saving technique as it meant that the interview did not need to be transcribed although the researcher did take some notes during the interview which were deemed significant. The importance of getting this permission of the participants in writing prior to the interview was

highlighted by Yin (2016) and steps were taken as the consent forms were signed in advance. Each interview lasted between 40 and 60 minutes.

Thematic analysis was carried out to analyse the data. This is the reorganisation of the data gathered into the common themes. Willis (2013) describes a theme as a noticeable reoccurrence of important patterns which are systemic rather than random. This research aims to identify the common factors which affect technology adoption among the thoroughbred industry, so this approach is a suitable tool. The research by Roberts *et al*. (2020) also used a version of Braun and Clarke's (2006) thematic analysis so this offers further support for this choice of approach.

Braun and Clark (2006) highlight and discuss the differences between both inductive and deductive (theoretical) thematic analysis. Theoretical analysis is more research driven and guided by their interest in the research area. The conceptual model used by the researcher in this literature review formed several themes, from which the interview questions were drafted, hence the reason for adopting a theoretical analysis in this instance.

4.8 Reliability and Validity

The reliability of the study relates to the degree which the selected data collection tools and techniques will produce consistent results across all data gathered (Saunders (2009) while Yin (2016) suggests that when carrying out qualitative research, validity is linked to accuracy. Data should be accurately interpreted, and the research should reflect this accordingly, hence the importance of honesty and transparency when carrying out exploratory research.

The following steps were taken to ensure reliability and validity:

- Research methods like those used in peer-reviewed literature were adopted.
- Emphasis placed on selecting interview participants who were knowledgeable in this area of study.
- A flexible approach was taken at each stage and changes made accordingly in the best interests of the research
- Interviews were recorded to ensure correct interpretation and increase the overall accuracy of the research.
- During data collection and analysis of such, a consistent approach was standard practice.
- Honesty and transparency were at the forefront of all communications that were carried out.

4.9 Ethical Consideration

As with every piece of research, the author is aware that there are ethical considerations with this dissertation. Ethics is described by Cooper & Schindler (2008) as the behavioural standards which direct the moral choices that people make in the context of their behaviour and relationships with others. The following steps and considerations were undertaken to ensure a high ethical standard.

An ethics form was completed and submitted to National College of Ireland (NCI) with the proposal in January 2021.

Participation was on a voluntary basis and prior to any interviews, the research topic was shared with all participants along with the aims and objectives of the research. A consent form was also distributed at this stage for signing which highlighted assurances of anonymity and the right to withdraw at any stage of the process. No reference to participants names or their organisations would appear in the research and the allocation of a unique identification number aided in this process.

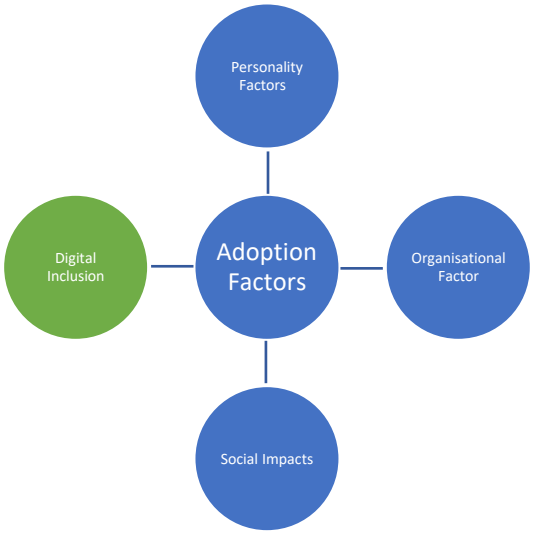
5.0 Analysis and Findings

5.1 Introduction

This research aims to clarify the factors which influence the adoption of technology in the Irish Thoroughbred Industry from the breeder's perspective using the thematic analysis framework produced by Braun and Clarke (2006).

From the literature review, which was carried out, a conceptual model with four overarching themes was produced. An analysis of these themes will be carried out against the views of the five participants who contributed via the semi-structured interviews. The researcher will analyse these themes in order of significance based on the information gathered from the participants.

Figure 6: AOD Model 2021



5.2 Thematic Analysis

Personality Factors

This theme explores the role of personality factors when making decisions on technology adoption. Rogers (1995) suggests that when it comes to technology adoption, personality is an important factor which affects the adoption of new technologies.

All participants highlighted the user's personality as a key factor when choosing to adopt technology in their business. Participant Four felt that personality factors were one of the primary considerations when it comes to deciding on adopting technology. They believe that they are from a different generation where technology was something that they were never required to know about. There was no requirement on them to be innovative and therefore they were risk adverse to any new changes.

''It was only last year that I became aware of what an iPhone was and even then, I would have said that I would never have any interest in getting one as I am happy with my current phone and will never need the extras which it offers. Over the last 12 months, to stay competitive in the industry I needed to have access to some of the functions its offers and I've recently made the change over from my Nokia 3210''.

This point was echoed by Participant One who felt that they were very cautious about trying something new as they had little experience of it and were unsure if the pros would outweigh the cons. Risk aversion and a lack of innovation was a barrier to deciding not to adopt new available technology options up to now.

''I would have been worried that by making the change over and using these new technologies, where would I be if I made a mistake or the pitfalls of not being able to use it correctly. I have come around to making some bank transfers using the computer but would be very concerned about doing it on my phone in case something was to go wrong – I just would not trust it''.

Participant Five discusses their experience in their family business which is involved in producing horse feed and supplements to the equine industry, an area which is reliant on innovative solutions and staying ahead of the curve. This is an example of how the personality factors can have a significant impact on the increase in technology adoption.

''Through growing up helping in my family's feed business I was always aware of the competitive culture of the industry and in order to stay in business, one must always be open to change, willing to take risks and be innovative in all areas of the business. With this in mind, as available technology became available which would assist me in my breeding operation, I was very quick to take advantage of it''.

Although participant's two and three could see how personality traits could be a significant factor in technology adoption, neither felt that they had been a barrier in their specific cases. However, after examining this further, participant two highlighted that he did have experience of it through a family member.

''My father would take a lot of convincing in order to embrace new devices that have come available. During Covid-19 when entries for the marts and horse sales had to be made online, he was not comfortable with trusting the system to do this as previously

he would have felt more at ease handing in the paper copy to the administrator at the mart. This way he knew for sure that they had received it''.

It is therefore clear from the respondents that personality traits have an impact on technology adoption. The older generation are slower to adopt the technology as they feel there are risks associated to these along with a lack of experience using digital devices while the younger generation have had more exposure to technology and therefore are more comfortable with trying it out.

Social Impacts

The social impact which technology adoption has on the participants is a significant factor in the decision-making process. Uaiene et al, (2009) believes that effects of a social group play an important role, particularly in the context of agricultural innovations as farmers share information and learn from each other. Mwangi & Kariuki (2015) support this when suggesting that farmers who are part of a social group discover and learn of the benefits through using technology.

When discussing the impact that social factors had on their adoption of technology, Participant One who had increased their technology usage, put this decision down to a recommendation from his family members.

''My wife and son would be much more tech savvy and confident with technology than I would be, and this was a significant factor in giving me the confidence to try it. The fact that they would be available to answer any queries or resolve any issues I had was another considerable factor''.

A second participant (Participant 4) supported the importance of social influence from his family and extended this to a wider circle of colleagues and friends from which a combination of all, gave him the confidence to get over the risk factor.

''My son had an iPhone and he was doing some of the tasks on that for me, and during covid I became aware that other breeders who would be friends of mine were doing it for themselves on similar devices and this encouraged me to do it for myself''.

When asked to talk about the personal experience of using the new devices, the same participant highlighted the personal satisfaction which he got from doing it for himself and this created an eagerness to want to learn more.

''I started using the internet and some of the functions on the iPhone but still used my old Nokia for calls and messages. It was a month or six weeks before I moved over completely and having this option allowed me to progress at a rate that I was comfortable with, while having people around who could help''.

Participant two and three also emphasised the importance which the social impact played but from their perspective the influence came from associates and friends rather than family. They had a good awareness of what is available and soon realised the benefits to their business as a result of adoption and the added benefit to having more people using the available devices.

Participant Two - *''I often purchase horses with a group of friends, but we all do our own groundwork looking at them at the sales and meet up at the end of the day to compare short lists. From using the new sales app on the iPad it has replaced writing handwritten notes into the paper catalogue. This app allowed us to share our lists and notes digitally as the app had this facility to do this via email. This made this process much more efficient and slicker, and it also reduced the possibility of us missing out on discussing a particular horse which could be costly''.*

Participant Three - *''Other breeders were sending me research articles and statistics on stallions and sales performances. Given the competitiveness of our industry now, it is essential to have immediate access to this knowledge in order to make informed decisions. The old way was to sit down and read through it a few days later when you got home and in front of a laptop. When flying over to the UK and French sales, I can now be doing some of my research while on the go. I simply had to make the move, or I would be left behind''.*

Participant Five also supports the belief that encouragement to adopt new digital devices came about as a result of seeing others embrace them and advertise their benefits. This person did however highlight the fact that he gains a sense of personal satisfaction from the old style of working and is keen to maintain that to some degree.

''From installing new cameras in the barns along with new monitoring systems, it has made it a more efficient operation, but I have always enjoyed the traditional working practices and would be keen to maintain these. When it comes to communicating with clients, I know of many others who only send emails and WhatsApp messages, but I still like to meet the client regularly in person. Obviously, this is not always possible, but a phone call is a close second best and I firmly believe this is a big element in building

and maintaining a good relationship. I also like to walk out and check the animals in person at night rather than just watching on the camera.

It is therefore clear that technology adoption among Irish thoroughbred breeders is certainly influenced by social impacts. All participants confirmed that their decision to adopt technology was influenced by another person who was either a family member, friend or industry colleague.

Digital Inclusion

This theme sets out to establish to what level does digital inclusion play in thoroughbred breeders adopting new technologies. Research from Bukchin & Kerret (2020) and Cafer & Rikoon (2018) argue that that the main barrier to the adoption of technology in rural and agricultural areas is the lack of access to sustainable technology while Edwards (2009) goes a step further when suggesting that broadband access is now considered a core public utility.

Participant One supports the theory that digital inclusion is a factor in technology adoption and when available to people, it has resulted in an increase in its use.

> *''Currently the wifi is of a sufficient standard for me to carry out the tasks but this has not always been the case. The quality of the service offered has been improved significantly recently and as a result it has enabled me to make more use of technology and further embrace technological opportunities''.*

Participant Three was equally decisive on the necessity of having access to available technology.

> *''A significant portion of my income comes from foaling mares for clients so monitoring these mares 24/7 is essential. Having good wifi meant that I could put in wireless cameras to keep an eye on these from my home. This was never an option when I was working for other stud farms in the past. Its significance cannot be overstated as quick action during a difficult foaling can be the difference between life and death of the animal''.*

Our next participant again shared their experience of not having access to technology due to their location but the contrast in having such access in their new location, highlights the importance of its availability in the future.

> *''I have only just recently relocated to a new farm near Fethard where the signal is second to none. Before this I was based near Dundrum and not only was there no*

broadband available, but phone signal was extremely poor as well. When looking at farms in which to rent or buy in the future, the accessibility to technology has very quickly become a significant factor (Participant Two).

Participant Four also felt this was a factor but not a significant one.

''My farm is located on the edge of the town and as a result, signal for the internet and phone works quite well, and I cannot recall having many issues with it''.

However, when probed further on the timelines of adoption of different technologies, it became evident that there was high speed broadband in place prior to the participant choosing to adopt such technology.

''When I got my first smart phone, my kids set everything up and it worked very well and soon after that an iPad followed so that I could read the papers and monitor the farm which away''.

The findings above reveal that digital inclusion is a barrier to technology adoption and this mainly occurs due to a lack of high speed wifi and poor phone signal availability in rural locations around Ireland.

Organisational Factor

This theme analyses the relative impact that organisational factors have when deciding to adopt technology in the ITI. Mwangi and Kariuki (2015) found that the size of the farm or organisation plays a critical role in the process of adopting new technology.

Participant one found that the size of the farm has influenced technology adoption and that it did have a positive impact on the organisation.

''I always have about 20 mares on the farm now and although this number has not increased massively over the last few years, it has become very competitive, and things must be done to a higher standard. This has increased the overall workload. I still employee two members of staff and this has not changed but from having the technology systems in place, it allows me more flexibility during the busy season''.

Another participant discussed the fact that he had inherited the farm from his parents and at the time they had one full time employee, but the farm was not commercially viable. Several changes had to be made to improve the efficiency of the operation.

''For the farm to return to profitability, a number of technological systems and additions were put in place to aid in managing the operation. This investment meant

that the farm now only required one part time employee which was a significant cost saving but still ran to a high standard and was achieving good results''.

The remaining participants had mixed opinions on the impact which organisational factors had on technology adoption, but they did agree that it might well become more significant to them if they were increase their numbers of livestock in the future.

Organisation factors only appear to be a significant factor in technology adoption among larger thoroughbred breeders. Many Irish thoroughbred breeders are sole traders and/or are family run operations and therefore do not appear to be impacted by organisational factors.

6.0 Discussion

6.1 Introduction

Following the completion of Chapter 4, outlining the key findings from the in-depth interviews, Chapter 5 will discuss and analyse these findings in relation to the previous literature. As a result of this research, key findings will initially be summarised but then broken down into some of the common themes evident and how they link back to the overall research objectives and questions.

6.2 Personality Factors

Rogers (1995) suggests that when it comes to technology adoption, personality is an important factor which affects the adoption of new technologies. All participants highlighted the user's personality as a key factor when choosing to adopt technology in their business.

Some participants showed a reluctance to take the risks that were required to embrace and try out the new technologies which were available to them. Research by Mukasa (2018) found that farmers are known to be more risk adverse and as such reluctant to embrace new technologies. Roberts research supported this when suggesting that there was a tendency to avoid options that entailed a risk even if that risk was relatively small.

There was a corelation between these participants and the age category which they fitted into. Unsurprisingly, the older the participants the more reluctance there appeared to be about adopting new technologies. Although some of these are now using technology successfully and benefiting from its adoption, their age appeared to be a barrier in not embracing it sooner and/or to a higher level. The literature surrounding the topic was supportive of these findings. Maurceri *et al*. (2015) found that age has a negative relationship with technology adoption while Roberts found clear generational differences with regards farmers views towards technology.

Another participant who also supported that personality traits affected technology, in contrast to previous participants, suggested that personality traits were a significant factor in the adoption of technology. This participant had gained significant exposure to the importance and significance to embracing technology in the thoroughbred industry and as a result had developed the personality traits which encourages them to adopt and embrace suitable innovations as they come along. Literature from Diagne and Cabral (2017) which is supported by Biagini *et al.* (2014) predicts that innovative technologies will play a significant role in the development of agricultural systems.

It is therefore clear from the respondents that personality traits have an impact on technology adoption. The older generation are slower to adopt the technology as they feel there are risks associated to these along with a lack of experience using digital devices while the younger generation have had more exposure to technology and therefore are more comfortable with trying it out.

6.3 Social Impacts

The social impact which technology adoption has on the participants is a significant factor in the decision-making process.

All participants who took part confirmed that their decision to adopt technology was influenced in some way by another person who were either a family member, a friend or industry colleague. According to Uaiene *et al.* (2009), the effects of a social group play an important role, in the context of agricultural innovations. Breeders and farmers are a close-knit community who are in regular communication and therefore share information with and learn from each other. Mwangi & Kariuki (2015) support this theory as their research suggests that farmers who are part of a social group discover and learn of the benefits through using technology.

The research shows that their decision to adopt different technologies is because of taking a form of recommendation from someone that they know. Two participants highlighted that they receive a form of confidence in these recommendation as it is coming from a trusted source, not a service provided or salesperson. Roberts *et al*. (2020) has supported this thought process when highlighting the occurrence of social reasoning among farming operations in Australia.

Another area in which the social element has been highlighted concerns the social impact which new technologies can have on farmers. One participant highlighted the personal satisfaction which they achieve from doing the manual work themselves and did not wish to replace this with a technological substitute. This finding supports the literature developed by Carolan (2008) who highlights the importance of physical work and traditional farm practices for farmers to maintain enjoyment of their role and maintain work satisfaction. Conversely, another participant spoke very positively about the enjoyment and satisfaction which they have got from adapting this new technology and the sense of achievement which has been realised. Again, this area has been covered in the literature. Rose *et al.* (2021) suggests that a lack of attention has been given to the social impacts of new technologies among users in rural areas. This is an area which may be worth examining further in future studies.

6.4 Digital Inclusion

This theme sets out to establish to what level does digital inclusion play in thoroughbred breeders adopting new technologies.

Research from Bukchin & Kerret (2020) and Cafer & Rikoon (2018) suggest that the main barrier to the adoption of technology in rural and agricultural areas is the lack of access to sustainable technology. The participants agreed that while this was a factor, it was not a significant one. Access to broadband was the most common area which was highlighted from the perspective that when a high-speed network was not available, it limited the participants options. Most participants now have access to a good quality broadband and as a result they have become more aware of what other technologies are available to them now.

A number of participants revealed that the new digital systems which they now have access to allowed them to alter how they carry out certain daily tasks in a more efficient manner. This finding is supported in the literature by Phillips *et al.* (2019) who suggested that through adapting and adopting new technology, it is disrupting established structures in associated sectors. The ITI industry is no different to any other in that they must continue to remain competitive through establishing new ways in which to conduct its business in the most efficient manner while at the very least maintaining the current level of customer service. According to Edwards (2009) ‘‘broadband access is now considered a core public utility’’ and the analysis gathered here supports this as without it, it could be seen as a barrier to progressing one’s business.

6.5 Organisational Factors

Mwangi and Kariuki (2015) suggest that the size of the farm or organisation plays a critical role in the process of adopting new technology. This analysis supports the literature in that the two participants who highlighted that organisation factors is a determinant in adopting technology were individuals that currently run the largest businesses among the participants who took part in the interviews.

The remaining participants had mixed opinions on the impact which organisational factors had on technology adoption, but they did agree that it might well become more significant to them if they were to increase their numbers of livestock in the future.

7.0 Conclusions

7.1 Conclusions

Through a combination of the identified research questions, the objective was to ascertain an understanding of the relationship between Irish thoroughbred breeders and the adoption of technology along with the factors which affect their decision.

The research findings show that the four factors which make up the conceptual model were appropriate. These factors revealed an understanding of the Irish breeder's awareness of the availability of technology to them, along with what they perceive the main barriers to be to them adopting these technologies. Of the participants who have adopted technology, the research also identified which additions have proved to be the most significant in terms of effect and successful impact. As the research questions have been concluded successfully, the research objective was achieved.

7.2 Research Limitations

Due to the Covid-19 situation, all interviews were carried out online. It is felt that given the demographic of participants, face to face interviews could have yielded better results as it would have allowed for a better connection to develop between the researcher and participant.

Although the face-to-face interviews would have resulted in increased traveling and organising, the researcher felt that this method could have given access to some different participants who would have added value to the research quality. It was the online interview method which the researcher felt contributed to some respondents choosing not to participate as it was not something that they were familiar with.

There has been significant research carried out on technology adoption but very little with a specific focus on the Irish agricultural and thoroughbred breeding industry. As a result, the literature that was used as a base for this research was carried out in non-European countries such as Australia. The lack of more European based literature on technology adoption in the agriculture industry is a limitation of the research.

7.3 Recommendations for Future Research

This research was carried out using an original conceptual model which had been revised to offer a better fit for this study. Although this revised model offered a good framework for this study the researcher feels that there could be a good opportunity to ascertain good research through refining this framework further. Given the structure of farmers and horse breeders businesses, the recommendation here would be to focus on a smaller number of factors. Many

of these operations are family business and/or only have a very small number of employees so if the focus was refined to just the personality and social factors, it would offer the opportunity for the researcher to delve deeper into these factors and perhaps gain further insights.

The research findings from this study should be used as a starting point in not only increasing the knowledge and understanding of the technology adoption in the thoroughbred industry but also in improving the current situation for the industry. This research and the new studies that follow can be used by the industries governing bodies to put in place the structures to raise awareness and encourage future training in this area. This should play a pivotal role in upskilling these people which would provide them with the confidence to adopt and embrace future opportunities.

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