THESIS

RANCHERS' READINESS TO ADOPT GPS-BASED MOBILE APPLICATION TECHNOLOGY TO

BRAND AND IDENTIFY CATTLE

Submitted by

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ABSTRACT

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The longstanding process of cattle branding remains relatively unchanged since the

origination of the technique. Meanwhile, society continues to adapt alongside the evolution

and progression of technological advancements. The infiltration of technology into the

realm of ranching and, specifically, branding seems to be inevitable, though the readiness of

ranchers to accept the fusion of branding with technology remains to be fully understood.

To achieve a better understanding of this level of readiness, a conceptualization for a

mobile application used in conjunction with a GPS microchip was developed. An

exploratory, qualitative study was conducted to examine the readiness level for ranchers to

abandon conventional branding methods in favor of the proposed technological approach.

A combination of theories and models—diffusion of innovations, technology acceptance

model, non-adoption of innovations, and uses and gratifications—were used in tandem to

formulate the research questions. Nine in-depth interviews with ranchers across the state

of Colorado yielded a better understanding of the current level of readiness for adoption of

such an innovation. An analysis of the phenomenon at hand produced results

demonstrating that ranchers are not ready to abandon their current practices. A strong

affinity for the ranching lifestyle and distrust in technological security heavily influenced

the respondents' hesitancy to express a willingness to adopt. The study conclusion posits

that an agricultural innovation such as this concept for branding must preserve as many

aspects of tradition as possible and must be introduced to the ranching community on a

trial basis, thus allowing the spread of adoption to take place organically.

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CHAPTER I

Introduction

Technology has, for many years, steadily crept further and further into the realm of society. Our lives have been infiltrated by technology, and many aspects of the world as we know it have become dependent upon these advancements. Failure to adapt our own lives alongside technology will result in widening gaps between those who do adopt innovations and those who do not. This study examined members of the agricultural industry and their readiness to abandon conventional methods of branding cattle in favor of a technological approach, which would utilize GPS chips and mobile phone applications. The readiness level was evaluated through qualitative in-depth interviews, with primary foci relating to ranchers' current technological practices and general attitudes toward technology.

A particular technological device that has become an essential part of daily life for many individuals is the mobile phone, which people use to stay connected to one another for personal, business, or a variety of other reasons. Brenner (2013) offers statistics regarding mobile phone usage in an article illustrating a remarkable increase in adults' cell phone ownership in the past several years. Perhaps the most intriguing findings of the study can be seen in these examples: 67% of adults noted checking their cell phones for messages or other notifications without even hearing a ring or feeling a vibration; 44% of cell phone owners were so worried about missing a phone call or text message during the night that they slept with their phone next to their bed; and 29% admitted that their cell phones were such valuable items that they struggled to imagine life without their devices (Brenner, 2013). These figures clearly show that people value and rely upon their mobile

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phones. The usefulness of mobile phone devices can be considered to have transformed the status of a cell phone from an instrument of utility to instead an extension of the self.

Based upon the previously mentioned statistics, cell phones appear to be a technology that has become so integrated into society that the perceived usefulness cannot be overlooked and must be accepted. Duggan (2013) found Internet usage to be a major component of cell phone use. A study summarized by Zickuhr (2013) conveys the similar notion that Internet and email are widely adopted—only 15% of American adults claimed to not use either. Yet, despite the fact that the amount of Americans who use such technology is significantly high, one must also consider the 15% and question what is preventing those individuals from following suit.

According to Zickuhr (2013), reasons for non-use of Internet include lack of access, cost, the feeling that he or she has no need for the Internet, and a desire to avoid the associated complexities that come along with the Internet. Despite the ubiquity of technology, not every industry is comprised of individuals who have widely adopted technology. More information is needed about specific demographics that have yet to advance their workplace operations along with the ever-evolving nature of technology. Rezende (2013) stresses the importance of information communication technologies (ICTs) by acknowledging that ICTs are "important factors for the economic growth of a country and, therefore, its municipalities" (p. 99).

Farmers are a unique population through which to examine technology adoption. Statistics from a study by the U.S. Department of Agriculture illustrate that farmers' use of technology is on the rise. According to the report, approximately 67% of U.S. farms have Internet access, which is 5% higher than in 2011; additionally, 40% of farms utilize

computers in some aspect of their agricultural operations (U.S. Department of Agriculture, 2013). The report does indicate, however, that households with a higher income reported more computer usage, but, in sum, the article shows that agriculturists in the United States are using computers and the Internet more often than years prior (U.S. Department of Agriculture, 2013).

A study by Fastline (2013) provides statistics regarding U.S. farmers' and ranchers' mobile device use, stating that nearly one out of every four 1,000+ acre farmers that own a smartphone are using Facebook from their mobile devices while on farm equipment. Moreover, the study shows that 48.46% of farmers are using their mobile devices to research equipment while they are operating the equipment (Fastline, 2013). Another survey by the Association of Business Information & Media Companies (2012) also suggests that agriculturists' mobile phone usage is on the rise. Among farmers and ranchers that utilize digital resources, it was found that two main factors seem to be linked to individuals who reported that digital media are essential for farm or ranch operations—individuals with a larger income and those who are younger in age; furthermore, 80% plan to implement digital agriculture resources the same or more in the next three to four years, while 57% plan to use agriculture-related mobile applications the same or more over the next few years (Association of Business Information & Media Companies, 2012).

With access to and an increase in usage of the Internet, computers, mobile phones, and other forms of technology, farming and ranching industries are experiencing a surge in the utilization of technologically oriented agricultural equipment and devices. Thus, attention must be paid to the way agriculturists are adopting or rejecting new

advancements in agriculture-related technology so that industries can better cater to the needs of the farming and ranching markets.

Mobile Applications

The process of communicating and accessing information is changing at a rapid pace. People adapt along with advancements in technology, and one of the most significantly adopted communication technologies is the mobile device. Duggan (2013) displays striking statistics found in a recent study pertaining to cell phone activity. Some of the most compelling findings of the study are the following:

> 91% of American adults own a cell phone; 81% send or receive text messages; 60% access the Internet; 52% send or receive email; 50% download apps; 49% get directions, recommendations, or other location-based information; and 48% listen to music. (Duggan, 2013, p. 1)

These numbers suggest a remarkable adoption rate of American adults' usage of cellular devices. Duggan's (2013) findings also point out that the number of users who download apps (50%) increased by 28% since 2009. But despite these convincing statistics, a deeper look yields questions about the researcher's target demographic—the rancher. According to the study, adults who live in urban areas and have higher levels of education and income are more likely to download mobile applications than those living in rural areas with lower levels of income (Duggan, 2013). What type of influence might this have on ranchers' willingness to adopt a new method of identifying cattle that relies on mobile app technology as a necessary component? Furthermore, what is a mobile app and what is its primary function? An industry-leading device in the mobile app market is Apple's iPhone. According to Godwin-Jones (2011), a surge of third-party applications were developed following Apple's decision to allow such applications to be developed by programmers and then distributed to consumers through digital downloads. The functions

of these applications are varied, whether the purpose is for entertainment, utility, or any other use.

The popularization of mobile apps began its emergence following the dissemination of mobile networks throughout the 1990's (Cortimiglia, Ghezzi, & Renga, 2011). Subsequent feature implementations made mobile devices even more valuable to consumers. Such advancements include the ability to access the Internet, take pictures, video chat, navigate the device by use of a touch screen, and enhanced social networking capabilities that allow individuals to connect on levels deeper than voice-to-voice interpersonal communication. A major feature of modern smartphones is the function of mobile applications, called "apps," which are software applications designed to run on particular devices such as smartphones or tablets (Janssen, n.d.); moreover, the apps are typically designed with tailored functionality, the purpose often being to calculate figures, provide gaming entertainment, or supply other uses of practicality. The word "app," which is the standardly used abbreviation for "application," was named the "Word of the Year" by the American Dialect Society in 2010, manifesting the apparent popularity of mobile apps. Further implicating the modern reliance upon mobile apps is the findings from a study by Gartner that are mentioned in an article from *The Guardian* projecting that a remarkable increase in app downloads would occur in 2013, reaching the mark of 103 billion downloads—more than 50% of an increase from the previous year (Dredge, 2013). Moreover, a smaller projection has been estimated by Juniper Research (2013), calculating a figure of 80 million downloads for the year 2013 and 160 billion by the year 2017. Despite these differences in estimations, each suggests a significant number of estimated downloads for the modern day.

A term has recently emerged to describe the use of mobile device use in farming and ranching: mAgriculture (Float Mobile Learning, 2012). The increased publicity of tablets in recent years has led to an interest in mobile computing throughout the economy, including agriculture, and many academic articles about mAgriculture have only been published in the last couple years, proving that our knowledge of agriculturists' mobile device use is relatively young (Float Mobile Learning, 2012). A project called SAWBO by the University of Illinois creates videos that are distributed via mobile devices and intended to educate individuals in developing parts of the world, including one video which teaches farmers a technique to make their own natural insecticides (Voice of America English News, 2013). An organic farmer in Africa also saw an opportunity to enhance the agriculture industry through use of mobile devices, developing an application called iCow which allows ranchers to receive personalized text messages regarding feeding schedules and the most appropriate time for fertilization (Baldauf, 2011). Other popular uses of agriculture-related mobile applications have been synthesized into a comprehensive table by the Texas A&M AgriLife Extension (n.d.). Such examples include the following: applications to track commodity prices, weather forecast information, livestock management, fertilizer mixture calculators, and field map views.

GPS

The Global Positioning System (GPS) emerged in the early 1970s for military-related purposes (El-Rabbany, 2002). As noted by Ta (2011), the infrastructure of the system utilizes a network of 24 satellites, implemented by the United States Department of Defense (DOD), that are linked together. The very nature of GPS enables continuous information feedback relating to the position of the receiving devices. Despite the initial

military-centered focus of the technology, the general public has since adopted its practicality for many other uses. In fact, "any civilian can use the GPS by simply purchasing a low cost GPS receiver" (Ta, 2011, p. 23).

The agricultural realm is very well suited for the use of GPS. Accoring to AgriMarketing (2008), the adoption rate among farmers to utilize GPS steering technology has been remarkably high. The high acceptance rate has forced manufacturers to pay close attention to the agricultural demographic. The capability of GPS to improve agriculture is a large reason why the technology has been adopted. Specifically, GPS is used in conjunction with farm machinery as a method of precision, allowing equipment to be guided by GPS satellites, thus increasing the production by decreasing the level of error through automatic steering technology (Schimmelpfennig & Ebel, 2011). Precision agriculture technologies have been found to be adopted by farmers who operate large acreage farms, as Winstead et al. (2010) notes a significant increase in lightbar manual guidance (a GPS steering aid) from 2005 to 2009. The increased reward for using GPS devices is an apparent motivator for farmers and ranchers to adopt such a technology.

A particular facet of the technology industry that enables civilians to make use of GPS is that of the mobile device market. "Chip advancements—which have lead to smaller GPS receivers—and a US Federal Communications Commission mandate that device manufacturers equip mobile phones with automated 911 location notification, have increased GPS use in mobile phones" (Schreiner, 2007, p. 7). As a result, consumers have access to an abundance of mobile apps that utilize GPS satellites to offer a variety of rich data, often with foci relating to location services in one form or another. One such topic of fear that comes along with these data, however, is privacy. Knowing that GPS offers such

precise location-based data, consumers express some resistance to divulging that information; therefore, privacy was a key factor in the researcher's analysis of ranchers' readiness to adopt a technology that utilizes location-based data.

Adoption

The term "adoption" is explored in great detail in subsequent sections of this thesis, but a brief, general understanding of what the word means will serve the audience well in following the remaining text. Two appropriate definitions for adoption, found on Merriam-Webster's (2013) online dictionary website are the following: "the act or process of beginning to use something new or different"; and "the act or process of giving official acceptance or approval of something" (Definition section, entries two and three). Essentially, adoption can take place at any point in time for an individual. The person, place, thing, idea, or anything else that is being adopted does not necessarily need to be new to everyone. Adoption of an idea can take place after many years of knowing it existed without an expression of approval for the idea.

In the particular context of this study, technological adoption is the main focus. Examining ranchers' previous technology adoption habits helps to provide a better understanding as to whether or not he or she is willing to adopt a new method of branding cattle in the future. A quick reference to a study that examined Internet adoption ought to help make sense of adoption within the realm of this study. Tan and Teo's (1998) study discovered several reasons that managers were hesitant to adopt Internet into their workplaces—the fact that this study was published in 1998, before the Internet became widely accepted, is worth emphasizing here. The researchers found the following reasons: "staff will waste time," "do not have expertise," "irrelevant to business," "costs too much,"

"organization too small," and "staff computer illiterate" (Tan & Teo, 1998, p. 13). The researchers set out to find what might influence individuals' adoption of the Internet, and the results are very telling. A more recent study by Lai, Tong, and Lai (2011) found similar reasons that led to a reluctance to adopt Internet-based interorganizational systems (IIOS), including the usability of the website, reliability of the system, availability of technology, and interoperability (infrastructural compatibility and process integration ease). People often hesitate to adopt an idea or thing for reasons parallel to the very definition of adoption—something new or different must be accepted or approved, and many individuals resist change.

GPS, Mobile Device Branding System Concept

Conventional cattle branding methods have been practiced the same way for many years, as hot-iron branding is thought to have been introduced as a practice during Biblical times (Paxton, 1962) while freeze branding did not come about until 1966 (Ferrel, 1966). A technique that has been practiced for so many years, branding ought to be examined closely to evaluate potential improvements that could be provided by modern technology. With the rest of the world advancing and developing alongside technology, ranching ought to follow suit so as not to widen the gap between agricultural employment of technology and the rest of the world. In an attempt to prevent this gap from widening, the researcher has developed a concept that would fuse branding with technology, and the following text details a synopsis for the conceptualization.

This study intends to examine ranchers' willingness to adopt a specific type of GPS, mobile device branding system; therefore, an explanation of how this technology would (in

theory) work is needed. GPS technology would allow a rancher to better monitor a herd's location and could potentially enhance pasture grazing through the tracking of graze patterns. Since GPS is already utilized in many agricultural aspects, such as auto-steering in tractors, the technology could be easier to grasp than alternative methods like radio frequency identification. A term materialized within the realm of telecommunications describes the way the Internet and objects are used in conjunction with one another. This term is the "Internet of Things," and according to Aztori, Iera, and Morabito (2010), the "Internet of Things" often includes the combination of things such as radio-frequency identification (RFID) and mobile phones to interact in such a way that a common goal can be reached. Kopetz (2011) similarly notes that the ability to control something from a distance by connecting a "thing" to the Internet, often in use with RFID tags, turns an ordinary object into a *smart* object. Though the proposed technology for this thesis incorporates GPS devices in opposition to RFID tags, the Internet of Things is similar enough in nature that the concept can be grouped within the same paradigm.

The initial stage of adopting the digital cattle branding system will require the possession of a smartphone or tablet device such as an Apple iPad or Microsoft Surface. A mobile application will then need to be downloaded and installed onto the device, followed by the construction of an online profile for the rancher. The profile could include a digital replica of his or her conventional brand symbol so as to preserve a semblance of tradition. The rancher will have the option of including additional relevant information such as the name and location of the particular ranch. In contrast to the traditional method of branding cattle with hot irons or freeze brands, the animal is to be injected subcutaneously with a tiny, grain-sized GPS chip that is later synchronized with the mobile application. Following

the synchronization process, information that is tailored to each specific calf can be updated through the mobile application. Such information might consist of veterinary records, the age of the calf, a history of illnesses, or other relevant information. Once created and saved, the calf's profile will be accessible at any time through the mobile application, and the location of the animal can be traced and monitored. Subsequent to the completion of a data entry for each heifer or bull, the entire herd is traceable through use of the mobile device. Personalized icons on the screen represent each animal, thus allowing a rancher to easily detect an icon on the screen that does not resemble his or her herd, catalyzing a social experience amongst ranchers with an enhanced communicative element. This communication takes place through an instant messaging function within the mobile application that is to be operated by neighboring ranchers. The enhanced communicative element among ranchers is a key component to the proposed mobile application, as it creates a digital environment that is not currently available—one that could improve the monitoring of cattle through increased discourse. In addition to improved dialog, further potential incentives and deterrents exist and are discussed in detail later in the text.

Need for Study

Differences in diffusion of technology across different areas in the world can result in major economic consequences and an increased digital divide (Chinn & Fairlie, 2007). The agricultural industry faces this phenomenon. As emergent technologies are adopted in various areas of agriculture, the individuals who are reluctant to adopt digital practices will struggle when the industry eventually becomes saturated with technology. The importance of this study lies in uncovering the potential motivating factors and disincentives of adopting a digitally oriented approach to branding cattle expressed by ranchers during

one-on-one interviews. This research provides insight into ranchers' current perceptions

toward technology and their readiness to alter the branding process—a major adjustment.

Media and technology producers will be able to use the knowledge obtained through the in-

depth interviews to approach the agricultural industry in a more effective manner.

Theoretical Framework

The theoretical framework of this study combines the diffusion of innovations

theory, technology acceptance model, uses and gratifications theory, and a non-adoption of

innovations analysis. Other academic studies have also been examined to provide further

support. The combination of these theories creates a solid foundation for evaluating the

readiness level of ranchers to adopt a new technology in their agricultural practices.

The diffusion of innovations theory examines the way innovations spread

throughout social systems (Rogers, 1976). This theory is directly applicable to a study of

ranchers' readiness to adopt a new technology. An article in the Huffington Post states that

the average age of farmers and ranchers is increasing and less people are waiting to take

over the farms (Montoya Bryan, 2012). More precisely, the 2007 Census of Agriculture

found that "the majority of farm operators are between 45 and 64" with the average age

being approximately 57 years old (USDA, 2007, para. 1). Perhaps this age group will be less

eager to alter conventional operations due to a strong affect for tradition, thus hindering

the diffusion of innovations. Another angle to be examined is the categories involved with

the diffusion of innovations theory: innovators, early adopters, early majority, late

majority, and laggards. The present tendencies of agriculturists to adopt innovations could

correlate strongly with their readiness to adopt the GPS-based branding technique.

The technology acceptance model lends itself well to an examination of why people adopt or reject technology, and the two dominant determinants defined by Davis (1989) include perceived usefulness and perceived ease of use. These factors could very well be the most telling factors of ranchers' readiness to transition from traditional branding methods to an approach that utilizes mobile technology. The average age of ranchers could play a major role in their perceived usefulness or perceived ease of use, thus enhancing the practicality of this model's practicality in the research study.

The uses and gratifications theory acknowledges that different circumstances result in different patterns of media usage for individuals (Katz, Gurevitch, & Haas, 1973). Two main typologies, ritualized use and instrumental use, are often discussed in relation to uses and gratifications (Rubin, 2009). A better understanding of ranchers' media usage, whether it is typically for ritualized or instrumental purposes, is beneficial in attempting to understand the underlying reasons that would motivate or hinder the adoption of a new technology.

Aside from focusing on the reasons that ranchers might be drawn to adopting a new innovation, one must also consider the reasons for non-adoption. Yapa and Mayfield (1978) suggest that some individuals choose not to use technology for intentional purposes rather than out of apathy. Economic factors often contribute to a decision not to adopt an innovation, whether the reason is due to a lack of necessary infrastructure or other economic factors. The limited availability of adequate technology in rural areas may prove that ranchers are indeed not ready to change methods of branding.

The time has come when individuals must choose to either adopt technology or be left behind while the world's economy advances. Ranchers must, at the very least, consider

adopting technology into their agricultural operations. The proposed concept for a GPS-based mobile application system for branding and identifying cattle is one possible solution for keeping pace with the technological industry, though a level of uncertainty remains as to whether or not ranchers would be willing to make the change. Thus, the use of the diffusion of innovations theory, technology acceptance model, uses and gratifications theory, and an analysis of non-adoption of innovations in conjunction with in-depth interviews should shed light into the world of a rancher and provide answers about his or her readiness to adopt a technological approach to branding cattle.

CHAPTER II

Literature Review

This chapter provides an overview of key constructs involved in examining ranchers' readiness to abandon conventional branding methods and adopt a new means of identifying and tracking cattle through use of technology. A review of relevant literature synthesizes the main components of the theoretical constructs and models that have been utilized to formulate the basis of this research study. This chapter addresses the potential incentives or barriers that might influence a rancher's willingness to replace conventional branding methods with an electronic cattle identification system. In addition, certain terms are defined for the purpose of clarity. The particular theories that have been reviews are the diffusion of innovations, technology acceptance model, uses and gratifications, and an analysis of non-adoption of innovations. Table 1 is a concept map that illustrates the various theories and models used for the study along with the specific elements from each theory or model that were used to formulate questions to be asked during the one-on-one interviews with respondents.

Table 1.

Conceptualization Map

Conventional Branding vs. GPS Mobile Technology Branding			
Factors Influencing Adoption			
Diffusion of Innovations (Rogers, 2003)	*Technology Acceptance Model (Davis, 1993)*	*Non-Adoption of Innovations Analysis (Yapa & Mayfield, 1978)*	*Uses and Gratifications (Katz, Blumler, & Gurevitch, 1974)*
Newness of technology	Perceived usefulness	Environmental factors	Enjoyment of technology
Felt need/problems	Perceived ease-of-use	Economic factors	Social interaction
Norms of social system	Individual differences	Infrastructure	Instrumental use
Socioeconomic characteristics	System characteristics	Cost	Ritualized use
Technology use/behavior	Subjective norms	Interest level	
Relative advantage	Facilitating conditions	Relevancy	
Compatibility	Attitude toward technology		
Complexity			
Trialability			
Observability			

The theories and models used in this study are similar enough in nature to work in conjunction with one another in such a way that the formulated research questions are not specific to just one theory but instead apply to the general topic at hand. Some of the areas that these previously mentioned theories have been applied involve the examination of how ideas and information is spread throughout society, particular reasons that individuals choose to seek out media content, and what factors contribute to the adoption or non-

adoption of technology. These theories are directly applicable toward evaluating the readiness level of farmers to adopt a new technology for their operations and are further explained in the following text.

Diffusion of Innovations

The early stages of mass communication theory ignited discussion about the effects media have upon individuals. One such emergent theory was the two-step flow theory, which posits that information flows from the media through leaders of opinion, who then disperse the information throughout the general public (Rosenberry & Vicker, 2009). With this said, the media's impact on society is thought to be less of a direct impact because society impacts itself through interpersonal communication. However, Rosenberry and Vicker (2009) note that this theory was later considered to have a flaw—technology was becoming more and more pervasive. Thus emerged the diffusion of innovations theory, which examines how information penetrates society and has specifically been applied in numerous agricultural scenarios. Everett Rogers has contributed much to academia through his work with the diffusion of innovations theory and offers the following definition:

> (1) the innovation, defined as an idea, practice, or object perceived as new by an individual or other relevant unit of adoption, (2) which is communicated through certain channels (3) over time (4) among the members of a social system. (Rogers, 1976, p. 290)

The process of getting a population to adopt a new idea or product often takes a great deal of time, and increasing this rate of adoption can be laborious and time consuming. A better understanding of the way messages and technology are disseminated through society is beneficial to the examination of ranchers' readiness to adopt a new

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method of branding cattle. Rogers (1995) defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). The communication in this process is particular to ideas that are new to the individual and ought to be viewed as a convergent or divergent process—that is, two individuals engage in the information sharing process so as to either come closer to a mutual level of understanding or one that is further apart (Rogers, 1995). As previously mentioned, Rogers (1995) declares four main facets of diffusion of innovation: the innovation, channels, time, and social system.

The Innovation

By definition, Rogers (1995) refers to an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 11). The key with innovations is that an individual perceives the innovation as being new. This does not, however, mean that the innovation must be new to everyone; in fact, the innovation can have existed for many years without a favorable or unfavorable attitude having been developed by the individual. Newness does not only pertain to a lack of knowledge about an innovation, as persuasion and decisions to adopt are also contributing factors (Rogers, 1995). The adoption rate of innovations can be explained in part by the following features that individuals use to characterize innovations—relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995):

1. Relative advantage suggests that an innovation will be more rapidly adopted if the individual perceives the innovation to be more advantageous than the idea it replaces, and strong contributors to relative advantage pertain to social status and ease-of-use.

2. Compatibility, on the other hand, is determined by how well the innovation will fit into an individual's existing set of social norms and values—including their current behavior and practices. If the innovation does not align well with the person's belief system, the adoption rate will be less significant.

3. Complexity affects rate of adoption based on whether or not an individual is able to understand the innovation. If the innovation requires the learning of new techniques or skills, the rate of adoption is likely to be much lower than if the individual already has an understanding about how to utilize an innovation.

4. Trialability deals with the level that an individual is able to test an innovation before committing to adoption. When individuals are able to test an innovation on a trial basis, they are more likely to adopt the innovation than if they were forced to make a blind decision.

5. Observability is the level to which the innovation can be viewed from an outside perspective. An innovation that is very beneficial and is also observable by surrounding individuals is more likely to be adopted due to an increase in discussion amongst members of the community. An innovation that is confined within a person's home has a low level of observability and thus a slower rate of adoption.

These characteristics have been applied to this study, and the interview questions stem from this foundation. Ranchers' readiness to adopt the proposed innovation is likely heavily influenced by these main characteristics.

Communication Channels

For the diffusion of an innovation to be possible, an exchange of information must take place, and the channels through which messages are transmitted can come in many forms be it mass media or interpersonal exchanges (Rogers, 1995). The ability of a mass media channel such as television, radio, or Internet to reach a broad audience makes it an effective means of transmitting information about an innovation. Yet, interpersonal interactions are highly personalized and often occur between individuals with similar socioeconomic statuses; furthermore, people depend highly upon information that is given to them from other individuals (Rogers, 1995).

Time

The element of time is crucial to the innovation adoption process. According to Rogers (1995), the time dimension involves the point from which an individual first learns of an innovation to the point of adoption or rejection, the rate at which the particular innovation is adopted, and the expanse of the adoption within the particular realm. The time from which an individual learns of an innovation to the point at which the innovation is adopted involves five main steps—knowledge, persuasion, decision, implementation, and confirmation—which are defined by Rogers (1995) as follows:

1. **Knowledge.** The point when an individual initially gains some understanding about the existence of an innovation and the way it works.

2. **Persuasion.** The occurrence of an individual formulating a favorable or unfavorable opinion of the innovation.

3. **Decision.** Incidents leading up to the point of rejection or adoption of an innovation.

4. **Implementation.** The innovation is utilized.

5. **Confirmation.** The innovation has already been chosen but additional support is sought, and the previous decision may be reversed.

A quick note about the difference between adoption and diffusion is worth mentioning. Adoption takes place on more of an individual level, as people separately make choices to either adopt or reject an innovation. The process of diffusion, however, encompasses a broader spectrum and includes adoption from more than one individual.

Social System

For the diffusion of an innovation to be possible, a boundary must exist within which the spread of adoption can take place. This system, comprised of individuals or groups, is bound together by common interests and goals that are shared by the members of the social system (Rogers, 1995). The norms of a social system play a major role in the process of innovation adoption, which is made clear in a study by Rogers and Kincaid (1981) in which the adoption of contraceptives were vastly different among villages based on the social norms already set in place. Two very important roles within social systems are the opinion leaders and the change agents. Opinion leaders function at the center of the communication network and have a strong ability to influence the opinions of others within the social system (Rogers, 1995). Change agents, on the other hand, often attempt to encourage the adoption of an innovation or thwart the adoption of unwanted innovations by influencing the opinions of the members of the social system and aiding those members who wish to make changes (Baran & Davis, 2010).

Categories of Adopters

Baran and Davis (2010) mention that innovations typically pass through stages before being adopted across a wide platform. Five categories of individuals—innovators, early adopters, early majority, late majority, and laggards—exist within a social system, each with different levels of innovativeness (Baran & Davis, 2010). The first step in the diffusion process is the acquisition of new information regarding the innovation, often from mass media outlets, which is then adopted by a small group of innovators (Baran & Davis, 2010).

Innovators have a tendency to actively seek out information about new innovations and have a high exposure to media content along with a broad range of social connections; furthermore, these persons are venturesome and are not strongly affected by the uncertainty that comes with adopting an innovation with no peer-related reinforcement (Rogers, 1995). *Early adopters* have high involvement within their social system and are often looked at as the individuals to check with before others adopt a new idea—these individuals are respected, and overall, this category has the most opinion leadership (Rogers, 1995). The *early* majority is the most numerous, and the individuals within the group provide connection amongst the social system through communication—they are not the first to adopt an idea but also not the last (Rogers, 1995). The *late majority* is heavily influenced by individuals' peers, and decisions are often made with caution and not until most others have adopted the idea (Rogers, 1995). *Laggards* are suspicious of innovations and have almost no opinion leadership (Rogers, 1995); these individuals are last to adopt an idea and do so cautiously.

A chart depicting the adoption of innovations from these individuals with different levels of innovativeness is shaped in an S-shaped curve, where "only a few individuals adopt the innovation in each time period; these are the innovators. But soon the diffusion curve begins to climb, as more and more individuals adopt in each succeeding time period" (Rogers, 1995, p. 23). Eventually, the curve flattens as the innovation has been so widely adopted that fewer individuals continue to adopt. Rogers (1986) illustrates this s-shaped curve, which can be seen in Figure 1.
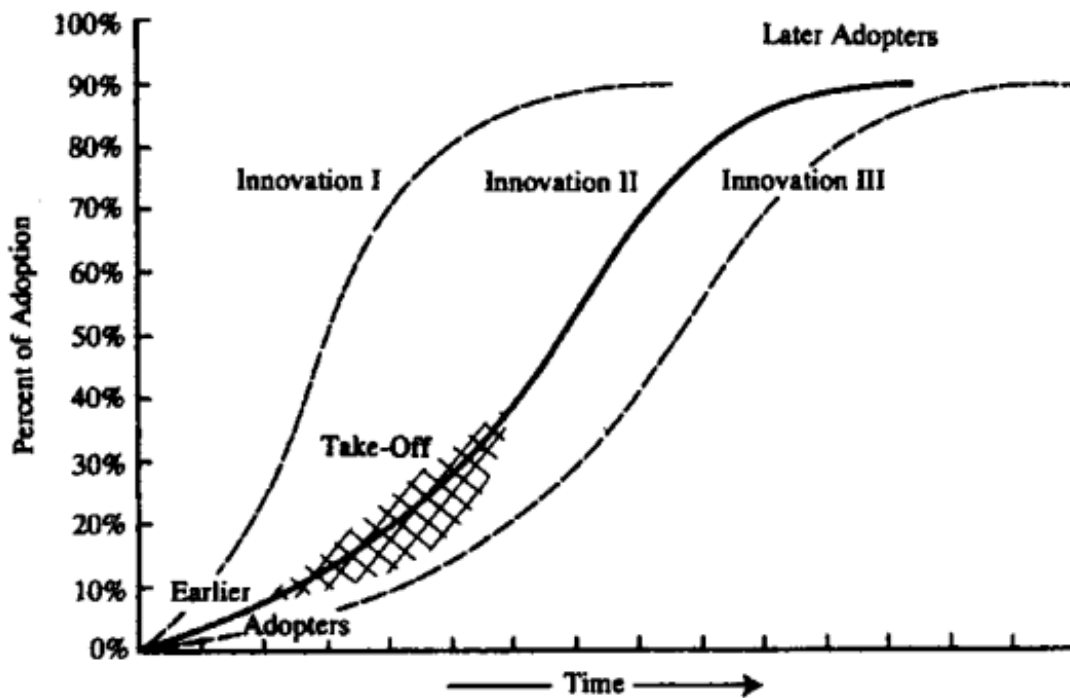
Figure 1. Diffusion of Innovations S-Shaped Curve

A critical point in the evolution of innovation diffusion studies came from Ryan and Gross (1943) who studied the diffusion of hybrid corn in Iowa. Following the release of a new agricultural innovation, hybrid corn, farmers' growing behavior had to be adjusted. The hybrid corn increased yields by about 20 percent per acre and were more drought-resistant, yet the seed needed to be purchased each year, a practice that farmers were not

accustomed to (Rogers, 2003). Though the corn offered a significant advantage over previously used seed types, the rate from knowledge of the product to the point of adoption took a substantial amount of time (Rogers, 2003). After analyzing the role of communication channels, Ryan and Gross (1943) discovered that farmer-to-farmer interpersonal exchanges were the most effective method of persuasion, thus illustrating the importance of community in the adoption of agricultural innovations.

Didier and Brunson (2004) similarly used innovation diffusion to examine the adoption of range management innovations by Utah ranchers. Personal interviews indicated that ranchers were motivated to adopt range management innovations in order to "improve profitability and conserve natural resources" (Didier & Brunson, 2004, p. 333). The respondents were willing to alter their practices for the betterment of the land and expressed strong commitments to the ranching lifestyle (Didier & Brunson, 2004). On the other hand, ranchers also volunteered reasons that would serve as barriers to adoption, such as time and cost. A strong commitment to "traditional ranching lifestyles reinforced a reluctance to adopt certain innovations," and social norms also impacted their decisions as "ranchers may be unlikely to innovate when their peers do not approve" (Didier & Brunson, 2004, p. 334). These findings suggest that ranchers are very protective of their land and lifestyles but are willing to adopt an innovation under the right circumstances. A better understanding of the way ideas and concepts are communicated through the ranching community will be beneficial to comprehending the spread of a new technology through the population.

Technology Acceptance Model

Considering that the breadth of this study focuses on the readiness level of ranchers to adopt a new innovation, an analysis of reasons for adopting or rejection the idea is of key concern. The Technology Acceptance Model (TAM) is a prime model achieving a better understanding of these reasons because the model evaluates the many reasons that affect why or how an individual will use a technology (Davis, 1993). A study by Bagozzi, Davis, and Warshaw (1992) expresses the idea that attitudes play a major role in a person's actions toward technology usage. Further emphasizing the idea that attitude is a contributing factor of technology use is the model for the technology acceptance model seen in Figure 2.
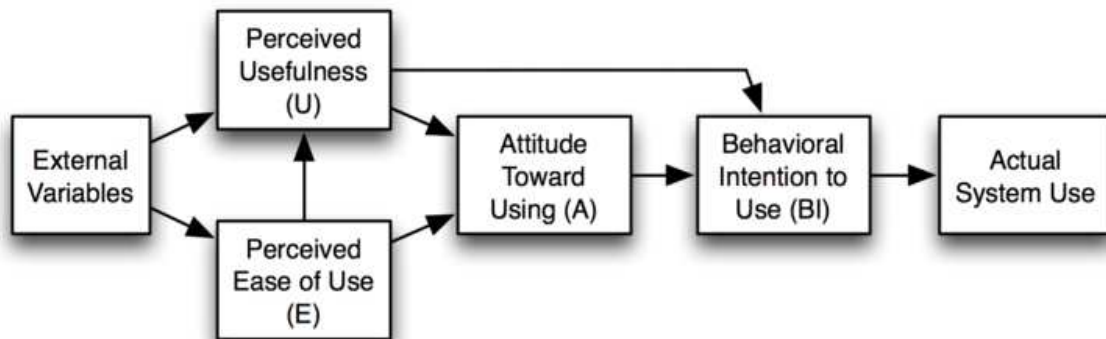
Figure 2. Technology Acceptance Model (Davis, 1989).

The figure illustrates the concept that a series of variables contribute to the final stage—the actual system use. Both the innovation's perceived ease of use and the perceived usefulness of the innovation—it's worth mentioning here that the perceived ease of use also impacts the perceived usefulness—contribute to the individual's attitude toward using the technology. Once an attitude is formed, the individual then develops an

intention to behave in one way or another, thus resulting in the actual use of the innovation (Davis, 1993). This model has since been expanded upon, and the updated model is better suited for the case of evaluating ranchers' readiness to adopt a new cattle identification innovation. For clarification, perceived usefulness has been defined by Davis (1989) as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320). Perceived ease of use is considered to be "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Each concept is highly applicable to the examination of whether or not ranchers would be willing to adopt a new technology into their practices. The updated TAM model, as seen in Figure 3, was adapted to account for additional variables that influence the perceived ease of use and the perceived usefulness of the innovation. Two of the key factors contributing to social influence—specifically to perceived usefulness—are subjective norms and the individual's image (Venkatesh & Bala, 2008).
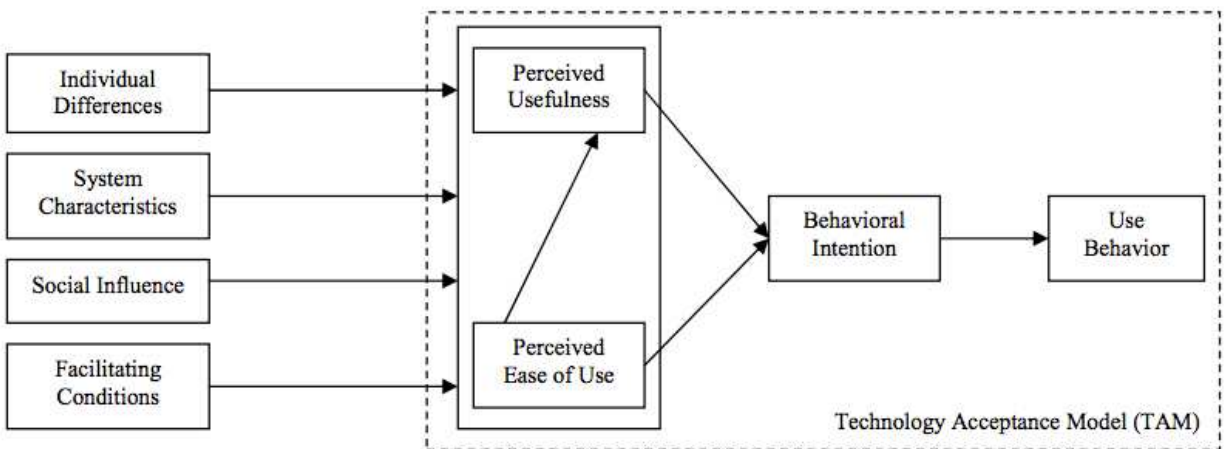
Figure 3. Updated Technology Acceptance Model (Venkatesh & Bala, 2008).

The subjective norms are, in essence, the way a person believes their use or non-use of a system will be perceived by other individuals that are of importance (Ajzen & Fishbein,

1977). The image pertains to the way a person thinks that his or her status will be impacted within the social system as a result of adopting an innovation (Moore & Benbasat, 1991). Among these determinants of perceived usefulness are the degrees to which an innovation seems applicable to a person's job as well as the belief that an innovation will help that individual increase their performance (Venkatesh & Bala, 2008).

The technology acceptance model incorporates crucial aspects for the examination of whether or not an innovation will be accepted by an individual. Findings from Venkatesh and Davis (2000) suggest that subjective norms exert a powerful influence over an individual's intention to use an innovation in cases where the use is mandatory but not in a voluntary context; furthermore, image, job relevance, and output quality were all found to be significant influencers of perceived usefulness. The way a rancher thinks he or she will be viewed by peer groups, the perceived complexity of the innovation, and the job-related benefits will likely play a role in each rancher's readiness level to accept the innovation.

Non-Adoption of Innovations: Evidence from Discriminant Analysis

Yapa and Mayfield (1978) state that "a lack of information and individual conservatism" (p. 145) are potential reasons that farmers do not adopt technologies that could improve their operations. The diffusion of innovation theory has a tendency to focus solely on the factors that lead to adoption of an innovation—but what about the non-adopters? Should more consideration be given to the very reasons that innovations are not accepted? Yapa and Mayfield (1978) take that stance that "non-adoption is not a passive state caused by apathy or resistance; on the contrary, it is an active state arising out of the structural arrangements of the economy" (p. 145). The perceived impact of one's individual

image due to a person's use or non-use of a system is also a factor, whether that person does not adopt due to a fear of their image being negatively impacted or because he or she adopts to enhance an individual image—perhaps through an elevation of status. Evaluating the reasons that might cause ranchers to not adopt this new innovation is imperative for achieving a comprehensive understanding of why the mobile application would or would not be adopted. A possibility exists that ranchers would want to adopt the technology but simply could not based on environmental or economic factors. Take, for example, the expectancy to cultivate high yields from hybrid grain; Yapa and Mayfield (1978) mention that this process is very expensive and requires additional products and management. Though the farmer would want to produce higher yields, his economic foundation might not allow for the extra costs. Several specific constraints mentioned by Yapa and Mayfield (1978) are lack of money, geographical elements such as low water tables, governmental regulations, and lack of knowledge. In sum, "tradition, conservatism, and 'peasant psychology' are not the sources of non-adoption" (Yapa & Mayfield, 1978, p. 153).

Stewart (2002) declares the importance of symmetrical balance for reasons of adoption and non-adoption. Stewart examined case studies to develop a list of reasons that people did not adopt technologies. Again, cost is seen as a major restriction, and lack of interest or motivation was found to be a common determinant of non-adoption (Stewart, 2002). Other individuals claimed that the innovation did not seem relevant to their needs or did not provide any advantage over existing services. An additional reason for non-adoption was simply a dislike for technology (Stewart, 2002). The following reasons depict individuals' resistance to implementing a change in technology (Stewart, 2002): too old in

age; no desire to change; do not possess necessary skills and do not want to learn; and lack in personal confidence to use the technology.

Stewart (2002) then mentions the specified restrictions and problems as being the following: "infrastructure/technical problems; too expensive; no time or space; and restrictions and limits imposed" (p. 9). Each of these reasons applies to an agricultural setting, as many ranchers may not immediately possess the technical skills required to implement a new innovation into their branding practices. Since the typical agriculturist is of an older age, he or she may have no desire to change their conventional practices or learn the new skills required to change. Furthermore, governmental regulations may also create obstacles that make adoption seem more like a hassle than a solution.

Uses and Gratifications

Katz, Blumler, and Gurevitch (1974) provide a useful description outlining the basics of uses and gratifications:

> (1) the social and psychological origins of (2) needs, which generate (3) expectations of (4) the mass media or other sources, which leads to (5) differential patterns of media exposure (or engagement in other activities), resulting in (6) need gratifications and (7) other consequences, perhaps mostly unintended ones. (p. 20)

Essentially, uses and gratifications theory focuses on what people do with media. The theory recognizes the idea that people choose media for specific reasons and to satisfy specific desires (Katz, Gurevitch, & Haas, 1973) due to differences in psychological makeups and sociological factors. Rubin (2009) categorizes uses and gratifications into two main typologies--ritualized use and instrumental use. "Ritualized use is using a medium more habitually to consume time and for diversion" (p. 172). The nature of this use is less purposive. "Instrumental use is seeking certain message content for informational reasons.

It entails greater exposure to news and information content and perceiving that content to be realistic" (p. 172-172). Rubin (2009) also mentions that psychological makeups and sociological factors play significant roles in impacting individuals' choices in media selection.

The uses and gratifications theory provides a solid framework for exploring the potential connections between ranchers' typical media usage and whether or not he or she would be willing to adopt the mobile application. For example, Ancu and Cozma (2009) found that "every time a medium with interactive features allows a person-to-person communication, people will use that medium primarily for social interaction needs rather than for other types of needs" (p. 579). This information could imply that ranchers who already actively engage in social interaction through social networks will be more apt to adopt a mobile application and will utilize the innovation for communication-related purposes. Severin and Tankard (1997) note that surveillance is a strong catalyst of media consumption, as people often seek out information that is beneficial to their lives. Through a study of college students' surveillance needs, Vincent and Basil (1997) discovered that news media is sought more often from individuals with a higher level of need for information. Interview questions stemming from the uses and gratifications theory will shed light as to whether ranchers would use the mobile application to be informed or educated, to identify with others as a form of social interaction, or for surveillance purposes among other reasons.

Overview of Livestock Identification Practices

Branding, or marking, livestock is an imperative aspect of ranching. Many elements are involved beyond its core function of identifying to whom the livestock belong—identification, record keeping, theft prevention, and various other purposes. The core function, though, is to serve as a method of identifying to whom the livestock belong. This system of labeling cattle is particularly necessary in locations where cattle are free to roam at will without being fenced in to a designated area (Bakken, 2000). A brand serves essentially the same purpose for a cattleman as a logo does for a company. The brand is the ranch's trademark, and many strict laws deal with illegal alteration of brands (Bakken, 2000).

Different identification systems have developed over time with early influences dating back to approximately 3000BC, evidenced by the tombstones that have been found from approximately this date depicting animals with hieroglyphic brands (George, 2012). As time has passed, multiple methods of identifying cattle have evolved. Among the most popular practices of marking cattle are the following: ear tagging, freeze branding, and hot iron branding (electronic identification is not widely adopted yet but has been used) (Neary & Yeager, 2002). Ear tagging can be thought of as an intra-herd identification system. Ranchers pierce the animal's ear with a plastic tag that is marked, often by permanent marker, with a number from a specific numbering system that is familiar to the rancher. The reliability of ear tagging is not necessarily high. Tags can rip out, and the marked numbers can smudge away, so this system is often used as a secondary identification method alongside a primary system of branding. A beneficial aspect of this method, however, is readability. Ranchers can quickly ascertain the identifying number for

the cow or bull. The numbering systems on these tags often serve the purpose of telling the owner what year the heifer or bull was born (Neary & Yeager, 2002). Ear tags serve a purpose within the herd, allowing a rancher to keep accurate records for each animal based on its number.

Hot iron and freeze branding serve an identification purpose outside the realm of the herd, as the purpose is to show explicit ownership. For example, herds that mix with one another can be sorted out based upon the different brands. Marking the hide of cattle is a fairly permanent and discernible method of labeling ownership. Freeze branding uses a branding iron that is "chilled in liquid nitrogen or dry ice and alcohol. Upon application to the animal's hide, the chilled branding iron kills the cells that produce color pigment in the hair follicles, but does not kill the growth follicles" (Neary & Yeager, 2002, p. 4). Conversely, hot iron branding requires heating the iron with fire or an electrically generated source; then, the iron is pressed onto the calf until the brand is permanently burned onto the hide (Clark, Baker, & Whitmore, 1971). Cattle must be restrained on the ground and held in place or pushed through a chute so that the brand can be applied.

According to Neary and Yeager (2002), the most common methods of electronic identification systems include electronic tagging with ear tags or collars and microchips, but these systems have not been widely adopted. An obstacle faced by using RFID chips to identify cattle electronically is proximity. One must be within a near vicinity of the animal in order to obtain an accurate reading. Also, electronic tags or collars can easily be stolen, allowing cattle to be relocated with no visible representation of which herd the animal belongs to. A benefit to electronic tagging, though, is the time and effort that can be saved

by tracking cattle with digital devices. Simply placing a collar around a calf's neck is much less time- and labor-intensive than hot iron or freeze branding.

Potential Incentives and Barriers for Adopting GPS, Mobile-Based Branding

Incentives

Reduce Stress and the Resulting Negative Effects.

Lay et al. (1992) conducted a study to analyze the behavioral and physiological effects of branding cattle and, despite a lack of sound measurement to gauge the level of pain that the animal's experienced, the study results can reasonably state that branding cattle with a hot iron causes a pain sensation. These findings are evidenced by an escape-avoidance reaction from the cattle while branding along with increased heart rates and distressed vocalizations. Stress placed on cattle can result in shrink--a loss in weight (Richardson, 2005). This loss of weight can be costly to the producer. Branding can be a highly stressful event for calves, so an improved method that is less stressful would be economically and ethically beneficial to ranchers.

Tracking Cattle Movement to Enhance and Monitor Grazing.

From an ecological standpoint, re-branding cattle with identification chips makes a great deal of sense as it would allow the monitorization of herds' grazing habits. Rangeland grazing is a controversial subject and concern has arisen over the way that rangelands have changed as a result of years of ranching. Cattle grazing can significantly impact the species of plants along with the animals that inhabit pastures (Milchunas & Lauenroth, 1993). Being able to monitor the grazing patterns of cattle could allow for better rangeland management, thus enhancing the biodiversity on the land.

Facilitation of Communication Among Ranchers.

An improvement in communication among ranchers could also serve to be beneficial. With current ranching practices, stray cattle that find themselves wandering into the wrong herd need to be identified and separated back to their own herd. The task of inspecting a herd to discover which brands do not belong can be laborious as well as time consuming. The ability to digitally identify stray cattle through a mobile application could allow for enhancements in interpersonal communication between neighboring ranchers. Cattle could be quickly identified and separated into their respective herds--a much more efficient method of management. Tripathi, Singh, and Kumar (2012) mention that technology plays a considerable role in the development of rural areas because economic growth is experienced when productivity increases--an increase made possible by effective use of technology. If ranchers become comfortable utilizing mobile applications to communicate with one another, the comfort level with other forms of technology should increase along with productivity.

Prospect of Virtual Fencing.

According to Rodgers (2001), technology has the potential to replace conventional fencing that is constructed from wood, wire, or other materials. Fencing animals with virtuality likely requires physical hardware that must be worn by the animal in order to receive the radio frequency (RF) signals. One such device utilizes the global position system to locate animals by using RF signals from GPS satellites (Rodgers, 2001). To fully comprehend the idea of virtual fencing, one must first understand the idea of an invisible fence. A boundary can be created in any geometrical shape to surround a group of animals, a herd of cattle in this case. This boundary cannot be seen by the naked eye. Conventional

fences deter cattle by use of sight or touch, but an invisible fence utilizes other sensory cues. Despite being large, heavy animals, the behavior of cattle can be influenced and manipulated through use of auditory cues (Wredle, Rushen, de Passille, & Munksgaard, 2004). A study conducted by Bishop-Hurley, Swain, Anderson, Sikka, Crossman, and Corke (2007) found virtual fencing to be a viable possibility of managing livestock, because the cattle responded to the virtual fencing treatments. The treatment with "vibration plus electrical stimulation was the most effective virtual fencing treatment for stopping the cattle" (Bishop-Hurley et al., 2007, p. 21). These findings could coincide very effectively with the proposed subcutaneous identification mobile application system. Potentially, a physical device could be worn by cattle as a mechanism attached to the ear, much like numbered tags that are already implemented on ranches. The device could communicate with the GPS chip under the hide of the heifer or bull and produce a vibration that intensifies as the animal approaches the designated boundary, resulting in a change of behavior, thus deterring cattle from exiting the virtual boundary.

Barriers

Digital Divide.

A phenomenon known as the Digital Divide poses a threat to the adoption of innovations in rural areas, as economic factors influence the ability for individuals to employ technologies based on existing infrastructure (Khalil Moghaddam & Khatoon-Abadi, 2013). For example, a rural area with limited cell phone coverage is limited in its ability to utilize technologies that rely on mobile networks. A poll conducted by National Public Radio, the Kaiser Family Foundation, and Harvard's Kennedy School of Government (n.d.) depicts data suggesting that individuals with lower incomes and education and over

the age of 60 have less access to computers than their younger, more financially stable counterparts. Chinn and Fairlie (2004) found that "income per capital differential accounts for the single most important component of the digital divide" (p. 2). A lack of access to technology and low income would inhibit a rancher's ability to adopt a digital approach to branding.

Privacy and Tradition.

Many Americans worry about their personal information being accessed by unauthorized individuals on the Internet (National Public Radio Online, n.d.). Abandoning traditional branding methods for one that involves cell phone and Internet use will be a cause for concern for individuals who worry about the security of the Internet. The importance of tradition will also likely be a factor in the innovation adoption process. Since cattle branding has remained very similar in nature over many years, ranchers may be unwilling to change the method out of respect for the tradition of their ancestors and culture.

Microchip Limitations.

Neary and Yeager (2002) state that microchips could "migrate into the meat of a market animal" (p. 6). Meat quality would thus be affected and might discourage ranchers from utilizing microchips. In addition, the proximity from which an animal could be traced may also impact the adoption rate. RFID chips limit the distance between the receiver and the chip, thus requiring an individual to be in close range to the animal being tracked. GPS chips offer greater possibility to monitor the location of a herd from a greater distance.

Research Purpose and Questions

The purpose of this study is to achieve a deeper understanding of ranchers' perceptions of branding and technology in order to evaluate their readiness to abandon conventional branding techniques in favor of a GPS, mobile application system. Upon evaluating literature from the theories and models to be used in the course of this study, the researcher has developed several research questions. The questions evolved subsequent to reviewing literature on the diffusion of innovations theory, technology acceptance model, uses and gratifications theory, and an analysis of non-adoption of innovations. Evaluating these questions will provide insight into the mind of a rancher and his or her readiness to adopt a branding technique that is implemented through technology.

- **Research Question 1**: From the ranchers' perspective, what are the relative advantages and disadvantages of conventional branding methods compared with technology-oriented methods?

- **Research Question 2:** What factors influence ranchers' decisions to adopt or not adopt a new, technology-oriented method of branding and identifying cattle?

- **Research Question 3**: What elements of branding and the ranching lifestyle necessitate a unique approach to technology adoption?

CHAPTER III

Methodology

A review of the literature substantiates a need to evaluate the readiness level of ranchers to adopt a new method of identifying and tracking cattle. The above research questions will be examined by use of in-depth, semi-structured personal interviews with ranchers in Colorado. This chapter details the methodological approach taken to conduct the research. The goal of this research is to uncover rich information that sheds light on the unknown factors that might incentivize or deter ranchers' abandonment of conventional cattle identification systems in favor of a technology-oriented approach. Specific aspects of the methodology that are detailed in this chapter include the research design, participant selection, data collection, instrumentation, data analysis, research rigor, and researcher subjectivity. The core of this methodological approach is the in-depth interview, which serves to offer a deep, enlightening basis of information regarding the readiness level to adopt the proposed prototype for cattle identification. An in-depth interview process recognizes the respondent as an autonomous individual, and the interviewer identifies his or her purpose as paying special attention to the participants' opinions while collecting data in a natural environment (Orb, Eisenhauer, & Wynaden, 2001).

Research Design

The nature of this study is exploratory and aims to examine research questions rather than evaluate hypotheses; therefore, the chosen method of examination is the in-depth interview. Considering that this is a study of readiness to adopt a method of tracking and identifying cattle that is not yet widely adopted, a need exists to acquire valuable uncharted data. Exploratory studies often quench a researcher's thirst for new information

and yield insights about phenomena of which little is known (Babbie, 2013). According to

Hesse-Biber and Leavy (2010), in-depth interviews provide "an excellent way to gather

rich qualitative data from the perspective of the people being studied" (p. 133). An

exceptional analogy is described by Kvale (1996), who labels the qualitative interview as

"literally an *inter view*, an inter-change of views between two persons conversing about a

theme of mutual interest" (p. 2).

Qualitative studies often fall within the interpretive paradigm, which approaches

research in an empathetic manner, seeking understanding from individual, unique

perspectives (Blanche, Durrheim, & Painter, 2006). With that said, the researcher's role in

the process of the in-depth interview is vastly significant, and he or she must be very aware

of their own personal values and must not let personal subjectivity influence the

respondents' answers. At the same time, however, in-depth interviews allow the researcher

to have much control over the data, as he or she can tailor the questions to run parallel to

the needs and attitudes of each interviewee. Qualitative interviews, by nature, allow

participants to provide detailed accounts of situations they have personally encountered,

resulting in very informative data that is difficult to otherwise achieve.

The interview questions are intended to help the investigator answer the research

questions, which "are appropriate when a researcher is unsure about the nature of the

problem under investigation" (Wimmer & Dominick, 2012, p. 24). Additionally, the

interviewer typically approaches the interview with a focused objective and moderately

adheres to an interview guide that can be adjusted to be best suited for each specific

respondent; yet, Kvale (1996) mentions that the researcher's goal is to direct the

participants toward a general theme without guiding the respondent in a specific direction

of valence. In essence, the researcher is a facilitator and should appropriately allow the data to be dictated by the respondents.

Alternate Methods

Though in-depth interviews are highly appropriate for this study, other methods of data collection were considered but not selected. Bartlett, Taylor, McKean, and Hof (1989) conducted a survey to examine the motivation of Colorado ranchers with federal grazing allotments. While this approach is effective for this study, a survey would not serve well in exploring the potential readiness of ranchers to adopt a technological approach to branding and identifying cattle. In the previously mentioned study, the surveys were distributed through mail. With this method, survey questions can be open- or closed-ended, but the lack of a present researcher eliminates the potential for tailored questions that can open doors to unpredicted topics of discussion. The responses are limited to the structure of the survey and unable to be manipulated for richer data collection. Ary, Jacobs, and Razavieh (2002) discuss the notion that, if the sample represents the target population, a level of generalizability is obtained; thus, an advantage of the survey is generalizability because of the ability to gather data from a broad range of participants. However, this exploratory study is not intended to be generalizable to the entire population of ranchers. The goal is to gain a deeper understanding of the matter at hand, with data that could be applied to similar situations, such as the adoption of other technological innovations in the agricultural community. An ethnographic study might be feasible if the mobile application-centered branding concept was available for use, but the prototypical nature of this study would not lend well to an ethnographic study.

Phenomenology

A contributing factor in the decision to conduct a qualitative study was the relationship between the information desired and phenomenology, which is an approach that sees the individual and his or her world as existing together in a symbiotic relationship (Morse & Richards, 2002). The researcher "must look not only at what people do but also at how they think and feel, and must experience what happens to them" (Ary et al., 2002, p. 23). Therefore, the researcher chose to adhere to a phenomenological approach to understand ranchers' current branding practices and how that experience impacts their readiness to adopt a technological method of branding cattle. The phenomenological approach is a well-suited tactic for conducting this study because, as Ary et al. (2002) state, these "studies begin with the assumption that multiple realities are rooted in subjects' perspectives" (p. 28). Since each rancher has a unique experience with cattle, every respondent has a different outlook on the mobile application-based approach to tracking and identifying cattle.

A lack of adequately sophisticated instrumentation makes the human investigator the most apt instrument for analyzing human experiences. This is emphasized by the words of Maykut and Morehouse (1994) who state, "The human instrument is the only data collection instrument which is multifaceted enough and complex enough to capture the important elements of a human or human experience" (p. 27). The roots of phenomenology can be traced back to Edmund Husserl, a German philosopher (Morse & Richards, 2002). At the core, Husserl saw the scientific explanation of objects as problematic because the meaning of these objects was being neglected—the *essence* of the phenomena was in need

of more examination (Lindseth & Norberg, 2004). The chosen method of data analysis

stems from phenomenology and is later discussed in further detail.

Participant Selection

The intended outcome of this research study was to capture the essence of the

readiness level for ranchers to change their methods of branding cattle; consequently,

people were designated as the unit of analysis. Much care must be given to the selection of

the individuals to be studied, as "sampling and data collection are critical to determining

the quality of a study" (Gibbs, Kealy, Willis, Green, Welch, & Daly, 2007, p. 540). In order to

obtain ample data results that were able to sufficiently answer the research questions, the

sample was initially selected purposively. This type of sampling is beneficial to the

researcher because participants that most optimally suit the criteria of the study are

chosen (Morse & Richards, 2002). However, a researcher that limits the sample to only

individuals known from an inner-circle of connections limits the variability of respondent

characteristics. Snowball sampling is often used in qualitative research as a means of

obtaining samples by asking participants that have previously participated in the study to

recommend other individuals that could potentially meet the interviewee requirements

(Morse & Richards, 2002). An advantage to this approach is that the respondents can

provide the researcher with contact information for participants that meet the desired

criteria, yet the researcher must be aware that the population under study can become

very homogenous due to close social circles.

After obtaining approval from the Institutional Review Board (Appendix A),

ranchers were identified who, to the researcher's knowledge, were potential matches for

the target population based on demographical characteristics. These individuals were

connections that the researcher had made through his personal experience with ranching

and an agricultural upbringing. A combination of purposive and snowball sampling was

utilized to select the participants. A select few individuals were chosen purposefully for the

study and were then asked to refer the researcher to other ranchers that might meet the

criteria. This method offers more variability than a strict purposive sample but is less time

contingent.

The researcher must also select the specific type of rancher to evaluate since

ranching is not limited to one characteristic. For many years, cattle and grass have evolved

together, and cattle have long utilized grass as a necessary source of nutrients to produce

quality meat (Ruechel, 2006). Grass feeding cattle is a common practice today, and many of

the potential benefits for the proposed mobile application identification technology are

directly applicable to grass-fed herds. Therefore, the gamut of rancher types that were

asked to participate in this study was limited to those that practice grass feeding.

Examining multiple types of cattle ranchers—such as those who deal with grass-fed beef

and those who raise dairy cattle—would complicate the interpretation of the data, as the

readiness level of these ranchers would likely be very different based upon the different

needs of the operations. While such an examination would yield compelling results, the

scope of this study is narrowed to only grass-fed beef producers (feedlot ranchers are less

inclined to brand cattle) in order to gain a basis for understanding ranchers' readiness level

to change methods of branding.

In addition to limitations of operation, the size of the ranchers' farms also factored

in to the participant selection process. To be considered for the research study, the

ranching operation was limited to at least 30 head of cattle and no more than 1,000. This

parameter was set in order to focus on the average rancher that does not operate on a large-scale basis with a feedlot or on a smaller scale by ranching as a hobby with a small herd. The acceptable ages ranged from 18 years old to any age in which the individual still actively engages in the ranching occupation. Interviewing individuals who have much experience in the ranching industry as well as those who are new to the business offers much richer data than simply focusing on a narrow age range. The different ages also shed light onto the impact of socioeconomic status and technological familiarity as potential influencing factors of the ranchers' readiness level to adopt the new technology. Additionally, ranchers will only be selected from the state of Colorado. This area is most accessible to the researcher and would allow the researcher to travel to the individual homes of the ranchers to conduct the interviews. A list of prospects was created and narrowed down to include only the individuals that met the desired characteristics.

The ranchers were initially contacted by telephone (Appendix B), mail (Appendix C) or email (Appendix D) and given a brief description about the researcher and the study without knowing the actual purpose of the research. Since Internet access is a potential socioeconomic factor that might indicate that ranchers are not ready to adopt the GPS-based tracking device, emailing participants was not an acceptable sole means of contact. The participants were notified that they would be partaking in a research study and would be asked to sign a consent form (Appendix E) representing their willingness to partake in the interview.

Data Collection

Each respondent was asked to partake in the study through participation in semi-structured interviews. Initial contact was made through telephone conversations, but the in-depth interviews took place in person. The following steps outline the interview process:

1. The researcher identified prospective interviewees.

2. The ranchers were contacted and asked if they would be willing to participate in a research study for Colorado State University.

3. The researcher asked demographical questions to be certain that the ranchers met the desired criteria of operating a ranch of at least 30 head but no more than 1,000 head of cattle, grass feeding their herd, working within the state of Colorado, and currently being at least 18 years of age. If an individual did not meet the specific requirements, he or she was dismissed from the process. This process continued until between seven and 10 ranchers met the criteria.

4. The researcher contacted eligible ranchers to set up a specific date, time, and location to meet for the interview, and the ranchers were notified that the interview could take approximately 90 minutes.

5. At the determined location (frequently the rancher's home), the researcher presented the respondent with a consent form to be signed.

6. The researcher began the interview with simple questions to build rapport with the subject and to establish a level of comfort.

7. The interviewee was presented with a tangible mock-up design of how the mobile application would appear.

8. Further questions were asked to the participants after he or she viewed the prototype illustrations.

9. The researcher concluded the interview and asked the participant for individuals who might also be willing to participate in the research study.

Semi-structured interviews allow the researcher to be flexible throughout the interview process. In fact, the researcher has the ability to mold the structure of the interview in the most appropriate manner based on the interviewee's responses. The individual answering the questions dictates the course of the interview. A strength of the semi-structured interview is the enablement of "probing for more information and clarification of answers" (Louise Barriball & While, 1994, p. 330). In order to elicit detailed responses from the interviewees, the researcher must work to establish rapport with the study participants. "This can be achieved by, for example, respecting the informants' opinions, supporting their feelings, or recognizing their responses. This can also be shown by the researchers' tone of voice, expressions or even gestures" (Berry, 1999, Establish rapport section, para. 1).

Berry (1999) identified nine probing techniques that a researcher can employ to enhance the quality of responses from participants:

1. _Contradicting_ – This entails deliberately giving an opinion opposite the informant's one, attempting to arouse his/her further comments.

2. _Linking_ – Linking up informant's comment with the information which the researcher wants to know.

3. _Faking puzzling_ – Pretending to be confused, indicating elaboration is needed.

4. *Challenging* – Demanding more information to prove the validity of the informant's previous claims.

5. *Encouraging* – Giving compliments to encourage the informants to carry on.

6. *Showing understanding + allowing time for elaboration* – Making the informant know that his/her comments are understood and treasured + allowing him/her time for further comments.

7. *Acknowledging* – Repeating the informant's answer to show attention.

8. *Direct question* – Asking question to get more information.

9. *Procuring details* – Asking further questions to see if more information can be obtained. (Third phase section, para. 2)

Since the researcher plays a vastly significant role in the semi-structured interview process, recording the audio from the interview allows the researcher to focus on his or her role during the interview with the ability to revisit the transcript at a later date to analyze the findings. Audiotaping is a common primary data source for a phenomenological research study (Morse & Richards, 2002). Permission from each volunteer was granted before the interviews were recorded (Appendix D). Knowing that one device could fail or be exhausted of battery, the researcher chose to record the interviews with two separate devices—a laptop and an iPhone. The digital recordings were stored on the phone and the computer.

Following the interview stage, the researcher manually transcribed each interview. Though the transcription process can be outsourced, the researcher can benefit greatly from spending much time with the material. Lindlof and Taylor (2011) mention the valid point that the researcher can become distanced from the data by hiring another individual

to type out the interviews. The researcher transcribed the interviews verbatim and stored the text documents on both a computer and a cloud service. Spending the necessary amount of time needed to transcribe the documents made the researcher more familiar with the content and enhanced the process of developing recurring themes amongst data sources.

Instrumentation/Questioning Guide

The researcher constructed an interview guide of 10 strong, foundational questions that were supplemented by various prompts. The interview guide is the key aspect to the in-depth, semi-structured interview process as it leads the researcher along, ensuring that the main research questions are answered. The researcher took careful consideration into the process of constructing the interview questions. The wording and structure were generated in such as way as to elicit valuable responses, and the wording was carefully scrutinized for any instances of biased wording. The researcher was also careful to avoid leading questions that might encourage a respondent to answer in a particular manner. The main goal of the interview questions is for the researcher to achieve an understanding about the readiness level for ranchers to adopt a technological approach to branding and identifying cattle. Therefore, the questions relate to specific elements of current ranching practices, attitudes toward and use of technology, demographic characteristics, and other topics of interest.

The full interview guide can be found in Appendix F, but the following are examples of prompts that are included on the guide:

- Walk me through the typical process of branding cattle on your ranch.

- Tell me some of the obstacles that you face throughout the branding process.

- Can you tell me about some potential problems that you see with using GPS

    chips and mobile phones to track cattle?

The questions were constructed with the goal in mind of eliciting information from

the respondents that would appropriately answer the research questions of the study. The

interview guide was tested through a pilot testing process. The researcher conducted this

test with a participant that met the necessary requirements in order to gauge the

effectiveness and quality of the interview guide. The data gathered from the pilot test were

not included in the final analysis. Upon examining the interview guide following the pilot

test, necessary adjustments were made to the questioning guide. Such alterations included

the elimination of confusing wording and the ordering of prompts for a more logical flow.

Data Analysis

To uncover the essence of ranchers' readiness level to abandon conventional cattle

branding methods in favor of a GPS-based mobile application method, the researcher

utilized a phenomenological method of analysis. Since phenomenological approaches seek

to understand the meaning or essence of phenomena, researchers often approach data by

reading and reflecting upon the interviewee's responses; furthermore, the reflections are

then transcribed into a textual representation of the respondents' lived experiences (Morse

& Richards, 2002). Following the transcription process, the researcher employed the

guidelines set forth by Morse and Richards (2002) in their description of common

phenomenological analysis procedures:

> Researchers select words or phrases that describe particular aspects of the lived
> experience they are studying and reflect on these. They may group and label similar
> expressions and eliminate expressions they believe are irrelevant. They then cluster

and label groups of expressions that bear close relationships to one another and check this identified core of common elements against a selection of original descriptors obtained in conversations with participants. For the phenomenological researcher, the value of the process of writing and rewriting cannot be overestimated. Insight is developed through reflection, and researchers have found that discussing their texts with others is helpful. (p. 147)

Five basic steps that ought to be practiced by qualitative researchers in the analysis stage have been outlined by Giorgi (1997) as the following:

(1) collection of verbal data; (2) reading of these data; (3) breaking data into some kind of parts; (4) organization and expression of data from a disciplinary perspective, and (5) [creating a] synthesis and summary of the data for purposes of communication to the scholarly community. (p. 237)

The researcher assigned pseudonyms for participants if they requested their real name to remain anonymous. The researcher read the transcripts carefully, and emergent themes were placed into corresponding categories. Potential relationships between participant characteristics and responses were also similarly grouped into categories (e.g., a relationship between participants' ages and outlook toward technology). A holistic process, the data analysis stage required thorough and meticulous attention to detail. The relationships that emerged from the data can be found in chapters four and five.

Research Rigor

A crucial aspect of the qualitative research process, rigor must be sought and maintained throughout the entire process of conducting the research study. According to Morse and Richards (2002), one way to ensure proper validity with qualitative studies is through the sampling process, often by means of purposeful sampling, snowball sampling, convenience sampling, or theoretical sampling. This study combines the purposeful and snowball approaches, thus adhering to a valid approach. The "major thrust or direction of

inquiry must be inductive" for qualitative studies, and certain criteria must be taken into account in order to achieve a high level of quality (Morse & Richards, 2002, p. 172).

Credibility can be achieved by ensuring that the data accurately represents the actual views of the research participants (Denzin & Lincoln, 2005). To achieve this credibility, the researcher ought to spend a considerable amount of time deep within the realms of the data, immersing himself with familiar patterns and recurring themes so as to accurately convey the opinions of the interview respondents (Lincoln, 1985). Krefting (1991) suggests that spending much time with the respondents also benefits the credibility of a study, as the "extended time period is important because as rapport increases, informants may volunteer different and often more sensitive information than they do at the beginning of a research project" (p. 217-218). One-on-one interviews are a credible way of obtaining data because the information comes from a direct source, and transcribing the interviews verbatim ensures a credible sample of data. Occasionally participants answer questions the way they feel the researcher *wants* them to answer.

A phenomenon known as the Hawthorne effect refers to the occurrence of a change in participants' behavior due to an awareness that he or she is participating in an academic study (Ary et al., 2002). Therefore, building rapport with the subjects and conducting the interview in the respondents' homes helps to achieve a sense of ease, resulting in more accurate data. The researcher practiced reflexivity, which requires an assessment of the potential influence of the researcher's background upon the evaluation of data in qualitative research (Krefting, 1991). Reflexivity is important due to the level of involvement of the researcher throughout the data collection process, because a one-on-one interview incorporates the researcher as an active participant of the process.

Transferability is a criterion that is achieved when the data can be applied to contexts outside the realm of the study at hand (Krefting, 1991). This study aims to achieve a better understanding of ranchers' readiness to alter their cattle branding techniques. The respondents are from Colorado, so the data is not generalizable to ranchers everywhere, though the data does give a general essence of ranchers' attitudes toward a technology-oriented approach to tracking cattle. The results of this study could be utilized by researchers or other individuals who wish to know more about ranchers and their willingness to accept technology in aspects other than branding, thus increasing the level of transferability for this study.

Dependability is a matter of concern in qualitative research much in the same way that reliability is a concern of quantitative research, which pertains to the way in which a study could be replicated with consistent results; however, qualitative studies vary and evolve throughout the process, so dependability is examined as "the extent to which variation can be tracked or explained" (Ary et al., 2002, p. 455). The interview process lends well to dependability because the data can be traced back directly to the source. One way to enable such a connection is by way of an audit trail, which ought to include detailed information about the method of data collection, the actual data recorded, tape recordings, and other relative information (Ary et al., 2002). The researcher kept a trail of the research questionnaire along with the transcriptions and audio recordings from the interviews in order to enhance the dependability of the study.

Confirmability in qualitative studies can also be considered neutrality. "Neutrality is the extent to which the research is free of bias in the procedures and the interpretation of results" (Ary et al., 2002, p. 456). In the context of a qualitative study, Ary et al. (2002)

mention that complete objectivity would be nearly impossible to achieve, thus confirmability relates to the way that the interpretation of data would be confirmed by other researchers studying the same collection of information. The researcher is an instrument in the qualitative research process, and a certain level of subjectivity comes with that territory; therefore, the focus rests upon the confirmability of the analysis of the obtained data (Ary et al., 2002). A main strategy for constructing a confirmable research project is to leave a sufficient audit trail, which was previously mentioned as a practice that the researcher used to enhance the dependability of the study. A proper amount of information detailing the specifics of the study ought to allow another researcher to arrive at a conclusion similar to that of the primary researcher.

Limitations of Study and Basic Assumptions

Despite efforts to create a sound research study, this thesis did contain limitations. The population of examination was limited to the state of Colorado, thus interfering with the generalizability of the data. The study was also limited to ranchers who grass feed their cattle and who do not operate dairies. Despite the existence of various types of cattle ranchers, the target population was limited for the sake of this study.

In order to complete the study, several assumptions were made throughout the process. The respondents were assumed to understand the language and wording of the verbal one-on-one interviews. An appropriate method of qualitative data collection, semi-structured interviews were conducted as the chosen method of data collection, and it was assumed that the participants gave honest answers that accurately represented their views and opinions. Finally, the researcher assumed that the respondents understood that

identifying cattle through GPS chips and mobile devices is not yet a common practice but is

instead a preliminary concept.

Researcher Subjectivity Statement

The researcher ought to practice strict objectivity in his or her execution of the in-

depth interview by remaining presuppositionless, which, according to Kvale (1996),

"implies a critical awareness of the interviewer's own presuppositions" (p. 31). Peshkin

(1988) acknowledges that researchers tend to expose their work to subjectivity when they

are insensible to their personal impressions and opinions and that recognition of this

subjectivity results in valuable results. The level of sensitivity a researcher has toward the

topic under study can result in significantly different data even if conducted by two

researchers adhering to the same interview guide, according to Kvale (1996).

Consider this instrumental explanation also from Kvale (1996) about the potential

impact of the interpersonal situation on the outcome of an in-depth interview:

> The interaction may also be anxiety provoking and evoke defense mechanisms in
> the interview as well as in the interviewer. The interviewer should be aware of
> potential ethical transgressions of the subject's personal boundaries and be able to
> address the interpersonal dynamics within an interview. The knowledge produced
> in a research interview is constituted by the interaction itself, in the specific
> situation created between an interviewer and an interviewee. With another
> interviewer, a different interaction may be created and a different knowledge
> produced. (p. 32)

In order to address the potential influence of the researcher's background, a

subjectivity statement follows. The researcher was born and raised on the eastern plains of

Colorado where he attended a small public school and was involved in school-related

agricultural activities. An advocate for the positive influence of technology, the researcher

also became very involved in the digital communication realm, ultimately graduating from

Colorado State University in 2012 with a degree in Journalism and Technical

Communication with a concentration in Computer-Mediated Communication. The

researcher's job and internship experience revolve mostly around design and

communication. The researcher is currently pursuing a master's degree in Public

Communication and Technology at Colorado State University, where his graduate studies

have piqued an interest in the influence of technology on society—particularly individuals

within the agricultural domain. These experiences have shaped the researcher's

educational path and have led to the undertaking of this research project.

Summary of Methodology

The researcher conducted nine semi-structured, in-depth interviews to examine the

readiness level of ranchers to adopt a technological approach to branding cattle. The

participants were selected based on a desired set of characteristics, and ranchers from

varying age groups were examined. The researcher facilitated the interviews through

adherence to an interview guide, and audio from the interviews was recorded and later

transcribed into text documents that were saved onto the researcher's computer. The data

was analyzed to uncover common themes so that the essence of the ranchers' readiness to

adopt a new branding method could be evaluated. Specific measures were taken in order to

ensure the credibility, transferability, dependability, and confirmability of the data.

CHAPTER IV

Findings

This chapter details findings from data collected through in-depth interviews with ranchers from various locations across the state of Colorado who met the criteria of being ranchers who brand their herds, operate within the state of Colorado, possess at least 30 but no more than 1,000 head of cattle, and grass feed their herds. The purpose of the study was to achieve a better grasp on the level of readiness for ranchers to abandon conventional methods of branding cattle through the adoption of a proposed technology-oriented approach that would eliminate the need for physical brands. Guiding the progression of the research study was the combination of four different—yet related—theories and models. Elements of the diffusion of innovations theory, uses and gratifications theory, the technology acceptance model, and the non-adoption of innovations model were fashioned together to construct a cohesive foundation of interview questions, resulting in data that sheds light into the mind of a rancher and his or her perceptions toward utilizing technology within the branding process. To examine this level of readiness, the following research questions were evaluated:

- **Research Question 1**: From the ranchers' perspective, what are the relative advantages and disadvantages of conventional branding methods compared with technology-oriented methods?

- **Research Question 2:** What factors influence ranchers' decisions to adopt or not adopt a new, technology-oriented method of branding and identifying cattle?

- **Research Question 3**: What elements of branding and the ranching lifestyle

     necessitate a unique approach to technology adoption?

Participants and Their Current Branding Methods

The ranchers who were interviewed came from uniquely different backgrounds. Though explicit demographical data was not recorded, participants provided information regarding their ranching practices and details about their journey toward becoming involved in the industry. Participants were selected through a modified snowball sample, as mentioned Chapter III, and the approximate locations of the ranches affiliated with the respondents can be observed in Figure 4. Specific demographical data—such as exact age— was not collected, but the researcher can objectively state that two respondents were recent college graduates and, despite having grown up on ranches, were relatively new to managing their own operations. The operations involved represent both organic and non-organic ranching practices. The following text offers brief summaries for each rancher who participated in the research study.

Nelson is a young rancher who recently graduated from Colorado State University. His family has been practicing the same branding techniques for over a hundred years. He enjoys ranching "because it's something different every day," offering a lifestyle of freedom.

David operates approximately 2,000 acres and has been raising Angus cattle since circa 1969. A former chemistry teacher in Denver, he puts much effort into the construction of his fencing layouts in order to achieve an efficient system of managing cattle. He loves ranching because of the contact with the animals and being able to watch them grow.

Mitchell has always lived on a ranch in Colorado. Having been raised in an agricultural setting, he appreciates the lifestyle and sees himself as a traditional cowboy. His part-time job is in emergency management. Mitchell has also been involved with rodeos for his whole life.

Lawrence, a recent electrical engineering college student, chose to go back home and help with the family farm and ranch. His interest in cattle arose around the age of 14. Lawrence would like to expand his operations, but he faces an obstacle many young ranchers are also experiencing – a limited availability of grass for sale.

Jacquelyn grew up in Northeast Colorado, and her family has been involved with agriculture for as long as she can remember. She has worked outside jobs to help support her family. Her husband purchased the brand symbol that her operation uses about 20 years ago when he was beginning his career in the ranching industry.

Dallace was born and raised in Michigan and eventually went on to study animal science. The ranch that she operates alongside her husband is one of the largest USDA certified organic ranches in Colorado, spanning nearly 130,000 acres in total. Her love of ranching comes from the lifestyle.

Darren began his agricultural endeavor right out of high school nearly 35 years ago. His brother handles the farming aspect while he is in charge of the ranching side of things. Darren's sons are also very interested in agriculture and may return to help operate the ranch after attending college.

Jannette admits that the ranching style that she and her husband operate is a bit unorthodox. They tend to begin working later in the day and also later into the evening.

Occasionally Jannette works right up until dark and says that on occasion most of the day's work gets done from about 5pm – 8pm.

Karolina, like the other participants, was born and raised around agriculture. In fact, she's a third generation rancher. She now splits her time between the ranch and also a full-time position working for Colorado State University in Fort Collins, Colorado.

A summary of information regarding participants' branding techniques and general geographic locations can be observed in Table 2. Pseudonyms were assigned to respondents to ensure anonymity for each individual. For the same purpose, exact locations have not been provided, though approximate locations are offered to shed light on the potential influences that geographic location may have on ranching perceptions and practices. The following paragraphs briefly detail each participant.

Table 2.

Summary of Participant Information

Pseudonym	Gender	Geographic Proximity	Branding Method
Nelson	Male	Eastern Colo. Plains	Rope and Drag
David	Male	Eastern Colo. Plains	Freezebrand
Mitchell	Male	Eastern Colo. Plains	Rope and Drag
Lawrence	Male	Eastern Colo. Plains	Electric + Chute
Jacquelyn	Female	Eastern Colo. Plains	Electric + Calf Table
Dallace	Female	Western Slope	Rope and Drag
Darren	Male	Eastern Colo. Plains	Rope and Drag
Jannette	Female	Front Range	Calf Table
Karolina	Female	Front Range	Electric Brand

Each participant who agreed to partake in the study was a rancher in the state of Colorado, though the depth of experience varied greatly along with the range of ages. Additionally, a diverse range of techniques for branding cattle existed across the spectrum of respondents. Of the nine respondents, four mention "roping, dragging, and branding" as their current practice for branding cattle. Mitchell explained this practice in further detail as the following:

> MITCHELL: I'm a cowboy, so I like to rope and ride my horse and stuff, so. You know you can drag 'em. When you're doin' it like we do it, you run everything in a pen, you sort the cows back off and put them out in another pen. And they're out in the pasture just to stay and they'll stay there with the calves. The calves are there. The calves are up in a pen, and you'll ride in, just walk in horseback and you'll heel 'em and you rope back two feet and then drag 'em to where the irons are to where they're hot. And then two people will hold 'em down—one on the back one on the front holding the legs. And you'll brand 'em and then you castrate 'em and you give 'em shots.

Suggesting that roping and dragging is a popular method of branding in modern ranching, nearly half of the respondents reported practicing this technique as their preferred method of branding cattle. Another popular method referenced by the respondents is the use of a hot iron or electric iron used in conjunction with a calf table or chute mechanism. The technique was described as follows:

> JANNETTE: So we take horses out [and bring] the cows in. And then we sort the cows. And then we pick the people into two [groups]. And we have specialized people [doing] specialized [things]. We've got people pushing the calves. We've got people that hold the table up. Each chute we have a recorder that puts the number, check marks when they get their vaccinations, if they're [*inaudible*] calves they get penicillin, and they've got an ear tag, and they've gotten branded. And the last person in our category checks off all that and nobody can let those calves go until that person says okay. We have people that we've taught to give shots correctly . . . We have two people that have trained specifically that are allowed to brand.

Despite the differences in which type of branding iron is used (electric or hot iron), the process is often similar while using a calf table or chute. Given that four of the nine

60

individuals who were interviewed mentioned branding with a calf table or chute, only one

respondent noted a branding method that was different than the two more commonly

mentioned techniques. That method is freeze branding and is practiced by David and is

portrayed as such:

> DAVID: Well, in the freeze branding, what has to be done is that you have to clip the
> hair . . . So you put alcohol on it, rub it down, and then what you do is you squirt -- I
> use methyl alcohol -- you spray that on there and douse it real good and meanwhile
> your iron is sitting in a mixture of dry ice and methyl alcohol. The temperature of
> that is about a minus 72 degrees. I think it's Celsius I believe. It might be minus 72
> Fahrenheit, I can't remember. But anyway, that's what it is. And then you, once you
> get the alcohol, get it cleaned, your clip cleaned, and then saturate it with alcohol,
> you stick the iron on there . . . And so anyway then you put that on there and you
> leave it for about 50 seconds.
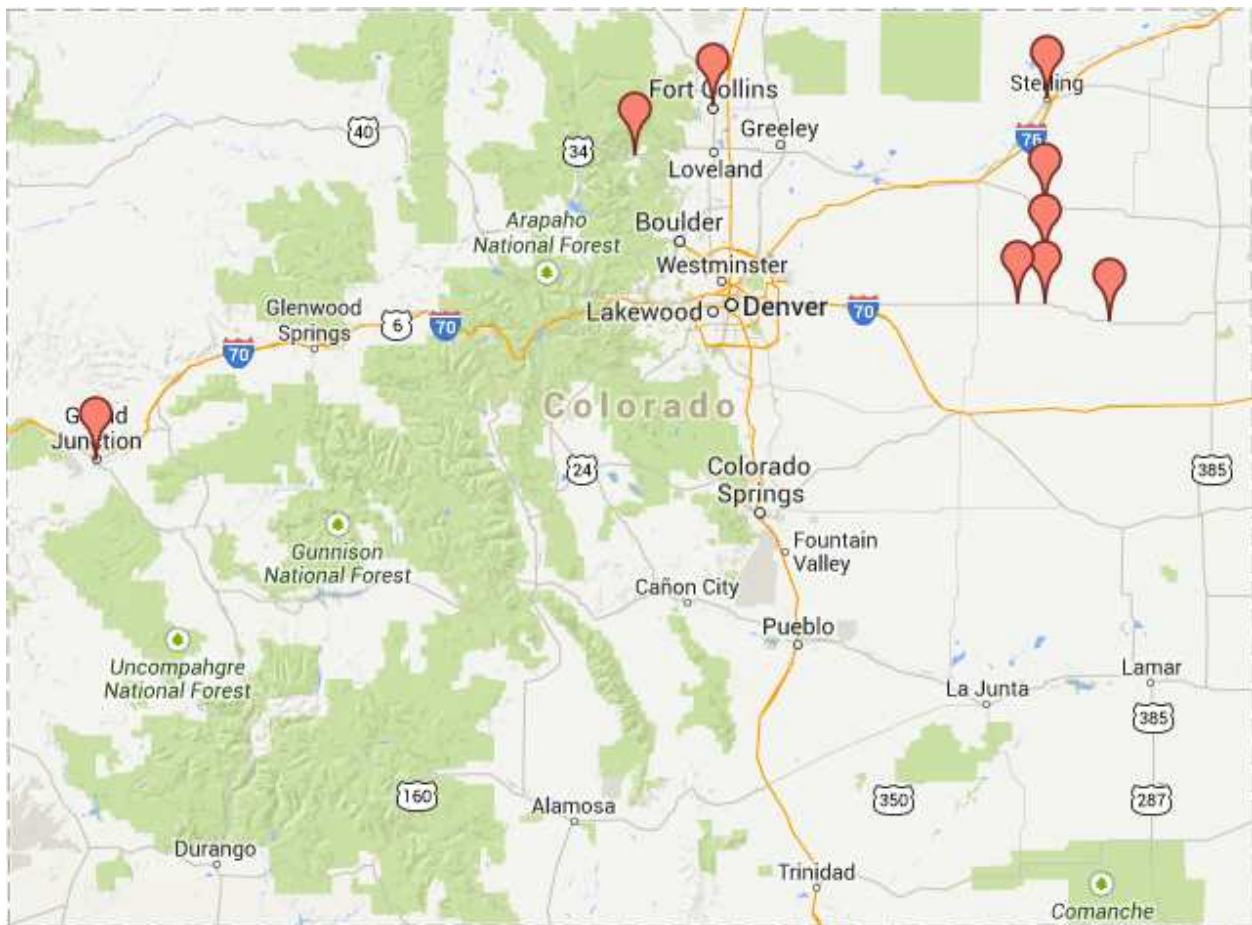
Figure 4. Map of Approximate Rancher Locations.

Research Question One

The first research question sought to uncover information pertaining to the advantages and disadvantages of their current branding techniques in direct comparison to the proposed technological approach of using GPS chips in conjunction with a mobile application. Upon investigating the question through the lens of the four basic models and theories mentioned previously in this study, several emergent themes became apparent: the perceived usefulness of the new approach to branding; the perceived ease-of-use of implementing such a technique; and the element of traceability that inherently exists alongside the functionality of the mobile application.

Perceived Usefulness

Despite the participants' inability to actually experience the proposed technology, respondents often cited profitability, a reduction in animal stress, and enhanced recordkeeping techniques as perceived useful applications of the GPS-based mobile technology.

Profitability.

Several respondents noted profitability to be a factor that would enhance their willingness to adopt the new system of branding cattle. For some respondents, the benefit of profitability was viewed as a shortsighted value to changing branding techniques, but for others, a long-term benefit would be enough to spark an interest in the technology. Nelson described a scenario in which he would need to be able to see a marked increase in profits for him to even consider transitioning. "If I could see that it would help make my ranch more profitable, I would be for it," he said. The element of profit seems to be a considerable driving force for Nelson in particular, as he later stated, "If I didn't see an advantage to my

profitability, to my efficiency, then I don't see why I would waste my time on it." Realizing

that ranching will come with great expenses no matter what, Lawrence produced a unique

perspective to express the notion that an increase in profitability may not be immediately

apparent but would manifest itself over time.

> LAWRENCE: I think that they'll probably make it justifiable. Just like when Kinsey -- they're working on their autonomous system, and when that gets released I hear John Deere is only a year or two behind them. Even if it costs $30,000/$45,000 for a tractor, I mean to be able to have a tractor going on its own without anybody out there, it's one whole person. That's one year's salary that you, you know, don't have to pay a hired hand and it's gravy after that. Yeah. Or with if it could help you with grazing, with your grass mapping and everything, you know, with intense rotational grazing, you can sometimes get twice the head of cattle per acre. So that would be a much greater efficiency.

A similar analogy was outlined by Darren, who likened the advantages in

profitability through using GPS technology for cattle management to the way corn has been

transformed to increase profitability in the crop industry. The focal point of his statement

was genetics. "Technology's going to help us get the better genetics quicker," he said. He

compared this technology to the way genetically modified organisms have significantly

increased corn yields.

> DARREN: When I was in high school, you could get a hundred bushel to the acre . . . I'd ask my dad, 'What'd we get?' 'Oh about same – a hundred bushel to the acre.' And now we're over 200, 220 easy, you know. I can't even quite fathom what it's going to help in genetics . . . we're going to get to that point where the tenderness – we're going to be able to get that tenderness for every cut of meat. Every steak that goes out there.

Less Stress.

Another element of usefulness comes in the ability to reduce stress on the animal

throughout the branding process. Four respondents emphasized the importance of

reducing stress on the animal for various reasons. Being able to place the animal in the

chute and inject a tiny chip instead of burning a symbol into their hide would create an all-

around less traumatizing event for the animal, whose welfare is in the hands of the rancher, according to Mitchell. "You know, you try not to stress 'em any more than you have to," he said. "That takes away from your profit, you know, in the long run." Mitchell later mentioned that animals don't like to be around humans in the first place, so any extra contact increases stress and leaves the calf more likely to get sick.

> MITCHELL: The less stress that you can put on 'em when you take 'em to the sale barn if you sell 'em there or, you know, everything's sold by the pound so you have to weigh 'em and stuff so the less stress you put on 'em, the less weight they lose because it's just like a person when you're stressed out, you don't eat. You lose weight. And that's the same thing with an animal like that. So you try to put as least amount of stress on 'em as you can, so.

> Tactics to reduce stress are already an important aspect of cattle ranching.

Jacquelyn mentions that when calves experience anything out of the ordinary they are stressed, thus proving the importance of creating the least stressful scenarios for cattle.

> JACQUELYN: We try to reduce the stress as much as possible just by having good working facilities. We try to design those to, you know, we have a tub and a chute that is set up to work them as efficiently as possible with less stress. We try to handle them quietly so that we're, you know, not running them through too loud, too fast. The cattle are our livelihood, so we don't want to put any more stress on them than they already have. We realize that's, you know, a big day that they get a lot of things done to them. But we kind of look at it as, like we take our kids to the doctor and they get like all their childhood vaccinations in one shot, but then they're done. So, it's kind of doing the painful unnecessary things all in one shot, you know.

> The importance of reducing stress also seems to be closely related to the

participants' interests in increasing profitability. The above excerpts from the in-depth interviews reinforce the idea that many elements of the ranching lifestyle coincide with one another. The main justification expressed in reducing the amount of stress on the animals was so that the calves could retain as much weight as possible, consequently resulting in an increased profit at the point of sale.

Record Keeping.

Several respondents discussed their interest in the ability to practice better recordkeeping habits by using their mobile devices instead of a pen and paper, the method that a majority of participants used before becoming more familiar with technology. A particular note of interest was the amount of references to a form of master journal that an apparent large number of ranchers use to record data about their herd. The name used to acknowledge this master journal is "red book." Jacquelyn stated, "We still carry, you know most people in ranching know what a red book is—it's a little red book that you put in your pocket that you put all your information in." On her ranch, they use the red book as a physical back-up in addition to using technology for recordkeeping.

> JACQUELYN: We'll still always write that information down. But those styles, you know, were just more prevalent in the old days. And now the computer has kind of taken over. You know, I think this year it's going to be a little bit more difficult to write it, because now with the apps on the phone, we can have access to it everywhere. In the past, we've just had access in the house in the office. And so you write it down when you're out doing it so you don't forget it. You bring it to the house and you input it.

Jannette also mentioned the importance of the red book and noted keeping physical records of data. "We keep our tax records and our cattle records [in an] Excel spreadsheet and word process," she said. A popular concept brought forward by participants was the ability to use mobile technology to generate charts and other visual data representations of records that could produce specific information through an easy-to-access medium. "There would be definitely some benefits to seeing how your animals performed in the feedlot and the slaughter plants and that kind of stuff, so I could see how it would be a good thing," said Nelson. The benefit to organic ranching operations, which are required to provide a great deal of information to regulating organizations, intrigued Dallace.

DALLACE: You know, that would be really efficient, because when we get audited, those are the things that they're asking us. 'Okay, did you treat any animals in the last 12 months?' 'Yes, we did.' 'What animal did you treat?' 'We treated this animal.' 'What did you treat the animal with?' 'We treated the animal with, you know, penicillin for three days.' 'What was the outcome for that animal? Did it get better did it get worse? Is it living? Did you put it down? How did you put it down?' So, if I could just sit there and pull up with the reports, like 'Guess what? We only treated two cows all year. They both got better.' And then the next question from them would be, 'Did you remove them from the herd? You know, did you remove them from the program?' . . . Or even like -- and they also ask us about lameness, like they have like a health one and a lameness one. So like if a cow gets [*inaudible*] or something, they'll kinda want to know what percentage of our herd -- what percentage did we treat for lameness. That's one of the questions they always ask, so. You know if I was driving in my truck and I saw a cow and she was lame, I could pull up that app, pull up her number, 'cause I would be sitting there in the truck and I could see her tag, I'd pull up her number, and I'd make a note in there and then when I got home I'd know to tell my guy, hey, you know, not only could I just tell him her number but then I could also have a history of that in the app. You know, that would be really useful.

In addition to the added benefits of being able to keep detailed records in the palm

of one's hand, the respondents also expressed a meaningful interest in the potential for the

mobile app to overcome the red book's downsides. "If we leave the house for a long period

of time like on vacation he's probably got the red book with him . . . And if he ever lost

that.... It would be a bad day. It's like the ultimate back up," said Jacquelyn. Jannette

explicitly explained the possibility of the red book's existence being transient. "They could

be dropped in the mud. They could be lost. They can be, you know, smeared," she said.

"Who knows? My other friend over here, she washed her husband's red book . . . If they

didn't love each other so much it could have been a divorce."

Perceived Ease-of-Use

Seven of the nine participants discussed ways that using mobile application

technology to replace branding would be easy to do or would provide an easier method of

branding in comparison to conventional branding techniques. Instances describing an

element of the branding experience involving obstacles that could be alleviated by using the mobile technology are included as perceptions of ease-of-use.

Technological Ease-of-Use.

All of the participants are familiar with technology and feel comfortable using devices such as their mobile phones. That comfort translates well into the perceived ease-of-use, as the individuals perceive that they would not experience great difficulty with understanding how to operate the mobile application. In fact, no expressions of concern were voiced by participants in relation to an inability to understand how to navigate and use the mobile application interface.

On the other hand, participants did express concern about obstacles that he or she face throughout the branding process, which could be circumvented if the technological approach was used to brand instead. One problem is the effect of the weather. "If the calves are wet, mud and dirt gets in the hair and then it won't burn through and get a good brand," said Nelson. "So it's got to be dry." Another obstacle faced when branding is the difficulty that accompanies burning the hide. Mitchell noted that burning the hide ruins that location of the hide that could be used for other things after the animal is slaughtered. Beside naturally occurring or aesthetic hindrances, time is also of utmost concern. Freeze branding, according to David, takes approximately five minutes per animal, which takes a considerable sum amount of time for a herd of 100. Jannette said that she and her husband deal with the complication of getting older while the calves keep growing larger.

The implementation of the proposed method of branding cattle could allow ranchers to avoid these obstacles by means of the easy-to-use nature of the mobile application. Jacquelyn said the following:

JACQUELYN: It just makes it easier. I mean I think anything that we can do to make life easier or more efficient so if I don't have to run to the house and look up information on the computer—if I have it in my pocket, and I'm out in the barn and I can access it… makes life easier. I think it makes the job easier, and if you don't use it, like we said before, you're kind of left behind.

She also recognizes the potential to easily market her product globally. Using a mobile device to manage data about cattle would allow for easy marketing of cattle with less effort spent converting information on paper to a digital format. "It puts our business out there to where people from a long ways away have the opportunity to look at and purchase our product," she said.

Not every participant saw a value in the ease of using technology for the branding process. The common theme that emerged was the idea that many other tasks must also be completed on the day of branding, thus rendering the ease of using a mobile device to be less impactful. "Branding isn't just about putting the brand on . . . that's the same day we're going to vaccinate, you know, do some other things to them as far as management and castration," said Jacquelyn. Jannette expressed that changing to a technology-oriented approach would not change anything about the fact that you still need to bring the cattle in whether you are putting a chip in them or are branding them.

Element of Time.

Responses from the study's participants suggests that time is of utmost concern to a rancher, yet the impact of the element of time is twofold. Several participants voiced their concern for the time that might be required to implement the microchip system while others discussed the ways that branding absorbs precious time due to the complexity of finding enough help.

For ranches that don't employ many hired hands, finding help is laborious and time

consuming. "It can be a problem—finding people to help," said Mitchell. "Finding young

boys and girls, men and women that want to wrestle the calves and hold 'em down and, you

know, I mean you get tired." Jacquelyn also voiced her concern with time:

> JACQUELYN: This time of year we struggle just with time management. There's a lot
> to do in this time of year. We're not large enough to employ anyone . . . It's hard to
> brand in the chute. That's why most people will still rope and drag to the fire, and it
> just gives you a little bit more flexibility. We just don't have the people that we can
> do that with.

On the contrary, Nelson's main concern was the time that it would take to

implement the new technology, especially after putting in many hours during the day. He

mentioned that he would not want to be working outside all day and then go home that

evening just to spend several more hours dedicated to inputting data into the mobile

application. "There's going to have to be some simplicity to it so that it's not doubling the

amount of time I've got to put in on a day," said Nelson. A similar concern is expressed

more forwardly from the perspective of Jannette's ranching operation:

> JANNETTE: You know, what you're talking about is great, but [only] if you find a few
> people who like all the computers and take time. But most of us don't have time to
> sit in front of a computer and do all that you're talking about! It's that simple.
> Technology is great. And this might be great . . . and it might work great on an
> organization that has, you know, 10 or 12 kids that maybe could designate all this
> stuff. But when you're working on an operation or a two person or a three person
> operation, there's no time to do [this]. One person [to spend half their life] in front of
> a computer doing all this stuff. It's totally ridiculous. So me, I think you're . . . some
> people may find it neat . . . but I think 90 percent of the people will find it a pain in
> the [butt] to tell you the truth.

Conditions of Facilitation

An element of the technology acceptance model, as seen in Figure 3, is the

conditions that facilitate the adoption of a technology, which ultimately influences the

perceived usefulness and ease-of-use of the innovation (Venkatesh & Bala, 2008). Two

major factors arose from the data: laws relating to brand inspection and also the enforcement of the technology.

Brand Inspection.

A glaring obstacle hindering the ability to adopt a new form of branding is the current state laws requiring animals to be branded with a physical brand. "You're gonna try to substitute this for brands, then you've got to change the state brand laws . . . The state brand law requires all cattle that are sold through have to have a brand on 'em," said Karolina. "So if you've got a chip rather than a brand, then you've got to have a brand inspector with some sort of a thing, too, so when you sell that calf, you can come read it and do the proper paperwork." This reason alone may prevent the adoption of the proposed technology. Dealing with brand inspectors was a common theme that emerged from multiple participants, each citing an issue with proving that the animal is yours unless the technology is adopted by brand inspection agencies as well. "How do I prove that that's my animal? You know, there's nothing visible there that, you know, other than what you're saying's on this iPhone or whatever so they have to be willing to accept what's going on," said David. An evident issue of legality was of major concern for the ranchers who participated in the research study.

Enforcement.

In order for the proposed technology to work as a replacement to conventional branding methods, participants indicated that the technology would have to experience widespread adoption.

> MITCHELL: Now, one thing I can see a problem with this is if I have this technology that's fine, but the end user has to—you know, whomever I'd sell to has to have the same technology. You follow? To be able to keep track of that and do that. Because it would do no good for me to have this but the sale barn in Brush, if I take calves there

to sell, not have it. I would see that it would have to be [a widespread adoption]. You know, at least those points of sale.

David specified that one would have to come up with a method that everyone would agree to and would be willing to use. However, the ranchers articulated that widespread adoption would require some form of forceful action—which would not be welcomed. Being forced to adopt the mobile app system is the only way that Nelson would be willing to change branding methods. "The main reason why we change what we do is either it makes life easier or because somebody tells us we have to," said Jacquelyn. "And I would hate for it to come to that, just because we don't want regulations, but, you know, those seem to be the two driving factors." Karolina reiterated the idea that everyone, including the markets, would have to take on the technology all at once, because "the minute you lose that ability to identify that animal, you lose that animal." However, she also sees a potential tipping point that would incentivize ranchers to adopt the mobile app on their own.

KAROLINA: Well what happens is when a rancher finds out that the brand inspector would rather look on his cell phone, the buyer would rather look on his cell phone, pretty soon you're like -- well then why am I spending a whole day branding cattle? Why am I doing this? And they will naturally set it aside. So it's not a brand issue, it's a choice issue.

Traceability

Perhaps one of the most discussed facets of the proposed branding technique was the facilitation of beef traceability. Many arguments were produced in favor of and also against the ability to access detailed information about the origin and treatments of a package of beef over the animal's lifespan. The major benefit that arose from ranchers' responses was the ability to trace major diseases back to the animal's origin. On the other

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hand, however, ranchers feared that a disease outbreak might be misattributed to the original ranch, thus destroying that operation's reputation.

More ranchers expressed favor to the idea of traceability than did not. A majority of the respondents were in favor of tracing a significant issue with beef back to its origin as long as it would be beneficial to the consumers and that it was indeed a significant issue. More than one participant expressed an emphasis on the necessity for the issue at hand to be of significant stature. "I could see to where something could get pretty nitpicky and completely destroy a market in a certain area and just completely destroy the whole producer in that area too," said Nelson. "But if somebody got too nitpicky about it, I could see it just being a pain in the butt." Karolina responded that she wouldn't want the entire beef industry to get a black eye due to one circumstance in a single herd, though she recognizes beef traceability as becoming more of a "protection to the ag-production person than it is a hindrance."

Respondents also acknowledged their responsibility to give the consumer what they want, and the industry appears to be heading more and more toward transparency. Nelson is in favor of "Exposing [the ranching process] to the world in a better way and maybe making the consumer more knowledgeable about what the process is and how we get to the final product and maybe making some people more acceptable to that process." Another concept worthy of mentioning is the responses indicating that ranchers should not be concerned about beef traceability unless they are producing marginal products.

Jacquelyn was very knowledgeable on the topic and had insight for both the pros and the cons. She liked the idea of being able to trace a major outbreak back to the original source, but her concern comes with the liability attached to the traceability:

JACQUELYN: If it's something that's truly my fault that I did as a production practice, then the liability, yes I think that should fall with me. But if I raise this calf and it goes through the food chain and it crosses all these other paths, you know, and then in the end something happens to it that gets someone sick or, you know, or injures somebody, can they trace that liability clear back to me even though it's not anything that I could control? There are natural things that occur in livestock. Like E.coli is a natural thing. It happens in their gut. But that's not something I can do anything to affect. But, the way it was handled as it was processed, the way it was handled as it was harvested, the way it was handled as it was shipped and cooked, that can affect those things. So then will that come back to me because I raised that animal?

Research Question Two

The purpose of the second research question was to discover the factors that influence ranchers' decisions to adopt or not adopt a new, technology-oriented method of branding and identifying cattle. The research participants brought many different factors to attention. Of the reasons, some of the most discussed include the ranchers' comfort level with using technology, the ability to test the equipment before the point of purchase, the cost to implement such a method, and the reliance of technology to work and keep their data secure.

Ranchers' Technology Use

Participants were asked questions related to their current usage of technology. The respondents regarded age as a major contributing factor to the technology's acceptance. The participants' level of comfort using technology was evaluated in order to shed light into the probability of being able to comprehend the new technology and all of its features.

Age.

Only one participant did not acknowledge age as having a significant influence on the innovation's adoption. When asked to describe the type of rancher who might be

willing to abandon conventional branding techniques in favor of the proposed

technological approach, age was often discussed. "I'm going to say anybody from 30 and

down. You get above that and they're just not going to like that I have a feeling," said

Nelson. Other respondents noted younger individuals as the type who would be more apt

to connect with technology.

An intriguing finding was that many respondents turned the discussion toward their

own fathers in order to assess the age-related predicament. Nelson believes his dad would

hate the idea of using technology for branding cattle. Mitchell's dad does not text message,

despite having a capable phone. "He calls me, 'Hey what's the weather gonna do?' . . . 'Hey,

look something up for me on the Internet.' . . . I bought him a GPS for his truck and

sometimes he uses it. Most of the time he still uses his old map," said Mitchell. Further

solidifying this finding, Lawrence thinks the older generation is suspicious of technology. "I

think [my dad] thinks that since he's older, it's not his job to, you know, so he doesn't want

to try to figure it out," said Lawrence. "He says he's gonna have us learn it and then teach

him." Lawrence later related the hesitancy to welcome the fast-paced digital era to his

grandfather by pointing out that he was born in a generation believing that slow and steady

wins the race.

Jannette was aware of the research showing that the average age of beginning

ranchers is between 35 and 45, and admits that people of her age are not the millennials. "I

think you need a younger group coming in to make it really feasible," she said. Meanwhile,

Jannette is waiting for her son to come home to show her how to download an app onto her

smartphone. When probed about the reasons that the older generation is less apt to accept

the technology, one participant illustrated his opinion:

DAVID: Like an old mother hen gets down in the dirt, you know, and just fluffs up [her] feathers and... don't disturb me. I'm comfortable the way I am. That's my answer . . . because again the older age of the rancher is going to be less inclined to change, you know.

Despite the lingering age gap, the respondents did not seem to be worried about the future of technology adoption in agriculture. "I think it's going to get easier as time goes by . . . the next generation comes along and they've been to college," said Darren. "I imagine within 10 years you should be able to do that (introduce technology into the branding process)." Karolina similarly stated that the next five years ought to bring about changes in the mindsets of agriculturists because the older generation is dying.

Comfort Level.

The participants produced a large amount of data related to their current technology habits. Eight of the nine respondents use an Apple device, such as an iPhone or iPad. Every participant owned a smartphone and was familiar with the function of applications. None of the respondents expressed an alarming concern for being able to utilize the proposed mobile app.

The driving force behind the participants' media usage varied, though much of the discussed usage was related to agriculture. Three participants use social media to market their beef product. Jacquelyn operates a Facebook page and a ranch website where she lists things to sell. Her ranch's production sale is conducted online so that a broader demographic can be present for the auction. Jannette posts on Facebook for the Colorado Cattlewomen. Karolina has a Twitter account where she posts agriculture-related information.

Nelson mentioned the use of spreadsheets for recordkeeping as a useful practice. He and David both mentioned using the Internet to examine Expected Progeny Differences

(EPDs) for animals that are being bought or sold. David, despite being the oldest respondent in the research study, keeps incredibly detailed records on his iPhone for every single cow that he owns. "If somebody wants to know something when you're standing out there in the field and you want to know something about this cow, I can tell you a name or tattoo or everything—her registration number, her birth date, who her sire is, everything you know," said David. "I can even go in and probably I can tell you something about her progeny."

Many participants also expressed the notion that they do not own only one device but instead operate multiple types of devices—iPhones, iPads, laptops, etc. Moreover, some respondents discussed purchasing smartphones and tablets for every member of their family as well. "I use the iPad. First I started with my computer . . . then they came out with the iPhone or the iPad, and I thought well you know I'd like to have one of those for a number of reasons," said David. "I like to read books. So I can read books off of it as well." Mitchell has an iPad that is used primarily for work and also discovered a group-messaging app that he uses to communicate with the Hazmat team as his second job. Dallace stated, "Both my kids have iPads. My husband has the iPad. I have three computers. We all have iPhones." Darren admits to knowing the least about technology in his family but has nonetheless adopted the latest devices. "We've got all the iPhones and iPads and Internets and all that stuff," he said.

Five participants mentioned using GPS for their agricultural operations, thus enhancing their comfort level with the idea of tracking cattle through use of GPS. The individuals questioned for this study appear to be very knowledgeable about ways that technology can be utilized in ranching, and many of them have begun implementing

technology into their everyday operations. Dallace's hired hand takes pictures of crops or

broken parts with the iPhone they bought for him. Jacquelyn has been seeing an increase

every year in the sales of her cattle after broadcasting the auction live on the Internet.

Jannette already uses a form of electronic identification by inserting EID tags into calves'

ears. She does not own a reader for the tags, but the system allows her to email calf-related

information to purchasers since the sale barns are able to scan the tags.

Observability

Despite the abundance of data expressing the respondents' comfort with using

technological devices, many expressed a hesitancy to adopt the proposed branding method

without first being able to see that the technology had been proven to be effective. "I don't

know that I would jump both feet in and just go gung ho at it," said Mitchell. "I think it'd be

a transition and maybe try on a limited basis and see how it works. And then transition to

it." Five of the respondents conveyed a positive valuation in the ability to see that a

technology will work before being willing to fully adopt the product. Lawrence referred to

a piece of equipment that his family only adopted after being able to view data and make

sure it worked well beforehand. Darren said, "They might get some hiccups along the way. I

mean it's not going to be perfected right away . . . it'll start out on the small scale and if it's

proven more people will get on board." Jannette stated that the first step toward adoption

would be the guarantee that the mobile device GPS technology would be reliable.

Surveillance

The ability to track the location of cattle was very appealing to many of the

participants. Areas that are spread out over great distances, specifically, were thought to be

most likely to benefit from this enhanced monitoring. David commented that seeing when

an animal was off by itself—especially in mountainous areas or gulleys—would prove to be

advantageous. In the case of Dallace's ranch, where the pastures are not contiguous, the

ability to track individual animal locations would be enough to convince her to buy the

technology. Mitchell considered the idea that one could determine when a cow might be

calving based on the locations of the cows. "You could tell if something's off by themselves,

more than likely they're probably getting ready to calve," he said. The main benefit to this

tracking ability would be to monitor cattle locations from a greater distance, but some

respondents ventured to express their interest in obtaining better data related to grazing

patterns. Having access to this data would allow a rancher to cross-fence in the proper

areas, according to Mitchell. On the topic of tracking grazing patterns, Karolina said the

following:

> KAROLINA: I think it would be a benefit not only in the tracking but if you look at
> the tracking patterns and you can certainly put this in a chip—the tracking patterns
> of animals that you really want them to graze a certain pasture. Well what do you
> need to do? You need to move the water. You need to move the salt. You need to
> move something that pulls them over here, and if you look at the tracking patterns,
> you may be able to find that out. In large cattle operations that are range cattle, I
> think this would be an interesting thing to try.

Taking the concept one step further, Jacquelyn developed an idea of her own. "I

don't know if the system could do some kind of alarm to where, like, okay like it knows that

this is the fence line," she said. "Can it alert me so I know in the middle of the night they're

on the train tracks or they're on the highway? That would be a huge safety."

Type of Usage

The participants' general purpose when consuming media was inquired about by

the researcher. Most responses indicated that media usage was typically for the purpose of

utility in relation to their agricultural operations. Weather applications were commonly

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mentioned as a popular tool along with virtual maps and cattle markets. "I watch the weather constantly, because I need to know whether I need to get hay staged in certain places," said Mitchell. "Or, you know, whether I need to be able to get the animals up to a different place if it's going to be a blizzard." Only one respondent claimed that her media usage was likely more for entertainment. Jacquelyn said, "ultimately we probably spend more hours of the day on entertainment than news source."

Cost

A factor that was not discussed in great detail by the respondents but was at least briefly mentioned by all but two participants is the cost of the GPS branding method. Responses often simply indicated the expense as a concern while others attributed stinginess as a personal attribute that would hold them back from adopting the branding technique. "I'm gonna think that would be—phew—expensive. I can see that, I mean I would be interested in something like that, it's just cost," said Mitchell. "Cost is probably the number one thing for me to look at with that." Jannette expressed concern that, in addition to paying for the technology, a rancher might also have to pay a veterinarian to come out to the farm to guarantee that the device was inserted properly.

Infrastructure

A frequent theme throughout the data collection process across the spectrum of participants was an obvious lack of trust for technology to function properly at all times. These concerns manifested in the form of technological limitations as well as apparent service-related issues that exist on many ranches. Seven of the nine participants voiced their concerns for infrastructural flaws that may prevent the proposed concept from functioning properly.

Technology Limitations.

Nelson wondered how he would protect himself if the system were to somehow shut down—how would he prove that the cows were actually his? His concern stemmed from previously encountered issues with GPS technology. Occasionally satellites are down or the signals are not producing entirely accurate results. Jannette doubted the helpfulness of the GPS tracking system as she has also personally experienced flaws with GPS. A system once took her off route to an unanticipated destination. Lawrence mentioned battery life as a potential issue for the technology, and Jannette cited Mother Nature as another conceivable obstacle. "Even the snowstorm and the windstorm can knock out our Internet and our television," she said.

Service.

Being able to use the mobile application in pastures that are far from cell service towers emerged as a main concern for several respondents. "Cell phone coverage is limited in a lot of areas that we graze and I know ranches far more remote than we are," said Jacquelyn. Dallace and Jannette also admit that certain spots on their ranches do not receive the best coverage.

Device Compatibility.

The last issue of infrastructure involves the compatibility of mobile devices. The participants voiced concern over the issue of having to purchase new technology every so often because the old technology becomes outdated after a short period of time. Despite the fact that each participant owns a smartphone, Jacquelyn was concerned about the equipment upgrades that would be required in order to maintain access to the cattle information. "A brand is there forever. I can see it with my eyes," she said. "Like, I don't

need to buy any equipment . . . where a phone or a chip—things just change so fast in the lifetime of that cow." Darren has experienced this same issue as he is on his third GPS system within seven years due to issues of compatibility.

Attitude Toward Technology

Despite the fact that many respondents are comfortable using technology and have adopted many of the latest devices, all but two of the participants discussed a negative view toward technology in one form or another. The two common concerns were that other individuals would have access to their data and that the technology could be manipulated in a way that would disable the mechanism.

Privacy.

An issue that seemed to strike a chord with the rancher participants was the topic of privacy. The government, specifically, was pinpointed as a major area of concern. "If government became involved in being able to track your animals on a consistent basis and constantly know where everything is at, I could see that being a problem," said Nelson. "If they became too invasive or just anything of that nature." Whether the third party was the government or just a random person viewing that data, the ranchers were very apprehensive of the sense that someone else might be able to view their data. When questioned about the origin of this apprehension, the ranchers did not pinpoint an exact reason for their interest in privacy other than the traditional lifestyle of the rancher.

> MITCHELL: It's rural people. Okay? Rural, agriculture. They're proud. They don't want to be told what to do. You know, that's just the lifestyle. That's the way they've been raised. That's the way people are. Example. USDA sends out this survey thing for you to fill out on what you have and everything and it's not mandatory that you do it, but they send it out to you. My dad throws it in the trash. He says, 'I am not fillin' that out. It's none of their business.' You know?

Lawrence could see the mobile branding system being a bad thing for the ranching industry if the government began gathering data and manipulating the markets. Jacquelyn connects the need for privacy to a lifestyle of tradition and stated that ranchers want to be the only ones knowing where their cattle are at all times—not the government or a big brother agency. "You know, I guess there's really no harm in knowing where my cows are at all times, but it's just the privacy issue," she said. Two participants brought an interesting notion to attention: a common culture in the ranching industry is to avoid asking a rancher how many cattle he or she has.

> KAROLINA: Nothing will stop a conversation in an ag family quicker than 'How many cows do you have?' You know, what you'll hear is, 'Well a few.' 'How much land do you have?' 'Enough.' So that's a privacy issue, and the ag industry is very private. Sometimes to our own detriment. And in this generation, one of the reasons that the traditional ag sometimes comes under more attack than positive is that we are so private. We don't blog about how wonderful it is to watch a calf born. We don't blog about this, we just do it. In a generation that tells everything. They blog about everything!

Perhaps Karolina summed up the issue of privacy best by pointing out that a wide generational gap exists between the ranchers who grew up in the public eye with social media as a staple component of everyday life and those who did not. Mitchell responded that he wouldn't be concerned with people knowing what he's doing, as he doesn't raise his cattle out of the ordinary, but that an animal rights group could obtain the data about his ranching habits and twist the information around in a way that would shed a negative light on the his operation. The distrust perhaps lies not simply with the information being accessible by third parties but instead in the potential for information to be manipulated against the rancher.

Distrust of Technology.

Four respondents did not trust that the technology would be safe and secure once implanted under the animal's hide. Theft was a central concern in conjunction with this level of distrust. "I think there would be somebody trying to figure out a way to deactivate that chip or somehow make it so that it's not responding or working and so that animal just goes off the grid," said Nelson. "And then they can do what they wanted." David also wondered how he would prove that a herd belonged to his ranch if someone were to load up his cattle and haul them 500 miles away. Jacquelyn relates her worry to an aspect of her second job where she keeps a great deal of information stored on the computers. "We're completely on an online database with our 4-H enrollment," she said. "But it scares me to think that what if one day that doesn't work?" Lawrence, a former electrical engineering student, provided a very educated a detailed description of a concern he had about the device's security:

> LAWRENCE: Because the chips—if it emits a signal, it can be tracked down and cut out, and a new one could be put in. Or it can be altered to send out a different signal. Or the signal can be masked or whatever have you, whereas it's harder to change a brand. I mean, once the original brand is set, then if any brands that are added to try and change the look of it will be discovered once the skin is pulled back, and you can see which brands were put on at which times. It's too susceptible to hacking I guess you could say—whether physically hacking it out or [virtually].

Research Question Three

Research question three asked this: What elements of branding and the ranching lifestyle necessitate a unique approach to technology adoption? Following the data collection stage, three main themes emerged from the interviews: social norms, compatibility, and felt need. These determinants were expressed to be influential enough

that a decision to adopt or not adopt the proposed concept may be based on these criteria alone.

Lifestyle

The impact of social norms was discussed so heavily that its relevance cannot be overlooked. The implementation of a new branding technique would greatly impact the social norms of a ranching individual, thus emphasizing the importance of norms in the decision to adopt a new innovation for agricultural folks. The below subsections of social elements, tradition, brand affinity, and the influence of other individuals emerged as essential variables.

Socializing.

Branding is more than simply a day of work. Ranchers value the task as an experience to be enjoyed by many—through food, fun, and socialization. Four participants revealed that a big meal is often associated with the day of branding. The following responses solidify the importance of the social element tied to the branding process:

> MITCHELL: If you have a branding, you feed everybody. You know, you have a meal when you're done. That's always a big thing. And when you go to a big branding like up at my sister-in-law's in Nebraska, we'll brand 500 head of calves in a day, and there'll be 30 people there helpin' and when it's done then they have the big barbecue and it's a social thing like that, you know.

> JANNETTE: And what we do is we have a lot of people out when we brand because it's also... A social event. Our son actually has two degrees at CSU in electrical engineering. So he brings a whole bunch of people that, you know, his compatriots that want to come out and see what it's like to ranch.

> DARREN: So, you know, we have a nice shop and we have a nice dinner there and we drink a beer or two. But no it's neighbors and friends and then the friends bring friends and the kids at school there's always somebody that's never been to one, and they enjoy the day. And we teach 'em the ropes a little bit. Stuff like that, so. That's part of the social end of it.

DALLACE: You know, everybody gets to rope, it's just a different atmosphere in the air that day, you know, and everyone looks forward to it. And we try to always have like a really nice meal afterwards so it's kind of like a team building also. It's team building, and we try to make it really pleasant, you know? You know? I don't know how to explain it any better than that. You know, it's just a really special day, and the kids usually have a lot calves, and sometimes the kids will help us or sometimes they'll be playin' down by the, you know, there's a little creek that trickles through there, and they might be playing down there. It's just a—it's different than any other ol' day, you know, everybody wants to be there.

Many of the ranchers ascribed the enjoyment of the branding experience to the individuals that are willing to help out with the labor. Despite the fact that the day of branding takes much preparation and hard work, a word to describe the event that was mentioned by more than one respondent was "fun." Jannette stated that people are so looking forward to her ranch's branding that they have already inquired about the date in order to schedule it into their calendar of events. The numerous mentions of help from individuals who are not affiliated with the ranch, the gathering of family members, and the preparation of a big meal indicate that branding is more than a job—it's a social event.

Tradition.

Ranching is unique in the sense that it is an occupation which is often passed along from one generation to the next, leaving a long trail of family history. Nelson's uncle has a brand that has been in the family for over a hundred years. David has been ranching since approximately 1970. Mitchell's dad owns a brand that he has used since the 1950s. The tradition that accompanies the ranching lifestyle is what the respondents credit to making it just that—a lifestyle. "People look at ranching and farming as glamour, you know, but they don't stop to recognize there's a lot of hard work involved with it," said David. One of Mitchell's favorite aspects of work is getting horseback, checking on the cows, moving the cows, doctoring sick cows—essentially just being near the animals. Mitchell also mentioned

experiencing the beginning of life by observing the birth of a baby calf to be something that draws him to the lifestyle. Karolina said, "There's a certain sense that comes when you watch something grow and you watch something die, and you're responsible at both ends." Some respondents even mentioned certain ranch practices that are done solely for the sake of tradition, not out of practicality. Roping calves on the day of branding is one traditional aspect looked forward to by Dallace as a chance to pay homage to the tradition of the lifestyle. Jacquelyn stated, "Branding to me is a traditional thing. I can smell the smoke. I can feel the dirt. It's just something I've grown up with. It's engrained in me." Despite the apparent emotional connection to the tradition of branding, the respondents acknowledged a realization that tradition is evolutionary, knowing that things are bound to change.

> DALLACE: I suppose part of that would be, you know a little sad not to be branding them in that kind of traditional way. But, would the benefits, you know, would you get over it pretty quick if you could sit at your desk and know where all your cows were? Probably.

Brand Affinity.

Eight of the respondents expressed strong feelings toward the actual brand that is applied to the animal's hide. To them, the brand design represents more than a symbol. A recurrent word mentioned by five of the respondents in descriptions of their brand was "pride."

> DALLACE: I bet you of all the people that you ask, they'll say that it does mean something or it's special or maybe they got it from their grandparents, or maybe they bought it from the people that they bought their ranch from.

Another word used when describing brands was "identity." Nelson compared a brand to the initials of one's name or the license plate on a car, while Lawrence likened a brand to a coat of arms. Several participants mentioned using their brand as a

representation of identity by emblazoning their symbol onto hats, belt buckles, sidewalks, and saddles.

Despite the differing connotations, the participants contend that branding a calf is much the same as branding any other product. Nelson takes pride in placing his brand on a product that he is proud of, even though that product is an animal. Not physically branding the herd anymore would be difficult for Jacquelyn, who incorporates her ranch's brand as a marketing tool:

> JACQUELYN: But it's also a thing of pride, because we advertise using our brand. And that's just like a branded logo on a product that you're going to get at the store. When I put that brand on the side of my cow or on the side of my bull, I've raised that product. That's my way of identifying it as mine and showing the world that that's a product that I produced. So it's a pride thing, too. It's a way of identifying the product that we raised.

> KAROLINA: I think people carry their brand with pride. There's a lot of history to it. There's a lot of history to the brand. And the other thing is is you run cattle through and the quality of your cattle that you run through—people recognize it. It really is a brand. They say these are good cattle, they're in good shape. You know, we can recognize the brand, we know the people that grew it, we know that the meat is good. So when you put your brand on that animal, it's no different than putting a Nike brand on a sweatshirt. If it falls apart, Nike's gonna get called. And if it falls apart, you're going to get called. So it's really not just a pride issue, it really states all the work you do for a year on that animal. It's not an insignia. Yeah. This isn't an initial. Yeah I didn't initial my cow, you know. I branded my cattle.

Proof of Ownership.

In contrast to the emotional connection that individuals have to their brand symbol, a utilitarian aspect influences the ranchers' unwillingness to do away with their personal brands. Ranchers expressed concern that they would be unable to prove that a calf belonged to their ranch without utilizing physical brands. Permanency was repeatedly mentioned as the missing factor in implanting GPS chips subcutaneously. "We need something that we could see, and I say from the back of the horse through the brush. It

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might work great on the flatlands, but [not] in these high mountains," said Jannette. According to David, "It still doesn't solve the problem about theft—something that's not visible. That's why the brand was developed, so that I could identify those are my animals."

Influence of Others.

The data suggest that other individuals have a significant influence on ranchers' adoption of technology. Among those highly influencing individuals are animal rights activists, consumers, educational resources, and other ranchers. Mitchell specified animal rights activists as being a motivating force to adopt the proposed branding technique because the more humane treatment of the cattle ought to appease the activists. "We got to just open our eyes to the fact that we got to keep these consumers happy, and they're attacking enough right now on the beef end of it," said Darren. Jacquelyn credits her technology adoption to the education she received in college, where she learned how to use computers and was able to bring that knowledge home. Jannette used to be a schoolteacher, and the technology flowed home with her as well.

The most notable finding was the word-of-mouth influence that ranchers have on one another. Dallace has noticed that neighbors tend to observe new techniques that her ranch implements and soon also integrate the same methods. "We have influenced our father-in-law to not only get a cell phone but to get a smartphone," said Dallace. Darren admitted that the reason he got an iPhone was because everyone else in his family had gotten one as well. He felt the need to keep up with the rest of his family.

> JACQUELYN: I think it's just kind of one of those things where you always have to keep up with the new trend, so like the neighbor has this thing on their tractor that allows them to do this or they have this new thing in their operation, I think then you're more willing to try it or want to keep up. So I think it's kind of the, like you know one person starts it and then it just domino effect. It's not something that we would probably ever just go out and integrate something new just because the

neighbor did it, but if they come to town, you know, telling us these wonderful stories about some new product or something that made life easier for them, we're probably going to be more apt to buy it.

KAROLINA: Any of these things need to come from them not to them. So I think if it came up through the industry itself and then had someone like Richard or someone like my friends say, 'Yeah we'll try it. We'll give it a shot. We'll see if it works.' And from that I think you also get better product control and improvement. You know, if they say, 'Wow, it sure would be nice if we knew this.' Or 'We don't need all the bells and whistles, we just need to know where it is.' So if you might get an opportunity to do really good inventive product control and research and development in it if you come through the industry. If it comes through Colorado Department of Agriculture that says you have to do this, it will never move. Give us a choice, we'll do whatever you want. Give us a demand, we'll do nothing.

Compatibility

Participants expressed concerns with the compatibility of implementing the GPS-based mobile technology into their current lifestyles. Concerns ranged from how the method would be approved by brand inspection agencies to the way that current devices would remain capable of handling the technology over time.

Felt Need

Much discussion has revolved around reasons that ranchers would or would not be willing to change their branding behaviors; however, a need exists to examine the rancher's felt need for such a change in technique. Do ranchers see a need for a different method of branding cattle? Upon collecting data, two themes emerged which influence the need for an alternative method of branding: size of operation and the necessity to be hands on.

Size of Operation.

Nelson does not see a need for the innovation at the ranch level but could see it benefitting the feedlot industry. "That way they don't have to take the time to put a brand on everything, and they just inject them and then they can input data on their computer, and I think it would save them a lot more time," said Nelson. "Where at the ranch level, I

don't—I think it would be a lot more time consuming than it would help." Four participants identified large operations as being ones that would benefit from implanting their cattle with GPS chips. Dallace's operation covers a wide spread of land that is not contiguous. Ranches in mountainous areas were also mentioned as potentially benefitting from the ability to track herds. Operations with a smaller herd size would be harder to convince to change branding methods according to Darren.

Necessity to Be Hands On.

A previously unforeseen limitation of the GPS-based mobile app concept is the idea that it might incentivize ranchers to actually decrease the amount of time he or she spends monitoring their cattle. Nelson would feel the need to go out and check on his herd anyway despite the ability to track its location via GPS. "You still need to be able to see your animal hands-on to tell if something is sick," he said. Furthermore, Lawrence describes the type of rancher that would use this technology as being "increasingly lazy."

> JACQUELYN: You know, I think a lot of what we do on a daily basis we think, 'Oh this'll make our life easier because I won't have to go check pastures.' But that creates other problems, because if I don't have to physically drive to that pasture to check to see that my cows are in, I don't look at 'em to see if they're healthy. You know, I don't see that the water tank has broken, and, you know, that it's not full of water. I don't look at the range and know that I'm managing the range appropriately. So, you know, it's kind of a fact that, like, yeah it makes life easier in one sense, but there's still so many things that are tied in to just going and physically checking on that cattle.

CHAPTER V

Conclusions

This final chapter exhibits the key findings, conclusions, and recommendations based on the data that were gathered throughout this research study. Nine Colorado ranchers were interviewed in order to evaluate the readiness level for ranchers to abandon conventional branding methods in favor of an approach that utilizes GPS chips and a mobile application. The diffusion of innovations theory, uses and gratifications theory, technology acceptance model, and non-adoption of innovations model were used as a foundation for examining this level of readiness. To evaluate this level of readiness, the researcher posed the following three research questions:

- **Research Question 1**: From the ranchers' perspective, what are the relative advantages and disadvantages of conventional branding methods compared with technology-oriented methods?
- **Research Question 2:** What factors influence ranchers' decisions to adopt or not adopt a new, technology-oriented method of branding and identifying cattle?
- **Research Question 3**: What elements of branding and the ranching lifestyle necessitate a unique approach to technology adoption?

Key Findings

Overall, the participants who elected to partake in the research study expressed convincing motives for and against the adoption of a technological approach to branding cattle. The sample of participants represented a broad spectrum of rancher types. Though a

cluster of ranchers from Eastern Colorado comprised a majority of the respondents, that particular location of the state represents a noteworthy portion of the state's agricultural production. The gamut of ages was also broadly encompassing, as the youngest rancher was new to the industry (recently acquiring his own operation despite being raised on a ranch) and the oldest had been ranching for over 40 years.

Several common themes were manifest by the end of the researcher's data collection process. Ranchers clearly value the work that they do as a lifestyle instead of an occupation. Alongside this connection to the tradition of the ranching lifestyles comes an affinity for the brand itself. These reasons alone could catalyze a sentimental motivation to not adopt the technological approach to branding. A high level of comfort with technology and a positive outlook toward the benefits that such a technology could provide could also lead to an adoption of the mobile app-based innovation. However, the fact that the branding process is currently bound to specific legalities was a clear obstacle in the minds of the participants. This barrier was so strong, in fact, that some participants became very fixated on the idea that this technology could not legally be introduced as of today, thus hindering his or her ability to explore the idea on a conceptual level while setting aside any cognizance of current legalities.

Participants expressed such strong regard for their personal brands that they would not be willing to entirely compromise that sense of identity. The brand serves the purpose of identification but also as a marketing device. Participants indicated that individuals who purchase their beef have grown accustomed to identifying a particular brand, and failing to continue physically branding the animals would eliminate the marketing traction that each rancher had worked so fervently to obtain over the years.

On one hand, participants demonstrated a clear technological fluency. Each rancher had a smartphone and was comfortable using the device to communicate or obtain information. However, many participants also expressed distrust in technology in the form of technical failure, susceptibility to hacking, or the invasion of third-party access to private information. The underlying concern seemed to be the potential for theft to occur due to the inability to prove that a calf belonged to a certain producer.

Another theme that materialized throughout the data collection process was the beef producer's consumer-oriented nature. Despite being skeptical of the traceability of such a technology, ranchers often referred to consumers as a driving force that would be strong enough to result in an adoption of the mobile app—if that was what the consumers were demanding. This focus on the consumer seemed to be driven by a lack of trust between consumer and producer. Participants suggested that they were concerned animal rights activists would take the increased amount of data available through the mobile app and used the information to portray ranchers in a negative light. Mainstream media was also attributed to the lack of trust. Participants expect the consumer to take news information at face value without digging deep enough to truly understand the ranching process.

Conclusions and Implications

Research Question One

When asked to consider ways that using mobile phones to track and identify cattle would prove to be advantageous to the rancher, respondents revealed several elements of perceived usefulness. A particular response indicated that the application would perhaps

be profitable to the rancher over a long period because the enhanced monitoring features would eliminate the need for hired help to be constantly monitoring the cattle. Also, being able to use enhanced data to improve breeding stock was an incentive to implement the technology. Another appealing factor was the reduced amount of stress that the animals would experience, which shows that ranchers are concerned with the wellbeing of their herd. This attention toward wellbeing could stem from empathy or could be connected to the previously mentioned variable of profitability. Less stress on the cattle results in more profitable products. These examples of perceived usefulness are supported by the findings from Venkatesh and Davis (2000) who discussed the heavy influence of subjective norms through their contributions to the technology acceptance model. Job relevance and output quality were found to influence perceived usefulness (Venkatesh & Davis, 2000). The ability for ranchers to reduce stress and to increase profits through enhanced monitoring features are elements of output quality were similarly found to be significant influences for the perceived usefulness reported by the participants.

The resulting advantages and disadvantages to recordkeeping were mixed. Some participants were receptive to the idea of being able to input a great deal of data into their mobile devices. The quick access to this data was also a desired factor. However, some respondents thought that inputting the data into their phone would take more time than it would be worth. The ease-of-access was outweighed by the time consumption of creating that data. Organic producers are required to fill out special paperwork, and the participant who operates organically was very excited about being able to produce charted data for the organizations which require such a great deal of information. The tradition of keeping records in a red book seemed to hold some participants back. Their responses indicate that

red books are a perfectly viable way to keep records, thus leaving no need for a different method. This resistance to change due to tradition was a common occurrence throughout the study.

No instances of concerns related to being able to operate the mobile application arose throughout the interviewing process. Participants detailed many different ways that they used technology in their everyday lives. This notion suggests that ranchers are adopting technology at a rapid pace along with the rest of society. A high level of comfort using mobile devices parallels the previously mentioned statistics regarding agriculturists' adoption of mobile technology, such as the Fastline (2013) study, which found that farmers are increasingly using their devices while carrying out various farm-related tasks. However, all participants in this study reported using technology—whether it be computers, smartphones, tablets, etc.—to improve their work. This finding suggests that perhaps computer usage on farms and ranches is still rising, as statistics from a year ago mention that less than half of farms utilize computers in some aspect of their agricultural operations (U.S. Department of Agriculture, 2013).

Furthermore, the researcher imagined that ranchers might first need to adopt smartphones before they would be able to consider adopting this technology, but the fact that every single participant was already using a smartphone is noteworthy. As previously touched on, ranchers did not produce many examples of ways in which the technology could save time. In fact, participants implied that using the application would take too much time to provide any usefulness. Responses insinuating that the technology would require too much time were centered on the idea that a person would need to input data on the computer at the end of the day. Perhaps this notion is restricted by common

recordkeeping methods, like using Microsoft Excel spreadsheets. They did not entertain the idea that data could be input on the go in the pasture or while driving a tractor. A decision to not adopt the innovation based on a particular reason—the time it would take to use the technology—supports the non-adoption of innovations indication that people reject technology for specific reasons, not out of apathy or lack of interest.

One aspect unique to branding that could immediately put a halt to the adoption of this concept is the state branding regulations. Participants said that state laws require an animal to be branded with a physical brand. Circumventing this requirement would require a change in regulations along with a widespread adoption. The purpose of having a brand is so that brand inspectors can determine who is the owner of the animal at the sale barn. This issue could easily be avoided if brand inspectors also adopted the mobile application on their own devices. This obstacle is an infrastructural issue that supports the non-adoption of innovations notion that a rancher would not adopt this innovation due to factors out of his or her realm of control.

Participants saw the traceability of the mobile application as both an advantage and disadvantage, but the benefits were mentioned more frequently than the downfalls. The commonly mentioned drawback was the fear of misattributed liability. Ranchers feared that their production could be tainted by an outbreak of a disease that was not a result of their doing. They expressed concern that their reputation, which had been earned over many years of hard work, could be compromised by information that was falsely presented by media to consumers. Despite these reservations, most participants stated that they think beef traceability is a good thing for the ranching industry. The general agreement among

ranchers was that major issues should be rectified—even if that means tracing the beef

back to its original producer.

Overall, ranchers were able to express convincing arguments for and against the

adoption of the mobile technology. A level of difficulty exists with evaluating which one

outweighs the other because participants had to rely on their own ability to think of

potential applications for the proposed technology with little time to truly explore the idea.

Many participants conveyed strong resistance to the technology for various reasons, but

possibly this was because the respondents were able to more quickly develop coherent

arguments against the technology by comparing it to current practices that, in their minds,

are not in need of change. In the end, participants outlined specific advantages that the

concept would provide over their current practices, yet many conveyed that the advantages

would not be enough to encourage adoption unless it was simple enough to use that it

would not take much time and also if it would increase his or her profitability. The high

level of mobile device use indicates that ranchers are indeed advancing their

implementation of technological innovations. Familiarizing the ranching community with

GPS and mobile applications would not be a barrier.

Research Question Two

Many factors come into play with the adoption or non-adoption of the alternative

branding method. Several notable factors applied to individual technology use and

behavior. When asked to describe the type of rancher who would adopt a branding

technique with GPS chips and mobile applications, participants mentioned the younger

generation. The commonly held belief was that the younger generation grew up alongside

technology and would therefore be more apt to adopt such a technique. Evidencing this

thought process, several participants referred to their own fathers to stress the impact of age on technology adoption. They detailed instances in which their fathers relied on other individuals to use technology to gather information. An interesting finding from the study was mentioned by Karolina, who believes that the industry's receptivity toward implementing technology into the branding process will change in the next few years as the older generation becomes less involved in the industry. Something worthy of mention is that, although many of the respondents were of an age group that did not grow up alongside mobile devices and the Internet, each of them expressed interest in adopting the proposed technology. One participant has already experimented with electronic identification on her ranch.

The element of age, despite being a seemingly large obstacle in the minds of some participants, will become less of a barrier with time. A USDA (2007) study found the average age of a rancher to be approximately 57 years old. As time passes, technology adoption should continue to rise and the older generation will become less involved with the ranching industry. These implications suggest that using technology in branding will become more appealing to the ranching industry as each year passes and younger ranchers take on more responsibilities within the ranching community.

No matter how much interest the respondents showed in adopting the technology, a majority expressed reservation about implementing the technology without first being able to observe the product in action. This finding coincides with the theory of diffusion of innovations, which indicates that individuals are more willing to adopt a technology if they can first observe it from an outside perspective (Rogers, 1995).

Surveillance is a key element to the uses and gratifications theory, as it is often a driving factor in media consumption and is regarded by Severin and Tankard (1997) to be a driving force behind media consumption. The same proved to be true for the respondents, who indicated that one of the most alluring elements of the mobile application was the ability to track their cattle from a great distance. The other element that received great interest was the ability to monitor grazing patterns. This interest from participants illustrates that ranchers would be drawn to the mobile application for the information gathering purposes provided.

Another element of uses and gratifications theory that was examined was the general purpose that guided the participants' media consumption. Only one participant admitted that her media consumption was likely more heavily weighted on the side of entertainment rather than to seek out information. When the participants were asked about the types of mobile apps that they most commonly used, nearly every participant mentioned the weather app. Other commonly used apps were the maps and crop markets. This occupation-specific use illustrates that ranchers have a tendency to consume media in an instrumental manner. Thus, the informational aspects of the mobile app would appeal to a rancher more than an entertainment feature would. Vincent and Basic (1997) declared that people who have a higher level of need for information are more inclined to seek out news media. Could the same be true for ranchers? Would the instrumental nature of ranchers' media consumption habits motivate him or her to spend more time using the mobile app to monitor cattle?

After describing the proposed technology to the participants, the researcher asked them to offer their initial thoughts and opinions about the concept. One of the first things

mentioned by participants was cost. Many ranchers feared that the technology would be unaffordable. In relation to the earlier mention of profitability, ranchers clearly are very motivated by finance. If the technology was not affordable and did not offer a potential for profitability, the participants indicated that they would not consider making the switch. This finding is similar to a study by Yapa and Mayfield (1978), claiming that a farmer may wish to implement hybrid grain in order to producer higher yields but may not be able to do so due to the extra costs.

Participants often cited distrust in technology that is apparent in many variations. First of all, participants mentioned a familiarity with using GPS but had experienced flaws with the system. These personal experiences have created skepticism from ranchers about the reliance of the technology that provides the foundation for the proposed method of branding. Many ranchers also reside in areas that have limited cell phone service. A pasture without sufficient service capabilities would not allow the tracking devices to connect with the user's mobile phone, thus rendering the concept inefficient. These results are also supported by Yapa and Mayfield's (1978) assertion that individuals may desire to adopt a technology but would not be able to because of various factors. In this case, the limited service would stagnate the adoption of the innovation no matter how strong the desire to implement the technology. This data also supports the idea that the Digital Divide poses a threat to the adoption of innovations in rural areas due to infrastructural incompatibility (Khalil Moghaddam & Khatoon-Abadi, 2013). The data did not produce any inclination that a financial Digital Divide exists, considering respondents reported having multiple devices. Yet, the devices serve to be obsolete if a sufficient mobile network infrastructure does not exist in all areas of the ranch.

Another often cited factor that created skepticism among the participants was the issue of privacy, which is supported by an article discussing the high level of concern for many Americans regarding the potential for their personal information to be accessed by unauthorized individuals (National Public Radio Online, n.d.). Ranchers are not the only demographic who are concerned about their data being accessed by a third party. According to two participants, it is considered impolite by common culture to ask a rancher how many cattle he or she has. By this same notion, ranchers are hesitant to adopt a technology that would potentially allow individuals to see how many cattle they own and where they were located. No mention of allowing third-party organizations to access their information was included in the overview of the proposed technology, so most of the participants developed cogent arguments against the security of the application on their own. The researcher questioned participants about the source of their skepticism, and none were able to pinpoint an exact reason that someone viewing their data would necessarily be a bad thing other than the fact that it was considered to be invasive.

This finding sheds light into the importance of tradition and a private lifestyle for the agricultural industry. Karolina summed up the issue very well by acknowledging that the average-aged rancher did not grow up living in the public eye through means of social media the same way that young people have experienced living in the spotlight. Her statement suggests that this mindset will likely change in the next few years as the younger generation becomes more involved in the ranching industry. Despite the fact that cattle can currently be stolen and taken off the grid, participants voiced their concern that chips would be hacked, allowing theft to occur.

Research Question Three

Upon examining the unique elements of ranching that necessitate a different approach to technology adoption, the researcher uncovered several emergent themes. The social norms of ranching have an incredibly strong influence over changes in the way a ranch operates. Participants spoke very highly of the branding experience. They often recalled positive memories that included food, family, and fun. The day does not end once the animals are branded with the company symbol. Friends and neighbors gather to enjoy each other's company. Since branding is often completed in one or two days, it is treated as an event to look forward to. The smell that is emitted from burned hides is something of which Jacquelyn is fond. The day was described as having a different atmosphere than most other days of ranching. Participants reported a sentimental attachment to the tradition that is involved with the agricultural lifestyle. Many of the participants grew up around agriculture and practice the same methods that their parents or grandparents used. The regard for family tradition could be strong enough to prevent ranchers from changing methods of branding no matter how many benefits the new method provided. A strong catalyst in the non-adoption of innovations is interest level (Yapa & Mayfield, 1978). Ranchers enjoy the traditional aspect of ranching so much that they would not be interested in changing branding methods if it meant that they would have to give up the elements of tradition and social gathering that come with the branding event.

Along with tradition, the ranchers also described much pride in their personal brand. The purpose of the brand is not only for identification but also as a means of identity. The ability to track one's cattle virtually would essentially eliminate the need for a physical brand, yet ranchers are not ready to part ways with that much tradition. The

participants stated that some of their brands had been passed down throughout their family from one generation to the next.

When asked about the influence that ranchers have on one another, participants expressed that word-of-mouth has a strong effect on their operations. This factor is closely related to observability. Participants have enjoyed being able to see how new equipment works for their neighbors before actually adopting the system on their own. But perhaps an even stronger interpersonal influence is the relationship that producers have with organizations not related to the agriculture industry. Karolina confidently stated that new ideas in ranching must come from other ranchers or likeminded individuals—not to them from an outside source. She said that the Colorado Department of Agriculture would not be able to successfully encourage ranchers to adopt this technology. However, they would be more inclined to adopt it if the information was spread throughout their own community as a choice, not a requirement. Again, ranchers value their privacy and independence.

The diffusion of innovations theory attributes special consideration to the communication channels through which an innovation travels, whether the exchange of information takes place through mass media or interpersonal exchanges (Rogers, 1995). The results of this study, however, suggest that ranchers would not elicit a positive reaction to the innovation if the idea was spread through the mass media. Other data suggest that ranchers do not trust the mass media and would likely feel that they were being taken advantage of or mislead if the information came from the media. This finding does, however, align well with Rogers' (1995) statement that people value interpersonal interactions from individuals with similar socioeconomic statuses. Ranchers would need to become the communication channel for the spread of the innovation to become successful.

Another aspect of the non-adoption of innovations that is relevant to the data is the relevancy of an innovation (Yapa & Mayfield, 1978). A key finding was brought to attention by Jacquelyn, who described a scenario in which this enhanced ability to monitor cattle locations would incentivize ranchers to spend less time physically observing their cattle. Though the ability for a rancher to observe his cattle's location from afar is one of the more enticing components to the participants, failing to check on the herd in person would allow other issues to remain unseen—like a lack of water, a sickness, or broken equipment, for example. Tracking cattle's movements from a great distance would not be relevant if the outcome resulted in poorer ranching practices, thus instigating a very appropriate reason for not adopting the innovation.

Altogether, the sentimental attachment to the branding process and the social event that is included is a unique aspect of ranching that would influence a rancher's intent to adopt. The particular branding regulations also provide a significant obstacle to the spread of the technology. The influence that ranchers have upon one another also influences the way that the spread of adoption would occur throughout the ranching community.

Summary of Conclusions

Upon careful examination of the data collected through in-depth interviews, several conclusions can be made regarding ranchers' readiness to abandon conventional branding techniques in favor of adopting a method of branding that uses GPS and mobile applications. A simple answer has manifested itself through the analysis of this data: ranchers are not yet ready to adopt a technological approach to branding. Many factors play into this conclusion, but the individual statements from the ranchers themselves is the

most compelling piece of data. Figure 5 is the model of adoption resulting from this study that certainly applies to adoption of GPS, mobile branding technology but may also be relevant for considering other innovations in the ranching community. An explanation of this model follows.

A. The initial stage of adoption is comprised of several basic categories that emerged from the data and are supported by the various theories and models used in this research study. For example, ranchers were uncertain if they truly felt a need to be able to track their cattle from a greater distance because they may overlook diseases and other conditions that need to be observed in-person. Infrastructural issues, such as device compatibility issues or technological limitations, also influence the perceived usefulness of the technology as do geographic constraints like limited cell phone coverage. The traditional aspect of ranching includes the affinity for the brand symbol, the emotional attachment to the social event tied to branding, and the fact that branding has been practiced the same way for many years and techniques have been passed down from generation to generation. Ranchers also expressed concern for their privacy and the potential for their data to be unjustly accessed by a third-party organization. Finally, the cost and potential to profit from using a new method of branding influenced the ranchers' perceived usefulness of the concept.

B. The above elements combine to create perceptions about the innovation's ease-of-use and usefulness. The overall perceived usefulness is a singular concept that is derived from many different stimuli—both positive and negative.

C. Ultimately, a rancher formulates an attitude toward the innovation based upon the perceived easy-of-use and usefulness. At this stage, the attitude is based upon many different factors and can be a mixture of positive and negative feelings.

D. The channel through which the innovation is communicated is one of the most compelling features of the spread of an adoption in a ranching community. Even with a very positive attitude toward an innovation, a rancher may not be willing to adopt the technology if the product was brought to the ranching community from an outside organization. Participants voiced concern over the possibility of other organizations attempting to take advantage of the ranching industry. An innovation is more likely to spread successfully throughout the ranching community if the channels are individuals of similar socioeconomic status.

E. A final barrier to actual system use is the ability for a rancher to try the technology or see it in use. The participants were not willing to completely abandon traditional branding techniques. Instead, they wished to try it on a limited basis while also physically branding the cattle until the device could be proven to work. A positive attitude toward the innovation could ultimately be thwarted by the inability to experience the innovation firsthand.

F. Each of the above elements contributes to the ranchers' eventual system use. To successfully spread the adoption of an innovation through a ranching community, the innovation must flow through a series of specific variables while maintaining ranchers' trust, interest, and desire.

Ranching Industry Model of Technology Adoption

A.

| Felt Need | Infrastructure | Geographic Constraints | Access To Information | Tradition | Security of Data | Cost / Benefit |

B.

Perceived Ease-of-Use → Perceived Usefulness

C.

Attitude Toward Innovation

D.

Communication Channel

Industry | Interpersonal Exchange

E.

Trialability/Observability

F.

Actual System Use

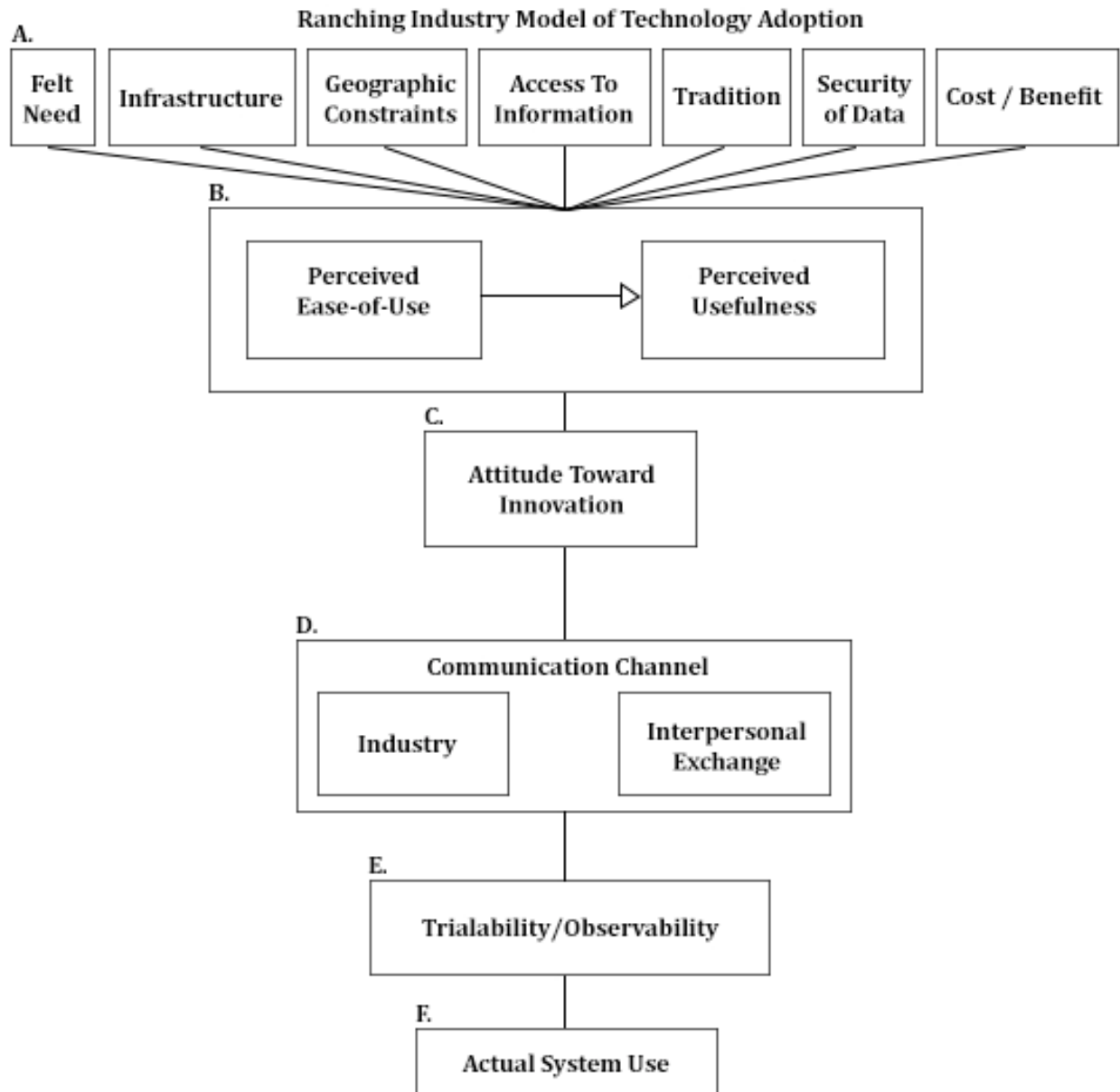*Figure 5. Model for Introducing Innovations to the Ranching Community.*

At the end of the in-depth interviews, the researcher asked the participants what they would consider to be their level of readiness to adopt the mobile app concept. A similar theme emerged. Ranchers would simply not be willing to abandon conventional branding techniques—for a variety of reasons. Nelson would only make the switch if he

was forced to do so. None of the ranchers expressed that they were currently ready to adopt the technology. Some interest was expressed, however, by participants stating that they would be willing to test the innovation as long as they could keep branding. For Mitchell, he would only want to keep branding with a hot iron until the technology is proven to be effective. For Jacquelyn, too much of her ranch's marketing relies on their brand symbol to simply do away with that visual representation. Dallace would not consider replacing conventional branding simply due to the laws currently in effect in the state of Colorado.

Though the reasons that ranchers are not ready to adopt the technology vary, several emerged prominently. These reasons support the non-adoption of innovations theory, as ranchers were very direct about their concerns toward adopting the mobile application. Apathy was certainly not a factor. Privacy was a major concern, and the researcher finds it curious that ranchers possess smartphones and are active users themselves but expressed a hesitancy to allow someone to access information about their animals. Why does the same concern for privacy not compel ranchers to avoid using technology for their own personal information? When asked about the point when participants made the decision to begin using technology in their lives, they could not remember a certain breaking point. The adoption process was gradual and not significant. Therefore, time may have the same influence on the adoption of technology in the ranching industry.

Tradition also became a popular topic among participants. Most have strong sentimental attachments to the lifestyle that they have experienced for many years. Would changing branding methods somehow feel like a disservice to their family history? The

social aspect of branding is too enjoyable for ranchers to dismiss. The simplicity of inserting a grain-sized chip would eliminate the need for such a grandiose gathering of friends and family. However, participants discussed the idea that cattle still need to be brought in each year to administer vaccinations, so the social event could be preserved at this time. The pride with which ranchers carry their brand is another testament to the traditional element that would be difficult for ranchers to leave behind.

Finally, despite an intriguing adoption of new communication technologies, such as mobile devices, tablets, and social media, ranchers do not fully trust technology to function properly at all times and also do not find it to be secure. The perceived limitations of technology held the participants back from being able to see technology as a viable alternative to conventional branding. The influence of observability could easily overpower any uncertainties about the reliability of technological devices.

Perhaps the most significant finding that arose from the data is that ranchers' reasons for non-adoption contradict the findings of previous researchers. Tradition and conservativism were not attributed to non-adoption, according to Yapa and Mayfield (1978). However, the ranchers included in this study demonstrated that each of these heavily influences their interest in adopting technology into the branding process. Traditional aspects, such as the social activities and the passing down of a brand from one generation to the next, emerged as significant reasons that ranchers would not adopt the innovation. Ranchers' conservativeness also became apparent in the discussion about privacy and the ability for data to be accessed and manipulated by a third party. Participants described themselves as private and noted that keeping their data secure was of great importance. Moreover, the results did not support Stewart's (2002) notion that

individuals are resistant to technological changes because they aren't skilled and lack confidence in using the technology. Participants expressed a high level of comfort in using technology, which is emphasized by the fact that each participant was an active smartphone user and was already familiar with using mobile apps. The fact that ranchers are highly comfortable using the technology that would be required to implement the proposed innovation yet still were hesitant to adopt the concept is particularly fascinating.

In conclusion, the features of the diffusion of innovations theory, technology acceptance model, and non-adoption of innovations that influence a person's acceptance of a new media can be used to support the finding that ranchers are not ready to adopt a technological approach to branding. The features of diffusion of innovations include relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995). Ranchers did not express a significant perception of an advantage to using technology to track cattle in place of conventional methods. Instead, the participants stressed the importance of the physical brand in order to prove ownership and deter theft. Issues of compatibility also were brought to attention, as the participants were not convinced that the technology would work well in their respective areas due to issues of cell phone service, the need to update devices frequently, and the obstacle of dealing with current brand inspection laws. In addition, the technology could incentivize ranchers to less frequently check their herd in-person for stress, diseases, and other problems that need to be assessed by actually looking at the cattle, and this was seen as a barrier to complete adoption of the mobile app. The ranchers did seem to understand the innovation and nearly every participant mentioned electronic identification as something they had already

heard was trickling into the industry. A need to test the technology on a trial basis or to observe it from afar was also important to the participants.

Recommendations

The findings of this study could aid future practitioners who aim to introduce an innovation to the ranching community. The emotional connection to the brand symbol must be preserved in order for ranchers to be willing to change their current branding techniques. The history and pride that is represented by brands is something that some ranchers will likely not be willing to ever compromise, so a semblance of that pride ought to be somehow preserved in order to continue the years of tradition that are engrained in the lifestyle.

Overcoming the distrust in technology and its security could become a difficult task, though certain methods can be implemented to appease this tension. Allowing ranchers to observe the technology from afar will allow them to gradually become familiar enough with the technology in order to obtain a sense of trust for the innovation. The lack of trust that ranchers have in technology must be overcome organically. As several participants brought to attention, the older generation will soon become less involved with the industry, and the next generation, which is more trustworthy of technology, will begin to take control and ought to be more receptive to implementing technology into the branding process.

Rogers (1995) brought to attention the importance of interpersonal interactions for the diffusion of an innovation to occur, and this was found to be true upon analyzing the data. Karolina declared that ranchers would be more apt to accept an innovation if it came from within the agricultural community instead of to them. By allowing certain ranchers to

test the technology, word-of-mouth will be one of the most influential marketing tactics to spread the innovation from one rancher to the next. A particular statement from Karolina struck a chord with the researcher as a very valuable item to remember when attempting to introduce a new technology to the ranching industry. She said, "Give us a choice, we'll do whatever you want. Give us a demand, we'll do nothing."

Future Research

This research study was conducted with the hope of obtaining better insight into the readiness level of ranchers to adopt a branding-oriented innovation. An analysis of the data concluded that ranchers are not yet ready to adopt such a technology. However, the fact that this particular study is exploratory in nature leaves much room for future research.

More research in the area of agriculturists' distrust of technology could yield valuable information for individuals who are attempting to introduce technology into the agricultural industry. This data would be beneficial for knowing how to acknowledge the areas of distrust and appease that lack of trust through careful consideration.

The ranchers included in this study seemed to be very comfortable using technology in their own lives but were hesitant to introduce technology into their ranching practices. They expressed concern about the privacy tied to data about their herds, but did not seem to be wary of privacy implications surrounding their own technology use. Further research could clarify this ambiguity.

Another area of intrigue is the sentimental connection that ranchers have for tradition and their personal brands. The participants in this study expressed great affinity toward the lifestyle as a whole. Something as simple as the smell associated with branding was mentioned as a motivating factor of preserving that tradition. Research in the area of

this sentimentality could prove to be very helpful for future practitioners who are attempting to facilitate any form of change in the ranching industry.

The technology acceptance model illustrates that perceived usefulness and perceived ease-of-use are the main indicators of one's attitude toward using a technology and the behavioral intention to use that technology (Davis, 1989). The participants in this study expressed many potentially useful applications of the proposed innovation, and the comfort level of the participants that were interviewed implies a high level of perceived ease-of-use. Yet the participants did not express an overall positive attitude toward using the technology or a behavioral intention to use the technology. Further research could provide better understanding to this unexpected finding. In addition, a revised model of non-adoption that is tailored to the agricultural industry could be constructed in order to illustrate the emergent themes that influence agriculturists' motivations to not adopt an innovation.

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APPENDIX A

IRB APPROVAL LETTER

Colorado State University

Jarell Barker

,

_____

Research involving the use of educational tests,….

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TELEPHONE CONTACT

In conversational style, ...

Hello, my name is Chase Baker and I am a researcher from Colorado State University in the Journalism and Technical Communication department. We are conducting a research study on ranching and technology. The title of our project is Exploring Ranchers' Current Agricultural Practices and Perceptions Toward Technology. The Principal Investigator is Dr. Katie Abrams from the Journalism and Technical Communication department. I am the Co-Principal Investigator, and I am a graduate student in the same department.

We would like you to participate in an interview that will take approximately 90 minutes. Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

We will be collecting your name but will keep your personal information confidential. When we report and share the data with others, we will combine the data from all participants. There are no known risks or direct benefits to you, but we hope to gain more knowledge on current perceptions toward technology in the ranching industry.

Would you like to participate?

If yes: Proceed.
If no: Thank you for your time.

Offer to give the participant your contact information and the Participant's Rights contact information (If you have questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator, 970-491-1655). This could be verbally or in the form of a study summary sheet/cover letter or contact card.

APPENDIX C

MAIL RECRUITMENT LETTER

Dear Participant,

Hello, my name is Chase Baker and I am a researcher from Colorado State University in the Journalism and Technical Communication department. We are conducting a research study on ranching and technology. The title of our project is **Exploring Ranchers' Current Agricultural Practices and Perceptions Toward Technology.** The Principal Investigator is Dr. Katie Abrams from the Journalism and Technical Communication department. I am the Co-Principal Investigator, and I am a graduate student in the same department.

We would like you to participate in an interview that will take approximately 90 minutes. Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

We will be collecting your name but will keep your personal information confidential. When we report and share the data with others, we will combine the data from all participants. There are no known risks or direct benefits to you, but we hope to gain more knowledge on current perceptions toward technology in the ranching industry.

If you have any questions about the research, please contact Chase Baker at bakerachase@gmail.com or 970-554-1655. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator, at 970-491-1655.

Dr. Katie Abrams   Chase Baker,

Professor, CSU   Graduate Student

APPENDIX D

EMAIL RECRUITMENT LETTER

Dear Participant,

Hello, my name is Chase Baker and I am a researcher from Colorado State University in the Journalism and Technical Communication department. We are conducting a research study on ranching and technology. The title of our project is **Exploring Ranchers' Current Agricultural Practices and Perceptions Toward Technology.** The Principal Investigator is Dr. Katie Abrams from the Journalism and Technical Communication department. I am the Co-Principal Investigator, and I am a graduate student in the same department.

We would like you to participate in an interview that will take approximately 90 minutes. Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

We will be collecting your name but will keep your personal information confidential. When we report and share the data with others, we will combine the data from all participants. There are no known risks or direct benefits to you, but we hope to gain more knowledge on current perceptions toward technology in the ranching industry.

Would you like to participate?

If you have any questions about the research, please contact Chase Baker at bakerachase@gmail.com or 970-554-1655. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator, at 970-491-1655.

Dr. Katie Abrams,   Chase Baker,

Professor, CSU   Graduate Student

INFORMED CONSENT

Consent to Participate in a Research Study
Colorado State University

TITLE OF STUDY: Exploring Ranchers' Current Agricultural Practices and Perceptions Toward Technology.

PRINCIPAL INVESTIGATOR: Dr. Katie Abrams, Public Communication and Technology, Journalism and Technical Communication, (970) 491-5315 or katie.abrams@colostate.edu

CO-PRINCIPAL INVESTIGATOR: Chase Baker, Public Communication and Technology, Journalism and Technical Communication, bakerachase@gmail.com or 970-554-1655.

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH?
I am currently working on my master's thesis at Colorado State University. You were selected as a potential participant in this study because you operate a ranch and are interested in using technology on your ranch. I am interested in learning more about your current ranching practices (more specifically, branding techniques) as well as the way you utilize technology in your everyday life.

WHO IS DOING THE STUDY? Chase Baker – graduate student at Colorado State University. Advisor Dr. Katie Abrams, professor at Colorado State University.

WHAT IS THE PURPOSE OF THIS STUDY?
The purpose of this study is to gather insight into how ranchers view technology. You will be asked questions regarding your current agricultural operations, the technology you use and why. The questions will relate to your outlook on technology and will also focus around your branding identification practices.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?

The study will take place at a location mutually determined by the researcher and you, and the study will involve an interview lasting approximately 90 minutes up to 120 minutes.

WHAT WILL I BE ASKED TO DO?

You will partake in an interview where you will be asked questions regarding your current agricultural operations. Because we want to capture your complete statements, the discussion will be audio-recorded. A pseudonym will be assigned to your answers in the analysis of data.

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY?

Ranchers who manage less than 30 or more than 1,000 head of cattle should not participate in this study. In addition, ranchers who do not grass feed their cattle should also not take part in this study.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

There are no known risks associated with this study, but we hope to achieve a better understanding of the way agriculturists view technology so that we can better communicate with the agricultural industry.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY?

There is no direct benefit to you for participation.

DO I HAVE TO TAKE PART IN THE STUDY?

Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

WHO WILL SEE THE INFORMATION THAT I GIVE?

We will keep private all research records that identify you, to the extent allowed by law. For this study, we will assign a code to your data (for example, a pseudonym such as "Bob") for the purpose of displaying the data. However, your name will not be linked to the specific

data, as the sole purpose of using a pseudonym is for the sake of clarity within the analysis portion of my final report. The only exceptions to this are if we are asked to share the research files for audit purposes with the CSU Institutional Review Board ethics committee, if necessary. When we write about the study to share with other researchers, we will write about the combined information we have gathered. You will not be identified in these written materials.

WHAT IF I HAVE QUESTIONS?

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the investigator, **Chase Baker** at **970-554-1655 or bakerachase@gmail.com**. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you.

WHAT ELSE DO I NEED TO KNOW?

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing ____ pages.

_____   _____

Signature of person agreeing to take part in the study   Date

_____

Printed name of person agreeing to take part in the study

_____   _____

Name of person providing information to participant   Date

_____

Signature of Research Staff

INTERVIEW GUIDE

1. Can you tell me what a typical day might look like on your ranch?

    a. What types of struggles do you face on a daily basis with raising cattle?
    b. What do you enjoy about this work?

2. Walk me through the typical process of branding cattle on your ranch.

    a. What made you choose to use that specific branding method?
    b. Tell me some of the obstacles that you face throughout the branding process.
    c. What is your favorite aspect of the branding process or what's working really well?
    d. Can you think of any ways that might help you save time with branding or make the process easier?

3. What type of requirements come along with branding that is different from your average day of ranching?

    a. Beyond the traditional aspect, what does branding or the brand mean?
    b. Are there any social traditions that are tied to your branding process?

4. What types of technology do you use for managing your farm (or herd management)?

    a. Why do you use (insert tech here)?
    b. Can you tell me how you decided to use that technology?
        i. What were you using before? What advantage did this one provide?

5. Have you seen or given any thought to using technology in the branding process?

    a. Can you explain why/why not?
    b. What technology have you seen?

Explain the Mobile Application Concept

(SCRIPT): The initial stage of adopting the digital cattle branding system will require the possession of a smartphone or tablet device such as an Apple iPad or Microsoft Surface. A mobile application will then need to be downloaded and installed onto the device, followed by the construction of an online profile for the rancher. The profile could include a digital replica of his or her conventional brand symbol so as to preserve a semblance of tradition.

The rancher will have the option of including additional relevant information such as the name and location of the particular ranch. In contrast to the traditional method of branding cattle with hot irons or freeze brands, the animal is to be injected subcutaneously with a tiny, grain-sized GPS chip that is later synchronized with the mobile application. Following the synchronization process, information that is tailored to each specific calf can be updated through the mobile application. Such information might consist of veterinary records, the age of the calf, a history of illnesses, or other relevant information. Once created and saved, the calf's profile will be accessible at any time through the mobile application, and the location of the animal can be traced and monitored. Subsequent to the completion of a data entry for each heifer or bull, the entire herd is traceable through use of the mobile device. Personalized icons on the screen represent each animal, thus allowing a rancher to easily detect an icon on the screen that does not resemble his or her herd, catalyzing a social experience amongst ranchers with an enhanced communicative element. This communication takes place through an instant messaging function within the mobile application that is to be operated by neighboring ranchers. The enhanced communicative element among ranchers is a key component to the proposed mobile application, as it creates a digital environment that is not currently available—one that could improve the monitoring of cattle through increased discourse.

6. What are your initial thoughts about the proposed new way of branding cattle?

    a. How does this type of technology fit into your current practices?
    b. What type of rancher would you say would be the type to use this method instead of the traditional ways of branding cattle?

7. Can you walk me through some potential problems that you see with using GPS chips and mobile phones to track cattle?

    a. Tell me how you might see this as being a bad thing for the ranching industry.

8. Potentially this technology could lead to beef being traced back to the original producer. Do you see this as being a good or bad thing and why?

    a. Is it better for ranchers to retain privacy or for consumers to have access to healthy beef? Can you explain that more?

9. What ways could you improve your ranching techniques by using this new method?

    a. Tell me a bit about how you could see this technology doing good things for the ranching industry.

10. What are the most important aspects of branding to you that would need to be kept the

same even with this change of technique?

    a. What are some of the traditions that you practice on your ranch that make you hesitant to change?
    b. Have long have you been practicing the current method of branding that you use?

11. As of this moment, what would you consider to be your readiness level to do away with conventional branding methods and adopt this new way of branding cattle?

    a. What might be some reasons that would convince you to change?
    b. What would the reasons be that would make you want to stick to the way you are currently doing things on your ranch?

12. As we've talked today, have any other ideas or stories relating to cattle branding or the technology come to mind that I did not ask you about?

13. Thinking about our discussion as a whole, is there anything you'd like to reiterate or emphasize?