Understanding Technology Acceptance: Phase 2 – Identifying and Validating the Metrics & Preliminary Testing of a Quantitative Model

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Overview of Report

Summary of Phase 1

In Phase I of the Technology Acceptance Project we conducted a detailed review of multiple literatures including (1) diffusion research; (2) adoption research; (3) uses and gratifications research; and (4) domestications research. Based on the empirical literature we developed a qualitative model to identify psychological factors that may potentially influence (positively or negatively) acceptance of technology. These factors, once identified within a psychological framework, were intended to serve as the basis for developing a predictive model of technology acceptance and subsequent empirical testing to be conducted in Phases II and III. Phase I yielded a logical flow model that identifies the key variables most relevant to technology acceptance and rejection. The details of the model are presented in:

> Van Ittersum, K., Rogers, W. A., Capar, M., Caine, K. E., O'Brien, M. A., Parsons, L. J., & Fisk, A. D. (2006). *Understanding technology acceptance: Phase 1 – literature review and qualitative model development* (HFA-TR-0602). Atlanta, GA: Georgia Institute of Technology, School of Psychology, Human Factors and Aging Laboratory.

Research Objectives of Phase II

The general research objectives of Phase II were four-fold: (1) develop a battery of reliable and valid metrics to assess technology acceptance, (2) test these metrics in the context of Deere-relevant products; (3) use these preliminary data to test components of the qualitative model; and (4) assess an initial quantitative model for Deere & Company products from different categories that have been more or less successfully deployed in the marketplace. These objectives are being accomplished in three broad activities.

- Activity 1 - Development of an easily searchable battery of reliable and valid metrics of all aspects of our technology acceptance model (objective 1)

- Activity 2 - Selection of the most relevant metrics for Deere-relevant products and pre-testing of these metrics in the context of a novel technology product (objectives 2 & 3)
- Activity 3 - Testing aspects of the technology acceptance model for specific Deere products (objective 4).

Overview of Research Activities

***Research Activity** 1*

The process of developing and testing the model viewer application is detailed in Chapter 2 of this report. The goal was to provide an easily accessible tool that could be used by anyone at Deere & Company. For each aspect of the technology acceptance model we identified reliable and valid metrics of the variable and provide the details in a searchable program. This application will enable users to measure any aspect of the overall model, using the metrics that have been developed and tested in the research literature. We are currently finalizing testing of the application and will make the tool available to Deere & Company following the January 19th, 2007 meeting (to enable us to make any requested changes that arise at that meeting).

Research Activity 2

The overall technology acceptance model contained an overabundance of potentially relevant metrics. Our goal was to reduce the number of variables needed to predict technology acceptance for Deere-relevant products. To that end, we conducted an assessment to determine which scales were the most important predictors. We tested the variable-acceptance relationship for 206 student respondents in a detailed questionnaire regarding a hypothetical product: a cell phone that used Global Positioning Systems. Chapter 3 provides the details of the scale-

reduction procedure and data collection method. In Chapter 4, we provide the analyses for the pre-test of the qualitative model that was developed based on the review of the literature.

Research Activity 3

Based on the results of Research Activity 2 we developed a plan to test the reduced technology acceptance model for specific Deere products. The originally proposed goal was to select two products that had not met sales projections and two other products that had met or exceeded sales projections. Based on numerous discussions with Deere personnel we decided to select one product from each category and to increase the number of survey respondents for each product. The Hybrid Riding Mower was selected for the first product category and the Autotrac Universal Kit was selected for the second product category.

In this report, we provide only the methodology for these questionnaires along with the questionnaires themselves (Chapter 5). Data collection for the Hybrid Riding Mower Questionnaire is complete – we have a total sample of 212. Our original goal had been 100 responses per product for four products. With the decision to focus on two products the revised goal was 200 respondents per product and we have achieved that goal. The data are currently entered into spreadsheets and prepared for final analyses. The results of the analyses will be presented at the January 19th, 2007 meeting.

The Auto Guidance Questionnaire is completely prepared and has been approved by the Institutional Review Board. It is scheduled for mailing January 3. Deere personnel encouraged us to wait until January to mail the survey as this would be a less busy time for the farmers we are targeting.

Next Steps

This report details the research activities of the Phase II project, wherein the objective was to conduct quantitative assessments to test the validity and completeness of the qualitative model, to develop a predictive model of technology acceptance. We have a meeting scheduled for January 19th, 2007 at which we will present the results from the Hybrid Mower Questionnaire (data collection for the Auto Guidance Questionnaire will be nearing completion at that point). Based on the findings and the discussions with the Deere personnel in attendance at the meeting we will select the product to be used in Phase III of the Technology Acceptance Project. We will also describe the general plans for empirically testing communication strategies that may influence technology acceptance.

Chapter 1 – Understanding Technology Acceptance

Background and Overview

Given that the success rate of new product and technology development (from initial ideas to launch) is relatively low, it is important that those products and technologies that do make it to launch will be accepted in the market place. Research to increase the understanding of customer acceptance of new products and technologies is widespread and scattered. Researchers from psychology, sociology, information technology, organizational behavior, economics and marketing all have examined the determinants of new product and technology acceptance with mixed success. The mixed success, in our opinion, is due to a **lack of integration of data and there being no theory supporting a predictive model of acceptance of technology**. The objective of this research project is to develop a predictive model to help improve the quality of the decision-making process and reduce the uncertainty when considering new technologies for product development programs. An overview of our research team is presented in Appendix A. We have proposed a three-phase approach.

In Phase I we conducted a detailed review of multiple literatures including (1) diffusion research; (2) adoption research; (3) uses and gratifications research; and (4) domestications research. Based on the empirical literature we developed a qualitative model to identify psychological factors that may potentially influence (positively or negatively) acceptance of technology. These factors, once identified within a psychological framework, can then be the basis for developing a predictive model of technology acceptance and subsequent empirical testing. Phase I yielded a logical flow model identifying the key variables most relevant to technology acceptance and rejection.

The focus of the present report is Phase II wherein the objective was to develop an operational definition (i.e., a measurable determination) for each of the variables identified in the qualitative model. We identified available metrics that have been validated in the research literature. For each metric we determined if it is appropriate for our model development and if it is relevant to Deere products. This process required revision of the metrics to suit the specific requirements of Deere products. The outcome of this aspect of Phase II is a battery of metrics available to Deere for testing critical variables relevant to their products.

The second major aspect of Phase II was a pretest of a quantitative model. We used the metrics we refined to assess whether the model is comprehensive. We developed a questionnaire tool that was tested first with subject matter experts and then administered to customers. We assessed technology acceptance retrospectively – that is, we queried both adopters and non-adopters about their decisions related to products that have already been deployed. This preliminary questionnaire enabled us to test the reliability and the validity of the metrics we have developed as well as to identify gaps in the quantitative model.

We assessed the validity of our initial quantitative model for two products from two technology categories: Hybrid Technology and Intelligent Mobile Equipment. We selected one product that has been very successful (i.e., widely adopted) and another that has been less successful in terms of its rate of adoption. We worked closely with the Deere & Company members of the team to identify the most suitable products and to develop a sampling frame of customers to receive the surveys.

Specific Goals and Objectives of Phase II

The objectives of Phase II of this project were to (1) develop a battery of reliable and valid metrics to assess technology acceptance, (2) test these metrics in the context of Deere-

relevant products; (3) use these preliminary data to test components of the qualitative model; and (4) assess an initial quantitative model for Deere & Company products from different categories that have been more or less successfully deployed in the marketplace.

Approach

Our approach to achieving our objectives consisted of multiple stages. First, we went back to the literature and identified all scales used in published research, and developed a scale-bank allowing for easy identification and retrieval of the most critical scales identified in Phase I. **Chapter 2** provides a detailed description of this process and the resultant tool. Next, we conducted an empirical study in which we tested the statistical properties of the scale to measure the most critical variables identified in Phase I. The statistical insights obtained were used to develop shorter, more manageable versions of the scales tested (e.g., instead of measuring the perceived ease of use with 10 questions, we can now measure it with 3 questions). In addition, preliminary insights into the predictive validity of our qualitative model were obtained. **Chapter 3** provides more details about this study and the scale development. **Chapter 4** provides the results of the pre-test of the quantitative model.

Based on discussions with Deere personnel the decision was made to focus on the use of these identified variables to predict technology acceptance for two Deere products: one that had not met sales projections, despite being well-received by those who did adopt it, and another that had met or exceeded sales projections. The product selected for the first category was the Hybrid Mower. **Chapter 5** presents an overview of the survey development process and the details of the survey itself. Data collection for the Hybrid Mower Questionnaire is complete – we have a total sample of 212. Our original goal had been 100 responses per product for four products. With the decision to focus on two products the revised goal was 200 respondents per

product and we have achieved that goal. The data are currently entered into spreadsheets and prepared for final analyses. The results of the analyses will be presented at the January 19th, 2007 meeting.

The product selected for the category of meeting/exceeding sales expectations was the Autotrac Universal Kit. We developed a companion survey for this product that will enable us to make direct comparisons between the variables that predict adoption and those that predict non-adoption. The details of this survey are also presented in **Chapter 5.** The Auto Guidance Questionnaire is completely prepared and has been approved by the Institutional Review Board. It is scheduled for mailing January 3. Deere personnel encouraged us to wait until January to mail the survey as this would be a less busy time for the farmers we are targeting.

This report details the research activities of the Phase II project, wherein the objective was to conduct quantitative assessments to test the validity and completeness of the qualitative model, to develop a predictive model of technology acceptance. We have a meeting scheduled for January 19th, 2007 in Atlanta at which we will present the results from the Hybrid Mower Questionnaire (data collection for the Auto Guidance Questionnaire will be nearing completion at that point). Based on the findings and discussions with the Deere personnel in attendance at the meeting we will select the product to be used in Phase III of the Technology Acceptance Project (see **Chapter 6**). We will also describe the general plans for empirically testing communication strategies that may influence technology acceptance.

Chapter 2 – Development of Model Viewer Application

Overview

The technology acceptance model viewer is designed to present a useful and usable tool that provides access to empirically verified scales that measure each variable that influences technology acceptance (see Figure 2.1). For each variable in the model, we have identified a verified scale to measure that variable. For each scale we provide reliability information and a description of the construct being measured. We then provide a link to the actual scale for use in a PDF form, along with the response options that were used. All information is provided with reference to the original source.

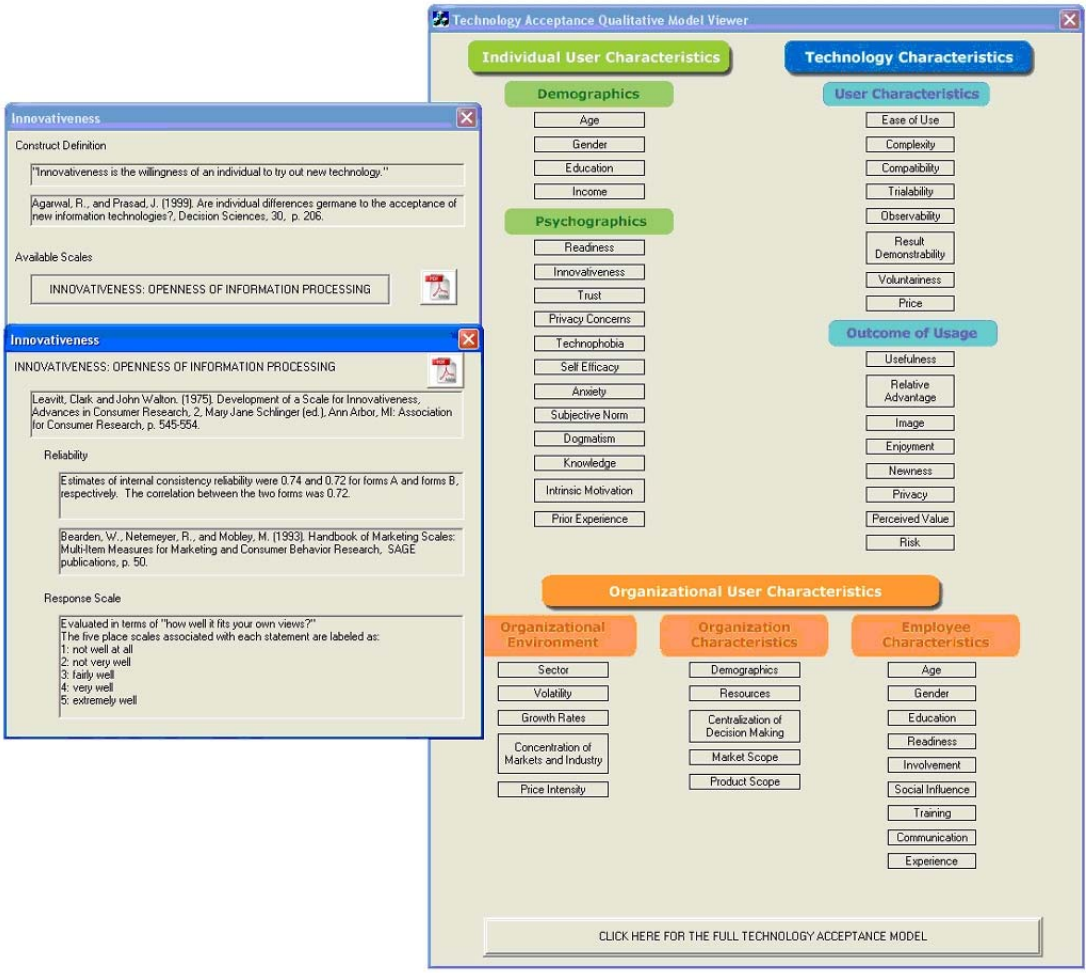


Figure 2-1. Technology Acceptance Model Viewer

To develop a robust application, we focused on two attributes: functionality, that is what the application can do, and usability, that is how users work with the application. We engineered usability into the application through an iterative design process, allowing usability to drive important design decisions. Formal usability testing was conducted, supplemented heuristic evaluation which is another established effective evaluation method. We adopted the product development life cycle provided by Rubin (1994) but modified the stages based on our needs. This process comprised 5 steps, as illustrated in Figure 2.2. The following sections describe each step in detail.

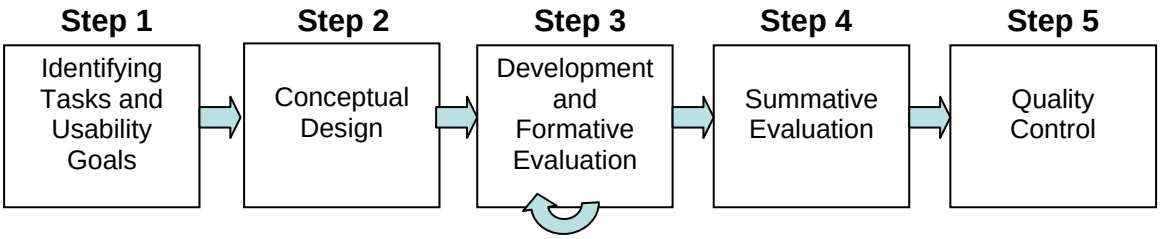


Figure 2.2. A summary of the development process

Step 1 – Identifying Tasks and Usability Goals

The purpose of the system is to provide users with easy access to scales that measure variables related to technology acceptance. There the primary user task is to acquire scales for use. This led to a clear usability goal to require minimal steps to access the scales. The secondary task is to access other information related to scales such as construct definition, reliability, and response scale. This implies that such information ought to be clearly visible and easily accessible to the users yet should not overwhelm them. We also identified other possible tasks at this stage:

- Conduct survey or make comparison between different scales in terms of reliability,

response scale, and the actual scale items

- Acquire the big picture of the technology acceptance model. Understand which variable belongs to which characteristic that influence technology acceptance (e.g., self efficacy and dogmatism are individual user characteristics)
- Access and view the full technology acceptance model to learn more about the relationships among variables (i.e., does a variable positively or negatively influence technology acceptance?)

Step 2 – Conceptual Design

Conceptual design includes high level and preliminary design of objects or elements that ought to be realized in the actual implementation. This process was executed in conjunction with identifying the mental model of users. For example, we decided to organize the layout similar to the full qualitative model so that users would be easily able to become familiar with the interface if they had previous experience viewing the model. However, those who did not have experience with the model were accommodated as well by making sure that the model characteristics were distinctly grouped and clearly visible.

Tasks identified in Step 1 directly influenced this conceptual design process. For example, we decided to provide one movable window per scale because we wanted to allow users to be able to arrange two or more windows side by side and compare the kinds of information they are interested in.

Step 3 – Development and Formative Evaluation

We used Microsoft's Visual C++ 6.0 to implement the preliminary design. Object oriented programming and built-in visual interface design tools were used to gain the flexibility necessary to conduct the interactive design process. Our first mock-up design (see Figure 2.3)

was followed by a usability testing with three participants and a heuristic evaluation conducted independently by two human factors experts.

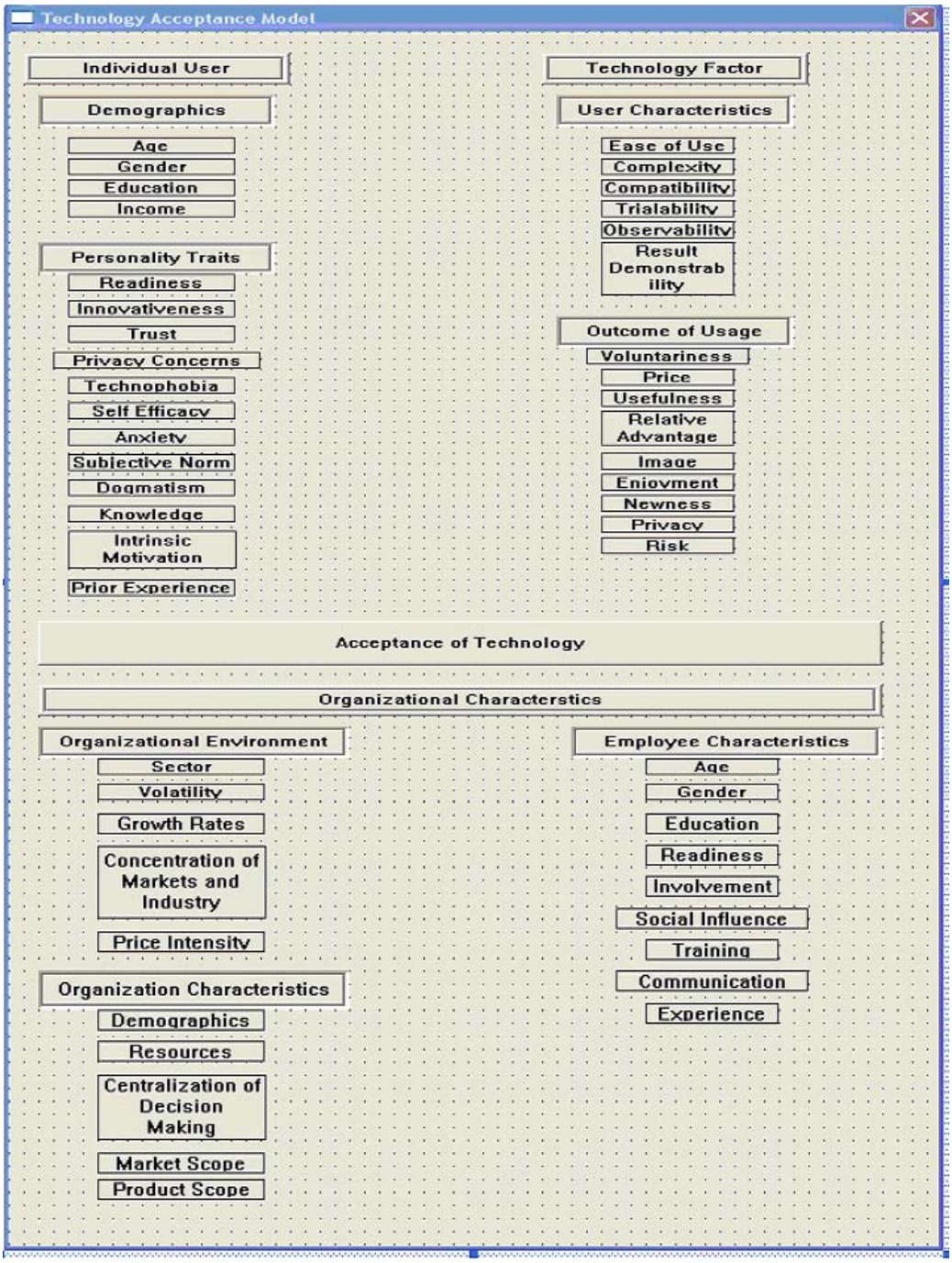


Figure 2.3. First version of the design

These evaluations led to a major revamping of the interface as seen in Figure 2.4. Another series of usability testing with two participants led to the near final design that was presented above in Figure 2.1.

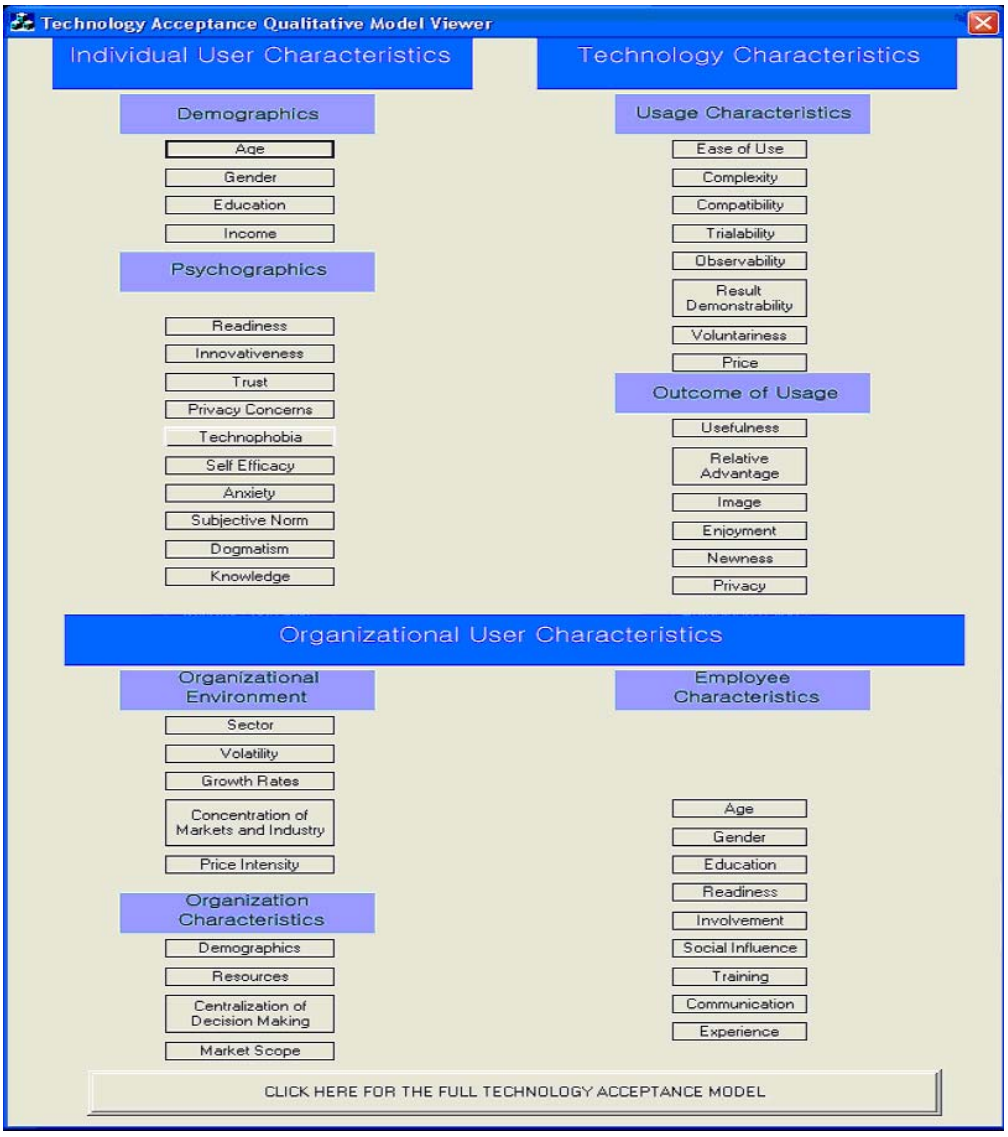


Figure 2.4. Second version of the design

Usability Testing

Tasks presented to test users were similar to the tasks identified in Step 1. The tasks ranged from relatively simple to rather complex:

- Acquire the scale named "openness to information processing" that measures innovativeness
- Acquire the full qualitative technology model
- Make a comparison between the two different scales that measure dogmatism
- Assuming you would like to do a study about how anxiety affects technology acceptance, which scale most appropriately accommodates your needs and why?

We adopted the think aloud protocol, asking participants to speak out aloud their thought process. The major issues that were identified during the evaluation are described next.

Failure to acquire scales easily. Two of the three participants tested with the first design showed confusion and frustration when asked to acquire the scale in a PDF form. Participant #2 did not recognize that the clip icon was actually the PDF file. Participant #3 commented why it should take three windows down to acquire the scale when it was supposed to be presented up front. She also confused the button that actually led to information about the scale with the PDF file. We addressed this issue by switching the clip icon to the PDF icon and making the PDF file accessible at the first window when the variable is called upon.

Confusing labels and grouping. All three participants tested with the first design commented that it was difficult to associate a variable (e.g., trust, privacy) with each characteristic (e.g., individual user characteristics, technology characteristics). For example, it was hard to tell if "personality trait" was a button or a label for the group of smaller buttons beneath (see Figure 2.3). We solved this problem by having clear color-coded labels for each characteristic and sub characteristic (see Figure 2.1).

Failure to get the full model. Two participants were unable to access the full model in an appropriate time. They did not think that the label (Acceptance of Technology) was in fact a button that would lead to the full model. Participant #2 asked why the button was located in the

middle. We resolved this issue by locating the button at the bottom with a clearer label (See Figure 2.4).

Heuristic Evaluation

Heuristic evaluation is performed by looking at an interface according to certain rules. Among the choices of guidelines, we decided to use the design checklist from Brinck, Gergle, and Wood (2001) as a model for our analysis because their checklist contains a relatively detailed breakdown of the major usability principles. Moreover, the guidelines emphasize and are weighted to architecture and navigation foci, where we anticipated the majority of the application's drawbacks might be. The heuristic checklist was as follows:

Architecture and navigation

- Does the structure fit the purpose?
- Is the navigation scheme clear?
- Does the user know where s/he is?
- Is there a reasonable number of navigation options?
- Are navigation options logically ordered?
- Are links meaningfully labeled?
- Are links clearly marked (position)?
- Does the user have control over navigation?

Layout and Design

- Does page size exceed window size?
- Is layout consistent between pages?
- Does the layout work visually?
- Is alignment used effectively?
- Is grouping used effectively?
- Is there good contrast?
- Is the layout cluttered?

Content

- Is the text clear and concise?
- Is text organized in small chunks?
- Are there spelling or grammatical errors?
- Is there distinguishing/relevant information placed at the beginning of headings, paragraphs, lists, etc?

Color

- Is the choice of colors appropriate for the site?
- Are too many colors used?
- Are colors used consistently?

Typography

- Is the text legible?
- Is the font size large enough?
- Is the font color appropriate and is there sufficient contrast?

Two human factors experts conducted the evaluation independently. Following individual evaluation, they consolidated their findings in a collaborative meeting. The two different viewpoints led to a comprehensive assessment of the design.

Navigation. In the usability tests, users often commented about feeling lost, and we also found this evident as we performed our checklist evaluation. Specifically, navigating through three windows to locate the actual scale was problematic. We resolved this issue by locating the actual scale up front in the interface, reducing the unnecessary steps to reach the actual scale.

Layout and design. Some layout appeared cluttered in the initial design. There was no visual separation between different contents such as reliability and response scale. Grouping was not used effectively. Some text seemed to belong to other information. For example, a reference, which in fact provides reference to where the scale had been retrieved, seemed to refer to reliability information. This was due to the violation of the Gestalt principle of proximity. In other words, some of the text paragraphs were too close together even though they had different purpose and functionality. We resolved this issue by chunking related functions and placing them in a clearly distinguishable frame.

Color and typography. There was no color in the initial design. Colors used in the second version of application (see Figure 2.4) were to give a sense that three major characteristics (coded white with blue background) were distinctive from sub characteristics (coded black with purple background). This was acceptable but had room for improvement. We then deployed colors based on group of characteristics (see Figure 2.1). This way we were able to make a distinction between different characteristics (e.g., individual user characteristics) and between characteristic (e.g., individual user characteristics) and sub-characteristic (e.g., demographics, psychographics).

The font size of the initial design was too small and the length of text was too long. This was effectively addressed in the second design.

Step 4 – Summative Evaluation

Summative evaluation used in Step 4 is distinct from the formative evaluation in Step 3 in that the focus is on whether the application enables users to achieve their goals. Hence, we revisited our tasks list and usability goals identified in Step 1 and assessed whether the application achieved its level of proficiency. We are currently finalizing this process.

Step 5 – Quality Control

To ensure overall quality of the final version of the application we examined all of the text for errors. We also tested every single link in the application. We are now in the process of testing the application for different computers and monitor settings through installation testing.

Summary

The technology acceptance model viewer is designed to enable users to acquire scales for use in assessing variables relevant to technology acceptance. For each scale we provide detailed information about the scale itself, the response options, and the reliability. We used an iterative design process which was vital in producing a final application with sound usability. Important product flaws or deficiencies missed during one test can be detected in another usability test (Rubin, 1994). For example, the difficulty to associate variables (e.g., self efficacy, subjective norm) to characteristics (e.g., individual user characteristics) was identified during the second phase of usability testing and improvement to the design was made accordingly. This tool will be available on JD Mindshare after February 1, 2007.

Chapter 3 – Testing the Scales for the Most Important Factors Influencing the Acceptance of Technologies

Introduction

An extensive review of the literature concerning the acceptance of technologies yielded a plethora of variables relevant to technology acceptance (Van Ittersum, Rogers, Capar, Caine, O'Brien, Parsons, & Fisk, 2006). In the literature, several scales have been used to measure each variables (e.g. Meuter, Bitner, Ostrom, & Brown, 2005; Venkatesh, Morris, Davis, & Davis, 2003; Parasuraman, 2000; Baumgarten & Steenkamp, 1996). Unfortunately, the internal reliability of these scales is questionable. In addition, scales from different studies that were designed to measure the same construct, seemed to differ suggesting a lack of validity for the measures. Thus, our first challenge was to determine the most appropriate scales to measure the variables related to technology acceptance.

To identify the most valid and reliable scales, we analyzed the scales we found in the literature and tested their validity and reliability. In this chapter, we provide information on the method we used to investigate the validity and reliability of the scales that measure the dependent and independent variables found in the technology acceptance literature.

Method

To analyze the scales we found in the literature and test their validity and reliability, we conducted a lab survey involving 206 student participants at a large U.S. university. Appendix C provides the full questionnaire. Appendix D lists the scales from the full technology acceptance model that were not included in this survey as they were note relevant to the product.

One third of the participants were female (35.9%) and the average age of the participants was 20.9 years (range 18-33 years). The technology we studied was Global Positioning Systems (GPS) in the context of cell phones. The cover story of the study is shown below.

Cell Phones with a Global Positioning System

The latest in cell phone technology concerns what is called a Global Positioning System, or GPS. GPS is a positioning system that uses satellite signals to determine the exact location of vehicles, vessels, and individuals on earth (based on longitude and latitude). Having this feature on your cell phone allows you to always determine exactly where you are and how to get where you want to go, in a city, in the countryside, or for instance on campus. It also allows you to automatically geo-locate every single call you make, picture you take, or document you create. In addition, it enables you to track friends and family and it enables friends and family to track you (with the express permission of those involved).

The system also provides emergency services with location information – e.g., a 911 call can be quickly located (no express permission required). The side-effect, invoking a sense of "big-brother" in its darker manifestation but a life-saving tool in the lighter, is that you can be tracked wherever you are on the planet as long as you have you cell phone with you.

The price of a cell phone with a Global Positioning System, a GPS cell phone, will be highly comparable to existing cell phones. The costs to use the GPS are approximately $5.00 per month. The cell phone industry will introduce this new technology in the coming 36 months.

We selected this particular technology and product context as it is an important and highly relevant product among college students but is also relevant to telematics initiatives at Deere & Company. Ninety-nine percent of the study participants owned a cell phone for an average of 54.3 months. Furthermore, more and more cell phone brands are introducing cell phones with GPS, which provides additional credibility to the cover story and the study. After the participants read the cover story, they were asked to respond to a wide variety of questions and statements that reflect the scales of interest. The details of the questions and scales will be provided when discussing the results (see Appendix C for the full questionnaire).

Analyses

The validity and reliability of the independent and dependent variables was tested using a multivariate technique referred to as structural equation modelling (SEM; Hair et al., 1992). SEM is a multivariate technique that allows for the simultaneous estimation of a series of separate, but interdependent relationships between what are referred to as latent constructs (Bagozzi, 1994; Hayduk, 1987). Besides using SEM for model testing, the technique can also be used to examine the composite reliability and discriminant validity of latent constructs. For more details on the actual analyses, see Bagozzi (1994), Hair et al. (1992), Hayduk (1987), Henson and Northen (2000), and Pennings and Leuthold (2000).

Latent constructs embody constructs that can not be observed directly and therefore are represented by observed variables, which are assumed to be measured with error. The relationships among these latent constructs are represented by what is referred to as the structural model:

$$\eta = \mathrm{B}\eta + \Gamma\xi + \varsigma, \qquad \text{(i)}$$

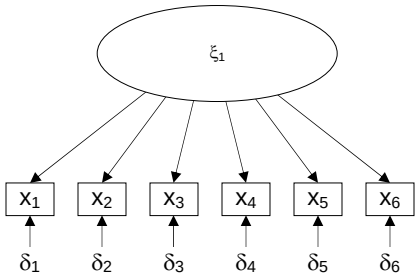
with η being a vector of endogenous latent constructs, B being a matrix of coefficients relating the endogenous latent constructs in the structural model, ξ being a vector of exogenous latent constructs, Γ being a matrix of coefficients relating the exogenous with the endogenous latent constructs, and ς being a vector of error. The relationship between a latent construct and its observed variables can be represented by what is referred as a measurement model (see also Figure 3.1.):

$$x = \Lambda_x\xi + \delta, \qquad \text{(ii)}$$

$$y = \Lambda_y\eta + \varepsilon, \qquad \text{(iii)}$$

with x (y) being a vector of observed variables for the exogenous (endogenous) latent constructs represented in ξ (η), Λ_x (Λ_y) being a matrix of coefficients relating the exogenous (endogenous) latent constructs and x (y) observed variables, and δ (ε) being the measurement error.

Figure 3.1. Example of Measurement Model (with six items)



To estimate the model parameters, we used the observed covariance matrix based on the Pearson correlations as data input. The main objective is to reproduce this observed covariance matrix by estimating the model parameters θ such that the discrepancy between the estimated covariance matrix $\hat{\Sigma} = \Sigma\left(\hat{\theta}\right)$ and the observed covariance matrix *S* is minimal. We used a Maximum Likelihood (ML) method, which assumes multivariate normal data and a reasonable sample size (about 200 observations), to accomplish this (Jöreskog, 1967) using the SEM software AMOS 6.0 (Arbuckle, 2005; Byrne, 2001). The accompanying discrepancy function we minimize is defined as:

$$F_{ML}(S,\Sigma) = log|\Sigma| + tr\left(S\Sigma^{-1}\right) - log|S| - k \qquad \text{(iv)}$$

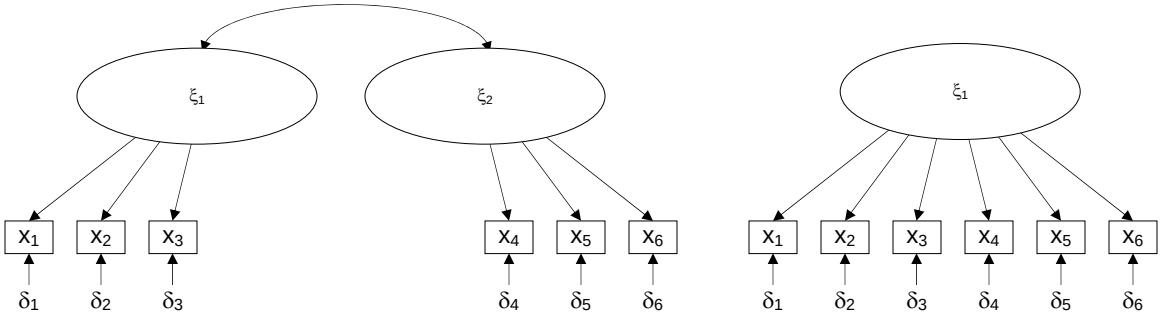
where "|.|" indicates the determinant of a matrix, "*tr*" indicates the trace, and *k* is the total number of stochastic variables (*x* and *y*) in the model.

Different *fit indices* are available to assess the fit of the model: χ^2 is a measure indicating whether the predicted and the actual covariance matrix, used as input, are identical. This

measure should be insignificant ($p > .05$). As this measure is sensitive to sample sizes, additional fit indices are used as well. *Normed Chi-Square.* This measure is calculated by dividing the chi-square of the model by the number of degrees of freedom. The value should be between 1 and 3. *Root mean square error of approximation (RMSEA).* This is a measure of discrepancy between the observed and the estimated covariance matrix per degree of freedom. This value should be < .10. *Goodness-of-Fit index (GFI)* represents the overall degree of fit (percent of observed covariances explained by the estimated covariances). This value should be over .90 and close to one. *Comparative Fit Index* (CFI) is based on a relative comparison of the fit of the proposed model to the fit of the null model. A CFI value of .90 or greater is considered to represent a good model fit. *Tucker-Lewis Non-normed Fit Index (TLI)* resembles the CFI, but is not based on the same assumptions and penalizes for model complexity. For more detailed definitions, we refer to Arbuckle (2005).

The *discriminant validity* of the scales is examined in different ways. First, for each pair of constructs, we compared the fit of the two-factor model (M1) with the fit of the one-factor model (M2) (see Figure 3.2.). If the change in chi-square is significant ($\Delta\chi^2$, $p<.01$), it can be concluded that both scales have discriminant validity. Furthermore, we examine if the constructs have correlations that were within two standard errors of 1.0.

Figure 3.2. Testing the Discriminant Validity



M_1: χ^2 M_2: χ^2

The *reliability* of a research instrument concerns the extent to which the instrument yields the same results on repeated trials. The internal consistency method provides a unique estimate of reliability. The most popular internal consistency reliability estimate is given by Cronbach's alpha. It is expressed as follows (one is using the correlation matrix):

$$\alpha = \frac{N \times \bar{r}}{[1 + \bar{r} \times (N - 1)]} \qquad \text{(v)}$$

where N equals the number of items and $\bar{r}$ equals the mean inter-item correlation. Constructs are considered reliable when Cronbach's alpha is > .70.

Results – Dependent Variables

The dependent variable in technology acceptance literature is "the acceptance of technology." Our literature review (Van Ittersum et al., 2006) revealed that it was important to differentiate between attitudes, intentions, and behaviors. Thus we classified the dependent variable as *attitudinal acceptance*, *intentional acceptance*, and *behavioral acceptance*. This distinction is based on the theory of reasoned action described by Fishbein and Azjen (1975). Table 3.1 shows the items and scales used to measure the three forms of acceptance and the results of our analysis.

Table 3.1. Dependent Variables

Scale	Items	Response Scale	Factor Loadings*	Reliability
Attitudinal Acceptance	Please indicate what your attitude is towards [technology].	1 = Negative, 7 = Positive 1 = Bad, 7 = Good 1 = Unfavorable, 7 = Favorable	.927 .907 .880	.931
Intentional Acceptance	Please indicate what is your intention is to buy [technology]. How likely is it that you will buy [technology].	1 = Unlikely, 7 = Likely 1 = No intention, 7=Strong intention 0% = Unlikely, 100% = Very Likely	.959 .955 .883	.948
Behavioral Acceptance	Will you buy [technology].	No-Yes		

* High factor loadings (> .60) indicate that a statement is a good indicator of the construct we want to measure.

Results – Independent Variables

Review of the technology acceptance literature revealed many drivers/ inhibitors of acceptance as the independent variables of this line of research (Van Ittersum et al., 2006). Based on the nature of these variables, we categorized them as *technology characteristics* and *user characteristics*.

Technology Characteristics

The literature on technology acceptance has long recognized that the properties of a technology can influence its acceptance (Rogers, 2003). Not all technologies are alike and understanding how technology-specific characteristics influence acceptance is a fundamental question in acceptance research. In the following section, we provide results of our analysis on the items used to measure these independent variables.

Perceived Usefulness. Perceived usefulness is defined as the extent to which a technology is expected to improve a potential adopter's performance (Davis, 1980, 1993). Venkatesh, Morris, Davis, and Davis (2003) suggested that *perceived usefulness, life fit, extrinsic motivation, relative advantage*, and *outcome expectations* are determinants of a higher order construct which they call "*performance expectancy*." *Extrinsic motivation* refers to "the perception that users will want to perform an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay or promotions" (Venkatesh et al. 2003, p. 448). *Job/life-fit* refers to how the capabilities of a system enhance an individual's job/life performance (Venkatesh et al. 2003, p. 448). The *perceived relative advantage* is defined as the degree to which an innovation is perceived to be superior to current offerings (Rogers, 2003). *Outcome expectations* refer to the performance-related consequences of the behavior (Venkatesh et al. 2003). We tested Venkatesh

et al.'s proposition. Table 3.2 shows the items and scales used to measure these constructs and the results of our analysis.

Table 3.2. Perceived Usefulness, Life Fit, Relative Advantage, and Outcome Expectations: Original Scales and Results

Scale	Items	Response Scale	Factor Loadings	Reliability
Perceived Usefulness	Using a GPS cell phone in my life would increase my productivity.	1 = Strongly Disagree, 7 = Strongly Agree*	.943	.890
	Using a GPS cell phone would improve my life performance.		.934	
	Using a GPS cell phone would enhance my effectiveness.		.931	
	Using a GPS cell phone in my life would enable me to accomplish tasks more quickly.		.914	
	I would find a GPS cell phone useful in my life.		.827	
	Using a GPS cell phone would make my life easier.		.505	
Life Fit	Use of a GPS cell phone can increase the effectiveness of performing tasks and activities.		.898	.907
	Use of a GPS cell phone can significantly increase the quality of my output.		.854	
	Using a GPS cell phone would enhance my effectiveness.		.841	
	Use of a GPS cell phone can increase the quantity of output for the same amount of effort.		.835	
	Use of a GPS cell phone can decrease the time needed for my important responsibilities in life.		.817	
	Use of a GPS cell phone will have no effect on my life performance.		.576	
Relative Advantage	Using a GPS cell phone increases my productivity.		.960	.825
	Using a GPS cell phone improves the quality of the work I do.		.900	
	Using a GPS cell phone would enhance my effectiveness.		.860	
	Using a GPS cell phone in my life would enable me to accomplish tasks more quickly.		.819	
	Using a GPS cell phone would make my life easier.		.417	
Outcome Expectations	If I use a GPS cell phone…		.944	.946
	I will increase the quality of output.		.911	
	I will increase the quantity of output for the same amount of effort.		.900	
	I will increase my effectiveness.		.888	
	I will spend less time on routine tasks.		.775	
	I will increase my chances of being rewarded.		Dropped	
	My friends will perceive me as competent.		Dropped	
	I will increase my chances of getting a raise.			

*This response scale is used for each item in this table.

In line with Venkatesh et al's proposition, we found a higher order construct, which we will refer to as the *perceived usefulness*. The final scale is presented in Table 3.3. Using the five highest loading items on each dimension yiyelded high reliability.

Table 3.3. Perceived Usefulness: Final Scale

Scale	Items	Response Scale	Factor Loadings	Reliability
Perceived Usefulness	Using a GPS cell phone increases my productivity.	1 = Strongly Disagree, 7 = Strongly Agree*	.967	.949
	Using a GPS cell phone in my life would increase my productivity.		.944	
	If I use a GPS cell phone I will increase the quality of output.		.932	
	Using a GPS cell phone improves the quality of the work I do.		.917	
	Use of a GPS cell phone can increase the effectiveness of performing tasks and activities.		.875	

*This response scale is used for each item in this table.

Perceived Ease of Use. The perceived ease of use is defined as the degree to which the potential adopter expects a technological innovation to be free of effort in use (Davis, 1993; Moore & Benbasat, 1991). After dropping one of the 6 items, we obtained high reliability for ease of use with 5 items (see Table 3.4).

Table 3.4. Ease of Use

Scale	Items	Response Scale	Factor Loadings	Reliability
Ease of Use	I would find a GPS cell phone easy to use.	1 = Strongly Disagree, 7 = Strongly Agree*	.908	.931
	It would be easy for me to become skillful at using a GPS cell phone.		.897	
	Learning to operate a GPS cell phone would be easy for me.		.842	
	My interaction with a GPS cell phone would be clear and understandable.		.842	
	I would find a GPS cell phone to be flexible to interact with.		.784	
	I would find it easy to get a GPS cell phone to do what I want it to do.		Dropped	

*This response scale is used for each item in this table.

Perceived Complexity. Perceived complexity can be defined as the degree to which an innovation is perceived as difficult to understand and use (Rogers, 2003). For complexity, we obtain high reliability for 3 items after dropping one item (see Table 3.5.).

Table 3.5. Complexity

Scale	Items	Response Scale	Factor Loadings	Reliability
Complexity	Using a GPS cell phone would involve too much time doing mechanical operations (e.g., data input).	1 = Strongly Disagree, 7 = Strongly Agree*	.953	.793
	Using a GPS cell phone would take too much time from my normal activities.		.697	
	Working with a GPS cell phone would be so complicated, it would be difficult to understand what is going on.		.626	
	It will take too long to learn how to use a GPS cell phone to make it worth the effort.		Dropped	

*This response scale is used for each item in this table.

Venkatesh et al. (2003) grouped ease of use with complexity under the higher order construct of "effort expectancy". However, using SEM we found that although the measurement model provided a good fit, ease of use and complexity are very different constructs. Whereas ease of use is related to operating technology, complexity is more likely to be related to integrating technology in daily life.

Newness. Perceived newness refers to the potential adopter's perception of the newness of a technology. This construct is measured with 4 items, providing a favorable reliability (see Table 3.6.).

Table 3.6. Newness

Scale	Items	Response Scale	Factor Loadings	Reliability
Newness	GPS cell phones are radical new products.	1 = Strongly Disagree, 7 = Strongly Agree*	.933	.821
	I consider cell phones with GPS radically new products.		.821	
	Adding GPS to cell phones is very innovative.		.708	
	A GPS cell phone is a novel product.		.471	

*This response scale is used for each item in this table.

Perceived Compatibility. Perceived compatibility is defined as the degree to which an innovation is perceived as being consistent with existing values, needs, and past experiences of potential adopters (Moore & Benbasat, 1991). This construct is measured with 3 items, providing a favorable reliability (Table 3.7.).

Table 3.7. Compatibility

Scale	Items	Response Scale	Factor Loadings	Reliability
Compatibility	I think that using a GPS cell phone fits well with the way I like to live.	1 = Strongly Disagree, 7 = Strongly Agree*	.960	.886
	Using a GPS cell phone fits into my life style.		.896	
	Using a GPS cell phone is compatible with all aspects of my life.		.698	

*This response scale is used for each item in this table.

User Characteristics

Besides technology characteristics, a major group of independent variables is the characteristics of the users. Because acceptance is an individual decision, it is important to understand the circumstances in which people make this decision. In the following section, we provide results of our analysis on the items used to measure these independent variables.

Risk Perception and Attitude. "Risk perceptions reflect the consumer's interpretation of the chance to be exposed to the content of the risk and may be defined as a consumer's assessment of the uncertainty of the risk content inherent in a particular situation" (Pennings, Wansink, & Meulenberg, 2002, p. 93). Risk perception is measured with 4 items, providing a favorable reliability (see Table 3.8).

Table 3.8. Risk Perception

Scale	Items	Response Scale	Factor Loadings	Reliability
Risk Perception	Owning the [technology] would be…	1 = Risky, 7 = Not Risky	.885	.871
	Owning the [technology] would expose me to…	1 = Much privacy risk, 7 = Not much privacy risk	.864	
	I think owning a cell phone with GPS would be risky.	1 = Strongly Disagree, 7 = Strongly Agree	.827	
	The chance of privacy breach is…	1 = Very small, 7 = Very large	.588	

"Risk attitude reflects a consumer's general predisposition to risk in a consistent way" (Pennings et al. 2002, p. 93). Risk attitude is measured with 4 items, providing a favorable reliability (see Table 3.9).

Table 3.9. Risk Attitude

Scale	Items	Response Scale	Factor Loadings	Reliability
Risk Attitude	Considering the likelihood of privacy breach, I would…	1 = Not be willing to own the [technology], 7 = Be willing to own the [technology]	.932	.870
	I would be willing to accept the privacy risk of owning a cell phone with GPS.	1 = Strongly Disagree, 7 = Strongly Agree	.815	
	I would be concerned with owning a cell phone with GPS.	1 = Strongly Disagree, 7 = Strongly Agree	.728	
	Owning the [technology] would be worth the privacy risk.	1 = Strongly Disagree, 7 = Strongly Agree	.708	

Anxiety. Anxiety is defined as "evoking anxious or emotional reactions when it comes to performing a behavior" (Venkatesh, Morris, Davis, & Davis, 2003, p. 432). Anxiety is measured at different levels, including product-specific anxiety and technology anxiety (Meuter, Bitner, Ostrom, & Brown, 2005; Venkatesh et al., 2003; Parasuraman, 2000). *Product-specific anxiety* is measured with 4 items (Venkatesh et al., 2003). After one item is dropped, the remaining items provide a favorable reliability (see Table 3.10.). *Technology anxiety* has been measured with two different scales in different studies. The first one is measured with 10 items (Parasuraman, 2000). After 3 items are dropped, the remaining 7 items provide moderate reliability (see Table 3.10.). The second technology anxiety scale includes 4 items (Meuter,

Bitner, Ostrom, & Brown, 2005). After one item is dropped, the remaining 3 items provide favorable reliability (see Table 3.10.).

Table 3.10. Anxiety

Scale	Items	Response Scale	Factor Loadings	Reliability
Product-Specific Anxiety	I hesitate to use a GPS cell phone for fear of ending up with problems that cannot be corrected.	1 = Strongly Disagree, 7 = Strongly Agree*	.890	.829
	It scares me to think I could lose location information using a GPS cell phone.		.853	
	A GPS cell phone is somewhat intimidating to me.		.622	
	I feel apprehensive about using a GPS cell phone.		Dropped	
Technology Anxiety[TRI]	There is no such thing as a manual for a high-tech product or service that is written in plain language.		.711	.700
	When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.		.589	
	Technical support lines are not helpful because they don't explain things in terms I understand.		.527	
	If I buy a high-tech product or service, I prefer to have the basic model over one with a lot of extra features.		.483	
	Technology always seems to fail at the worst possible time.		.427	
	There should be caution in replacing important people-tasks with technology because new technology can breakdown or get disconnected.		.422	
	Sometimes, I think that technology systems are not designed for use by ordinary people.		.414	
	It is embarrassing when I have trouble with a high-tech gadget while people are watching.		Dropped	
	Many new technologies have health or safety risks that are not discovered until after people have used them.		Dropped	
	New technology makes it too easy for governments and companies to spy on people.		Dropped	
Technology Anxiety (Meuter)	I have avoided technology because it is unfamiliar to me.		.837	.841
	I hesitate to use most forms of technology for fear of making mistakes I cannot correct.		.829	
	Technical terms sound like confusing jargon to me.		.758	
	I feel apprehensive about using technology.		Dropped	

*This response scale is used for each item in this table.

Although these three scales are meant to measure the same construct, we found that they had discriminant validity, meaning these three anxiety scales reflect different types of anxiety, or anxiety towards different objects. To select the best scale, we used predictive validity[1], and

[1] We used the scale to predict acceptance.

found that product-specific anxiety predicts best, followed by technology anxiety proposed by Parasuraman (2000).

Optimism. Optimism is defined as "a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives" (Parasuraman, 2000, p. 311). This construct is measured with 10 items. After dropping 2 items, we obtain favorable reliability (see Table 3.11).

Table 3.11. Optimism

Scale	Items	Response Scale	Factor Loadings	Reliability
Optimism	Technology makes me more efficient in my occupation.	1 = Strongly Disagree, 7 = Strongly Agree*	.747	.845
	I prefer to use the most advanced technology available.		.698	
	I like computer programs that allow me to tailor things to fit my own needs.		.689	
	Technologies give me more freedom of mobility.		.689	
	I find technologies to be mentally stimulating.		.665	
	I like the idea of doing business via computers because I am not limited to regular business hours.		.609	
	Technology gives people more control over their daily lives.		.525	
	I feel confident that machines will follow through with what I instructed them to do.		.509	
	Products and services that use the newest technologies are much more convenient to us.		Dropped	
	Learning about technology can be as rewarding as the technology itself.		Dropped	

*This response scale is used for each item in this table.

Innovativeness. Innovativeness is defined as the predisposition to buy new and different products and brands rather than remain with previous choices and consumption patterns (Steenkamp, Hofstede, & Wedel, 1999). To measure this construct we used two different innovativeness scales found in different studies: innovativeness and consumer innovativeness. Innovativeness is measured with 7 items (Parasuraman, 2000). We obtained favorable reliability after one item is dropped (see Table 3.12).

Table 3.12. Innovativeness

Scale	Items	Response Scale	Factor Loadings	Reliability
Innovativeness	I find I have fewer problems than other people in making new technology work for me.	1 = Strongly Disagree, 7 = Strongly Agree*	.838	.812
	I can usually figure out new high-tech products and services without help from others.		.803	
	I enjoy the challenge of figuring out high-tech gadgets.		.792	
	Other people come to me for advice on new technologies.		.680	
	In general, I am among the first in my circle of friends to acquire new technology when it appears.		.465	
	It seems my friends are learning more about the newest technologies than I am.		.295	
	I keep up with the latest technological developments in my areas of interest.		Dropped	

*This response scale is used for each item in this table.

Consumer innovativeness is measured with 9 items (Baumgartner & Steenkamp, 1996). This scale was tested, but was not found to be productive. This is likely due to the scale being developed in the fast moving goods domains (as opposed to the new product and technology domain). For this reason, we report only the innovativeness scale.

Insecurity. Insecurity is defined as "distrust of technology and skepticism about its ability to work properly" (Parasuraman, 2000, p. 311). This construct is measured with 9 items. After 4 items are dropped, the remaining 5 items provide favorable reliability (see Table 3.13).

Table 3.13. Insecurity

Scale	Items	Response Scale	Factor Loadings	Reliability
Insecurity	I do not consider it safe to do any kind of financial business online.	1 = Strongly Disagree, 7 = Strongly Agree*	.944	.798
	I do not consider it safe giving out a credit card number over a computer.		.897	
	I worry that information I send over the internet will be seen by other people.		.731	
	I do not feel confident doing business with a place that can only be reached online.		.543	
	The human touch is very important when doing business with a company.		.212	
	Any business transaction I do electronically should be confirmed later with something in writing.		Dropped	
	Whenever something gets automated, you need to check carefully that the machine or computer is not making mistakes.		Dropped	
	When I call a business, I prefer to talk to a person rather than a machine.		Dropped	
	If you provide information to a machine or over the internet, you can never be sure it really gets to the right place.		Dropped	

*This response scale is used for each item in this table.

Image. In the context of technology acceptance image is defined as the degree to which potential adopters believe the adoption of a technology will bestow them with added prestige in their community (Moore & Benbasat, 1991). This construct is measured with 3 items, providing high reliability (see Table 3.14).

Table 3.14. Image

Scale	Items	Response Scale	Factor Loadings	Reliability
Image	People who own a GPS cell phone have more prestige than those who do not.	1 = Strongly Disagree, 7 = Strongly Agree*	.916	.901
	People who own a GPS cell phone have a high profile.		.895	
	Having a GPS cell phone is a status symbol in my social environment.		.798	

*This response scale is used for each item in this table.

Subjective Norm. Subjective norm is "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein &

Ajzen 1975, p. 302). Subjective norm is influenced by others' normative beliefs and the individual's motivation to comply with belief (Schaik, 1999).

This construct is measured with 2 items, providing favorable reliability (see Table 3.15). Since no measurement model can be calculated with only two items, we cannot provide loadings for these items.

Table 3.15. Subjective Norm

Scale	Items	Response Scale	Factor Loadings	Reliability
Subjective Norm	I think that people who influence my behavior think that I should use a GPS cell phone. I think that people who are important to me think that I should use a GPS cell phone.	1 = Strongly Disagree, 7 = Strongly Agree*	Only 2 items	.861

*This response scale is used for each item in this table.

Social Factors. Social factors are defined as "the individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (Thompson, Higgins, & Howell, 1991, p.126). This construct is measured with 4 items. After one item is dropped, we obtain favorable reliability (see Table 3.16).

Table 3.16. Social Factors

Scale	Items	Response Scale	Factor Loadings	Reliability
Social Factors	My friends and family will be very supportive of the use of a GPS cell phone for my job.	1 = Strongly Disagree, 7 = Strongly Agree*	.899	.796
	In general, my friends and family will support the use of a GPS cell phone.		.730	
	My friends and family will be helpful in the use of a GPS cell phone.		.641	
	I will use a GPS cell phone because of the proportion of friends and family who use a GPS cell phone.		Dropped	

*This response scale is used for each item in this table.

Venkatesh et al. (2003) grouped image, subjective norm, and social factors under the higher order construct of "social influence". Using SEM to test this construct, we found that these three scales provide good fit in one measurement model. Although they are highly

correlated (>.90), image, social factors and subjective norm have discriminant validity. As a result, we can say that these three scales are three different components. In addition, a closer look at the items suggests that these three constructs are different. Image represents social prestige, social factors represent social support, and subjective norm represents social force.

Facilitating Conditions. Facilitating conditions are "objective factors in the environment that observers agree make an act easy to accomplish" (Venkatesh et al., 2003, p. 430). This construct is measured with 3 items, providing poor reliability (see Table 3.17.). However, after the item with the lowest loading is dropped, we obtain favorable reliability.

Table 3.17. Facilitating Conditions

Scale	Items	Response Scale	Factor Loadings	Reliability
Facilitating Conditions	Specialized instruction concerning a GPS cell phone will be available to me.	1 = Strongly Disagree, 7 = Strongly Agree*	.893	.825
	A specific person (or group) will be available for assistance with system difficulties.		.786	
	Guidance will be available to me in the selection of a GPS cell phone.		Dropped	

*This response scale is used for each item in this table.

Behavioral Control. Perceived behavioral control is defined as "the perceived ease or difficulty of performing the behavior" (Ajzen 1991, p. 188). This construct is measures with 5 items. After dropping one item, we obtain moderate reliability (see Table 3.18.).

Table 3.18. Behavioral Control

Scale	Items	Response Scale	Factor Loadings	Reliability
Behavioral Control	I have the knowledge necessary to use a GPS cell phone.	1 = Strongly Disagree, 7 = Strongly Agree*	.965	.721
	I have the resources necessary to use a GPS cell phone.		.699	
	Given the resources, opportunities and knowledge it takes to use a GPS cell phone, it would be easy for me to use a GPS cell phone.		.665	
	A GPS cell phone is not compatible with other systems I use.		.230	
	I would have control over using a GPS cell phone.		Dropped	

*This response scale is used for each item in this table.

Venkatesh et al. (2003) grouped perceived behavioral control, facilitating conditions, and compatibility under the higher order construct of facilitating conditions. However we found high discriminant validity among these constructs (correlations < .50), meaning that these scales represent different constructs.

Knowledge. Knowledge refers to the knowledge related to the technology in question, or to similar technologies. This construct is measured with 2 items, providing high reliability (see Table 3.19). Since no measurement model can be calculated with only two items, we cannot provide loadings for these items.

Table 3.19. Knowledge

Scale	Items	Response Scale	Factor Loadings	Reliability
Knowledge	I have a lot of knowledge about GPS technology. I am very familiar with GPS technology.	1 = Strongly Disagree, 7 = Strongly Agree*	Only 2 items	.928

*This response scale is used for each item in this table.

Intrinsic Motivation. Intrinsic motivation is the perception that users will want to perform an activity "for no apparent reinforcement other than the process of performing the activity per se" (Davis, Bagozzi, & Warshaw, 1992, p. 1112). This construct is measured with 3 items, providing favorable reliability (see Table 3.20).

Table 3.20. Intrinsic Motivation

Scale	Items	Response Scale	Factor Loadings	Reliability
Intrinsic Motivation	Using a GPS cell phone will be enjoyable.	1 = Strongly Disagree, 7 = Strongly Agree*	.902	.799
	The actual process of using a GPS cell phone will be pleasant.		.716	
	I will have fun using a GPS cell phone.		.672	

*This response scale is used for each item in this table.

Attitude Toward Behavior. Attitude toward behavior refers to "an individual's positive or negative feelings about performing the target behavior" (Venkatesh et al. 2003, p. 456). This

construct is measured with 4 items. With one item dropped, we obtain favorable reliability (see Table 3.21).

Table 3.21. Attitude Toward Behavior

Scale	Items	Response Scale	Factor Loadings	Reliability
Attitude Toward Behavior	Using a GPS cell phone is a good idea. I dislike the idea of using a GPS cell phone. Using a GPS cell phone is pleasant. Using a GPS cell phone is a foolish idea.	1 = Strongly Disagree, 7 = Strongly Agree*	.840 .715 .664 Dropped	.771

*This response scale is used for each item in this table.

Affect Toward Use. Affect toward use refers to "feelings of joy, elation, or pleasure; or depression, disgust, displeasure, or hate associated by an individual with a particular act" (Venkatesh et al. 2003, p. 456). This construct is measured with 3 items. With one item dropped, we obtain favorable reliability (see Table 3.22).

Table 3.22. Affect Toward Use

Scale	Items	Response Scale	Factor Loadings	Reliability
Affect Toward Use	A GPS cell phone makes life more interesting. Working with a GPS cell phone is fun. A GPS cell phone is okay for some jobs, but not the kind of job I want.	1 = Strongly Disagree, 7 = Strongly Agree*	.858 .704 Dropped	.747

*This response scale is used for each item in this table.

Affect. General affect refers to "an individual's liking of the behavior" (Venkatesh et al. 2003, p.456). This construct is measured with 5 items. After 2 items are dropped, we obtain moderate reliability (see Table 3.23).

Table 3.23. Affect

Scale	Items	Response Scale	Factor Loadings	Reliability
Affect	I look forward to those aspects of my life that require me to use a GPS cell phone.	1 = Strongly Disagree, 7 = Strongly Agree*	.872	.696
	I would like working with a GPS cell phone.		.760	
	Once I start working on a GPS cell phone, I will find it hard to stop.		.401	
	Using a GPS cell phone would be frustrating for me.		Dropped	
	I will get bored quickly when using a GPS cell phone.		Dropped	

*This response scale is used for each item in this table.

Venkatesh et al. (2003) grouped attitude toward behavior, intrinsic motivation, affect toward use, and affect under the higher order construct of "attitude toward using technology." Using SEM, we found that although there is some discriminant validity among these constructs, there are also high correlations, and the higher order model fits reasonably well. Hence, we selected the 5 highest loading items to measure the higher order construct, which we call affect/enjoyment, and obtained high reliability (see Table 3.24).

Table 3.24. Affect/Enjoyment – Final Scale

Scale	Items	Response Scale	Factor Loadings	Reliability
Affect/Enjoyment	Working with a GPS cell phone is fun.	1 = Strongly Disagree, 7 = Strongly Agree*	.852	.903
	I will have fun using a GPS cell phone.		.835	
	I would like working with a GPS cell phone.		.823	
	Using a GPS cell phone will be enjoyable.		.769[2]	
	Using a GPS cell phone is pleasant.		.758	

Main Conclusions

The study reported in this chapter aimed to test and improve the reliability and validity of a wide range of determinants of the acceptance of technologies, as identified through our extensive review of the literature (Van Ittersum et al. 2006). The results can be summarized as follows. First, in line with Venkatesh et al. (2003), we found evidence for the convergent validity of two sets of scales that are supposedly measuring the same underlying constructs

[2] The model fits much better after this item is dropped.

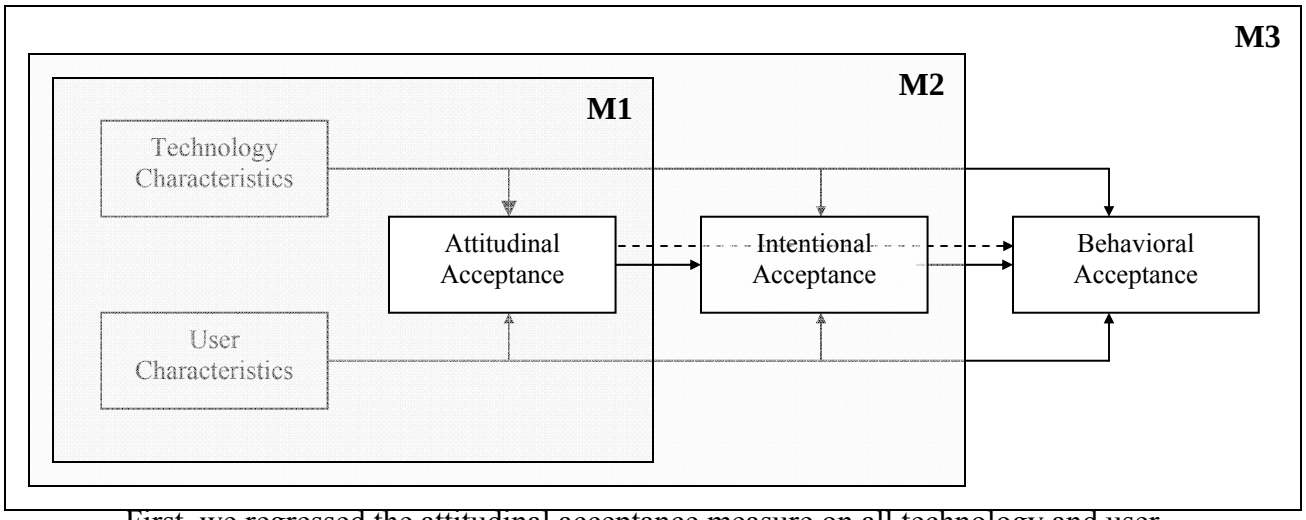
(perceived usefulness and affect). This allowed us to reduce the number of scales from eight to two scales. However, for three other sets of constructs that were supposedly measuring the same underling constructs we founnd no evidence of the convergent validity. Instead, we found significant evidence for the discriminant validity of the scales within each set of constructs.

Second, we conducted analyses allowing us to reduce the number of items per construct. For some of the original constructs, participants had to respond to up to 10 statements. We were able to reduce the number of statements to a required minimum of three items per construct while maintaining adequate reliability of the measures.

Chapter 4 – Pre-Testing the Quantitative Model of Technology Acceptance

The outcomes of the analyses presented in Chapter 3 were used to conduct a pre-test of the qualitative model of technology acceptance that we developed in Phase I of this project (see Van Ittersum et al., 2006). This pre-test is based on the data from the study described in Chapter 3. To test the proposed model, we used OLS and logistics regression analyses (using SPSS). We took a three-step approach (see Figure 4.1).

Figure 4.1. Effect of Technology and User Characteristics on Attitudinal, Intentional, and Behavioral Acceptance



First, we regressed the attitudinal acceptance measure on all technology and user characteristics measured using OLS regression (**M1**). Next, we regressed the intentional acceptance measure on all technology and user characteristics measures *and* on the attitudinal acceptance measure (**M2**). The idea is that any unique effects of the technology and user characteristics on attitudinal acceptance are filtered out, such that only the unique effects of the technology and user characteristics on intentional acceptance are captured. Finally, we regressed the behavioral acceptance on all technology and user characteristics and the attitudinal and

intentional acceptance measures, using logistic regression analyses (**M3**). The results are presented in Table 4.1. The definitions of the constructs are presented in Appendix B.

Table 4.1. Effect of Technology and User Characteristics on Attitudinal, Intentional, and Behavioral Acceptance

	Dependent Variables		
Independent Variables	**M1 Attitudinal Acceptance[a]**	**M2 Intentional Acceptance[a]**	**M3 Behavioral Acceptance[a]**
Attitudinal Acceptance		.370***	-.564
Intentional Acceptance			3.05***
Technology Characteristics			
Perceived Usefulness	-.004	.165***	.209
Ease of Use	.094	.119**	.222
Complexity	-.057	-.049	-.370
Compatibility	.035	.239***	.608**
Newness	.044	-.011	-.373
Newness2	-.080*	.011	-.133
User Characteristics			
Risk perception	.047	-.223***	-.280
Risk attitude	.507***	.283***	.580
Risk attitude x Perc.	.030	-.051	-.281*
GPS Anxiety	-.135**	-.045	-.664*
General Anxiety	.056	-.086*	.521
Optimism	.073	.103**	2.579***
Innovativeness	.029	-.058	-2.61
Insecurity	.018	.131***	.639*
Image/Prestige	.001	-.088*	.119
Social Support	.034	-.079	.341
Social Force	.048	.308***	.509
Facilitating Conditions	.005	-.047	-.351
Behavioral Control	-.104*	.057	-.746*
Knowledge	-.077	.156***	.519*
Affect	.103	-.043	.032
Financial Value	.017	.054	.194
Gender	-.034	-.004	1.376*
Age	-.057	-.031	.326*
R-square	.473	.624	.868
F-value	.6.572***	11.639***	67.003***

[a] Attitudinal and Intentional acceptance results are based on OLS. Behavioral acceptance results are based on logistics regression. Hence, the path-coefficients cannot be compared.
* $p < .10$, ** $p < .05$, *** $p < .01$ (one-tailed)

In discussing the results presented in Table 4.1., we will focus on those variables that have a significant effect at $p < .05$. We have identified those variables that have a significant effect at $p < .10$ for descriptive purpose only.

The results in Table 4.1 reveal some interesting patterns. First, as a general finding, most of the independent variables influence behavioral acceptance through consumers' intentional acceptance. We will discuss the results for each model (M1-M3) separately.

***M1:** Attitudinal Acceptance.* With few exceptions, the technology and user characteristics studied in our research on GPS cell phones had no significant effect on attitudinal acceptance. Participants' attitudes towards the possible risk of personal information falling into the wrong hands as a result of using the cell phone with GPS technology is one such exception. The more (un)favorable participants' attitudes towards this risk, the more (un)favorable their attitudinal acceptance of cell phones with GPS. Their anxiety towards using cell phones with GPS also significantly influenced attitudinal acceptance. The higher their anxiety, the more unfavorable their attitudinal acceptance. The overall fit of the model **M1** was modest (R-square = .473).

***M2:** Intentional Acceptance.* Most of the independent variables that influence acceptance, did so at the intentional level. In line with the Theory of Reasoned Action (TRA; Fishbein & Azjen, 1975), *attitudinal acceptance* positively influenced intentional acceptance. Next, in line with the Technology Acceptance Model (e.g. Davis l989), *perceived usefulness* and *ease of use* significantly influenced intentional acceptance. With increased perceived usefulness and ease of use, intentional acceptance increased. Furthermore, the more favorable consumers' perceptions of the *compatibility* of the GPS cell phone with their lifestyle, the higher their intentional acceptance. *Risk* perceptions also significantly influence intentional acceptance. The higher the

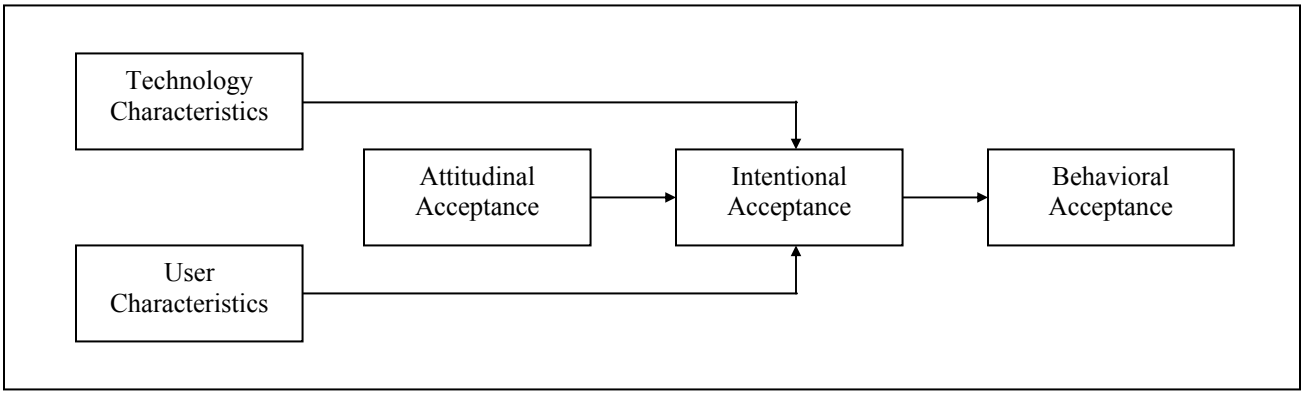
perceived likelihood of personal information falling into the wrong hands as a result of using GPS cell phone, the lower the intentional acceptance. The more favorable people's risk attitude, the higher their intentional acceptance. *Optimism* about technology in general positively influenced acceptance. Increased *social force* also positively influenced intentional acceptance. Interestingly enough, the effect of image/prestige and social support remained insignificant . Finally, the more *knowledgeable* consumers were about GPS cell phones, the higher was their intentional acceptance. The overall fit of the model was good (R-square = .624).

M3: *Behavioral Acceptance.* First, again in line with TRA, there was a significant impact of intentional acceptance on behavioral acceptance. The effects of technology and user characteristics remained limited to *compatibility* and *optimism*, both of which also influenced intentional acceptance. It is interesting to note that the effects of gender and age had some influence on behavioral acceptance, while having no impact on attitudinal or intentional acceptance. The overall fit of the model was great (R-square = .868).

Conclusions

The pre-test of our qualitative model of technology acceptance revealed some interesting results. One of the main findings is that most technology and user characteristics influence behavioral acceptance through intentional acceptance. These results could be summarized as presented in Figure 4.2.

Figure 4.2. Acceptance of Technology Model



Drawing *generalizable* conclusions about which specific characteristics are most influential in the technology acceptance process is difficult considering that we only tested the model for GPS cell phones among a sample of students. Additional technologies and populations must to be investigated. However, we can draw specific conclusions for our study. First, it seems that fear is critical component influencing attitudinal acceptance. Second, as to be expected, functionality of technologies plays a critical role in intentional acceptance. Next to functionality, fear and optimism are important drivers. Behavioral acceptance is primarily driven by intentional acceptance. This suggests that measuring attitudinal, intentional, *and* behavioral acceptance is recommended (as opposed to only measure one of the three).

To gain more definite insights into the technology acceptance process and the impact of technology and user characteristics, a more comprehensive list of independent variables was constructed and administrated to decision makers. More specifically, one of the recommendations from the integrative literature review was to measure customers' perceptions of technology-specific aspects (versus more general aspects such a perceived usefulness). Furthermore, no organization characteristics were studied in the pre-test. The technologies being investigated are hybrid riding mowers and auto guidance systems. The methodological details of these studies are presented in Chapter 5. The data collection and analysis are still in process.

Chapter 5 – Testing the Quantitative Model of Technology Acceptance: Hybrid Riding Mowers & Auto Guidance Systems

To test our quantitative model among managerial decision makers, two technologies have been selected in close collaboration with Deere personnel. The technologies selected were Hybrid Riding Mowers and Auto Guidance Systems. The acceptance of Hybrid Riding Mowers is being studied among a sample of superintendents of U.S. golf courses. The acceptance of Auto Guidance Systems is being investigated among a sample of U.S. farmers.

Hybrid Riding Mower

Method

To test our quantitative model for Hybrid Riding Mowers, we modified our questionnaire with respect to this technology. The questionnaire was designed to measure a wide variety of scales found in the literature (and tested in Chapter 4 and 5 of this report), as well as acceptance of Hybrid Riding Mowers. To control for the length of the questionnaire, and to increase the response rate, we combined some of these scales based on our initial test of these scales (see Chapter 3). All the scales included in this study are presented in Table 5.1 and 5.2 (to be discussed hereafter). In this questionnaire we randomized the order of items so that no two items of the same scale were placed consecutively.

In addition to the questionnaire, we prepared a cover letter and a consent form. The cover letter explained the objectives of the survey to the participants, why they were asked to participate, how they were contacted, the terms of privacy, how much it takes to complete the questionnaire, how to enter the sweepstakes, how to return the completed questionnaires, and whom to contact for their questions.

The questionnaire, along with other documents (consent form, cover letter, and

sweepstakes entrance form), were sent to superintendents of 3000 golf courses in USA. The names and contact information of the participants were retrieved from the National Golf Foundation database. The survey was distributed by the Survey Research Center at The University of Georgia.

To increase response rate, participants were offered to enter a sweepstakes. They were told that they had the chance to be entered in the sweepstakes regardless of whether they completed the survey or not. The sweepstakes was for a $20 gift certificate to a local restaurant. These gift certificates were to be given to a total of fifty participants.

Data collection is completed and the data are entered into spreadsheets for final analysis. The final dataset contained 212 completed interviews. Of the 3000 records in the original file, 193 were returned undelivered, leaving a total of 2807 valid records. Thus the response was 212/2807 for an effective response rate of 7.6%. It is our understanding that this is in the typical range for Deere-administered questionnaires.

Dependent Variables

The primary dependent variables were attitudinal acceptance, intentional acceptance, and behavioral acceptance. Table 5.1 shows the items we used to measure the dependent variables, and the response scales corresponding to these items.

Table 5.1. Measurement of Dependent Variables – Hybrid Riding Mower

Dependent Var.	Items	Response Scale	
Attitudinal Acceptance	Please indicate what your attitude is towards a hybrid riding mower, relative to a regular riding mower, by circling the appropriate responses.	1=Bad, 5=Good 1=Unfavorable, 5=Favorable 1=Negative, 5=Positive	
Intentional Acceptance	Please indicate what your intention is to buy a hybrid riding mower	1=No intention, 5=Strong intention 1=Unlikely, 5=Likely	
Behavioral Acceptance	Will you buy a hybrid riding mower	Yes-No	

Independent Variables

Table 5.2 shows the items we used to measure the independent variables and the response scales corresponding to these items. For instance, ease of use, a technology characteristic, was measured with 3 items, and the response scale used was a 5 points Likert scale with 1=strongly disagree and 5=strongly agree.

In addition to these items, we asked the respondents questions about their current ownership and usage of and experience with hybrid/regular riding mowers. For instance we asked how many regular/hybrid riding mowers they had as a means to understand their current acceptance of regular and hybrid riding mowers. Similarly, we asked how much experience they had with operating regular/hybrid riding mowers.

We also asked demographic questions about their organization and themselves, such as location, terrain and quality of the golf course, education level and position of the respondent, and the degree of influence the respondent has on riding mower purchase decisions. The details of these and other questions and scales can be found in Appendix E.

Table 5.2 Measurement of Independent Variables – Hybrid Riding Mower

Construct	Items	Response Scale	
Technology Characteristics			
Ease of Use	Learning to operate a hybrid riding mower would be easy for us It would be easy for us to become skilful at using a hybrid riding mower We would find a hybrid riding mower easy to use	1=Strongly Disagree, 5=Strongly Agree	
Complexity	Using a hybrid riding mower would take too much time from our normal activities Working with a hybrid riding mower would be so complicated, it would be difficult to understand what is going on Using a hybrid riding mower would involve too much time doing mechanical operations	1=Strongly Disagree, 5=Strongly Agree	
Compatibility	Using a hybrid riding mower is compatible with all aspects of our work Using a hybrid riding mower fits well with the way we like to work Using a hybrid riding mower fits into our work	1=Strongly Disagree, 5=Strongly Agree	
Trialability	We can use a hybrid riding mower on a trial basis to see what it can do It is easy to try out the hybrid riding mower without a big commitment We have had opportunities to try out the hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	
Observability/Visibility	In my organization, one sees a hybrid riding mower on many courses The hybrid riding mower is not very visible in my organization	1=Strongly Disagree, 5=Strongly Agree	
Result Demonstrability	I have no difficulty telling others about the results of using a hybrid riding mower I believe I could communicate to others the consequences of using a hybrid riding mower The results of using a hybrid riding mower are apparent to me I would have difficulty explaining why using the hybrid riding mower may or may not be beneficial	1=Strongly Disagree, 5=Strongly Agree	
Voluntariness	The use of the hybrid riding mower is voluntary I am not required to use the hybrid riding mower Although it might be helpful, using a hybrid riding mower is certainly not compulsory in our job	1=Strongly Disagree, 5=Strongly Agree	

Table 5.2 Measurement of Independent Variables – Hybrid Riding Mower (-continued-)

Perceived Usefulness	Use of a hybrid riding mower can increase the effectiveness of performing tasks and activities Using a hybrid riding mower improves the quality of our work Using a hybrid riding mower increases our productivity If we use a hybrid riding mower, we will increase the quality of output	1=Strongly Disagree, 5=Strongly Agree	
Image	Golf courses which own a hybrid riding mower have more prestige than those who do not Golf courses which own a hybrid riding mower have a high profile Having a hybrid riding mower is a status symbol in my social environment	1=Strongly Disagree, 5=Strongly Agree	
Perceived Financial Cost	It would cost a lot to use a hybrid riding mower There are financial barriers to me using hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	
Newness	I consider hybrid riding mowers radically new products Adding hybrid technology to riding mowers is very innovative Hybrid riding mowers are radical new products	1=Strongly Disagree, 5=Strongly Agree	
User Characteristics			
Optimism	I prefer to use the most advanced technology available I like computer programs that allow me to tailor things to fit my own needs Technology makes me more efficient in my occupation	1=Strongly Disagree, 5=Strongly Agree	
Technology Anxiety	Technical support lines are not helpful because they don't explain things in terms I understand There is no such thing as a manual for a high-tech product or service that is written in plain language When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1=Strongly Disagree, 5=Strongly Agree	
Innovativeness	I can usually figure out new high-tech products and services without help from others I enjoy the challenge of figuring out high-tech gadgets I find I have fewer problems than other people in making new technology work for me	1=Strongly Disagree, 5=Strongly Agree	

Table 5.2 Measurement of Independent Variables – Hybrid Riding Mower (-continued-)

Insecurity	I do not consider it safe giving out a credit card number over a computer I do not consider it safe to do any kind of financial business online I worry that information I send over the internet will be seen by other people	1=Strongly Disagree, 5=Strongly Agree	
Knowledge	I have a lot of knowledge about hybrid riding mowers I am very familiar with hybrid riding mowers	1=Strongly Disagree, 5=Strongly Agree	
Social Factors	My colleagues will be helpful in the use of a hybrid riding mower My colleagues will be very supportive of the use of a hybrid riding mower for our job In general, my colleagues will support the use of a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	
Subjective Norm	I think that people who influence my behavior think that we should use a hybrid riding mower I think that people who are important to me think that we should use a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	
Behavioral Control	We have the resources necessary to use a hybrid riding mower We have the knowledge necessary to use a hybrid riding mower In light of the resources, opportunities, and knowledge required to use a hybrid riding mower, it would be easy for us to use a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	
Experience	We do not have much experience using hybrid riding mowers	1=Strongly Disagree, 5=Strongly Agree	
Facilitating Conditions	Specialized instruction concerning a hybrid riding mower will be available to us Assistance will be available to deal with system difficulties	1=Strongly Disagree, 5=Strongly Agree	
Affect	Operators would think using a hybrid riding mower is pleasant Operators would find working with a hybrid riding mower is fun Operators would like working with a hybrid riding mower	1=Strongly Disagree, 5=Strongly Agree	
Product Specific Anxiety	It scares me to think I could get into problems when using a hybrid riding mover I hesitate to use a hybrid riding mower for fear of ending up with problems that cannot be corrected A hybrid riding mower is somewhat intimidating to me	1=Strongly Disagree, 5=Strongly Agree	

Table 5.2 Measurement of Independent Variables –Hybrid Riding Mower (-continued)

Product Specific Items	The hybrid riding mower yields quality output The hybrid riding mower will cause maintenance problems We will have no problems in fixing the hybrid riding mower in case of a breakdown The replacement costs of failed parts of the hybrid riding mower will be high Adopting the hybrid riding mower will require training of technical staff We will incur high maintenance costs when using a hybrid riding mower The benefits of using the hybrid riding mower will compensate for the increasing cost of fuel The hybrid riding mower will perform well in heavy tasks (e.g. thick, long, wet grass) The electrical component of the hybrid riding mower will fail in a wet environment Diagnosing problems with a hybrid riding mower will be easy The hybrid riding mower will reduce leak problems The hybrid riding mower will be less noisy Using a hybrid riding mower will be good for the environment	1=Strongly Disagree, 5=Strongly Agree	
Risk Attitude	I would be concerned about performance when using a hybrid riding mower I would be concerned about using a hybrid riding mower I would be willing to accept the risk of using a hybrid riding mower I would …	1=Strongly Disagree, 5=Strongly Agree 1=…not be willing to use a hybrid riding mower, 5=…be willing to use a hybrid riding mower	
Risk Perception	Relative to regular riding mower, using a hybrid riding mower would be… Using a hybrid riding mower would expose me to… I think using a hybrid riding mower would be risky	1=Risky, 5=Not risky 1=Much risk, 5=Not much risk 1=Strongly Disagree, 5=Strongly Agree	

Auto Guidance System

Method

To test the quantitative model for Auto Guidance Systems, we modified our questionnaire with respect to this technology. The questionnaire was designed to measure a wide variety of scales in the literature, as well as acceptance of Auto Guidance Systems. As with the Hybrid Riding Mower questionnaire, we combined some scales based on our initial test of these scales (see Chapter 3). The randomization of the order of items was identical to the Hybrid Riding Mower questionnaire. The details of this questionnaire can be found in Appendix F.

The general methodology for distribution of the Auto Guidane Questionnaire will be identical to the Hybrid Riding Mower Questionnaire – it is scheduled for distribution January 3, 2007. Deere personnel recommended this time frame to find the farmers at their least busy time. The names and contact information of the participants were retrieved from a publicly available database of farmers in the U.S. The farms were selected to be of at least 500 acres.

Dependent Variables

The primary dependent variables will be attitudinal acceptance, intentional acceptance, and behavioral acceptance. Table 5.3 shows the items we are using to measure the dependent variables, and the response scales corresponding to these items.

Table 5.3 Measurement of Dependent Variables – Auto Guidance Systems

Dependent Var.	Items	Response Scale	
Attitudinal Acceptance	Please indicate what your attitude is towards auto guidance systems, relative to traditional steering, by circling the appropriate responses	1=Bad, 5=Good 1=Unfavorable, 5=Favorable 1=Negative, 5=Positive	
Intentional Acceptance	Please indicate what your intention is to buy an auto guidance system	1=No intention, 5=Strong intention 1=Unlikely, 5=Likely	
Behavioral Acceptance	Will you buy an auto guidance system	Yes-No	

Independent Variables

Table 5.4 shows the items we are using to measure the independent variables and the response scales corresponding to these items.

Table 5.4 Measurement of Independent Variables – Auto Guidance Systems

Construct	Items	Response Scale	
Technology Characteristics			
Ease of Use	Learning to operate an auto guidance system would be easy for me It would be easy for me to become skilful at using an auto guidance system I would find an auto guidance system easy to use	1=Strongly Disagree, 5=Strongly Agree	
Complexity	Using an auto guidance system would take too much time from my normal activities Working with an auto guidance system would be so complicated, it would be difficult to understand what is going on Using an auto guidance system would involve too much time doing mechanical operations	1=Strongly Disagree, 5=Strongly Agree	
Compatibility	Using an auto guidance system is compatible with all aspects of my work Using an auto guidance system fits well with the way I like to work Using an auto guidance system fits into my work	1=Strongly Disagree, 5=Strongly Agree	
Trialability	I can use an auto guidance system on a trial basis to see what it can do It is easy to try out the auto guidance system without a big commitment I have had opportunities to try out the auto guidance system	1=Strongly Disagree, 5=Strongly Agree	
Observability/Visibility	One sees auto guidance systems on many farms The auto guidance system is not very visible on my farm	1=Strongly Disagree, 5=Strongly Agree	
Result Demonstrability	I have no difficulty telling others about the results of using an auto guidance system I believe I could communicate to others the consequences of using an auto guidance system The results of using an auto guidance system are apparent to me I would have difficulty explaining why using the auto guidance system may or may not be beneficial	1=Strongly Disagree, 5=Strongly Agree	
Voluntariness	The use of the auto guidance system is voluntary I am not required to use the auto guidance system Although it might be helpful, using an auto guidance system is certainly not compulsory in my job	1=Strongly Disagree, 5=Strongly Agree	

Table 5.4. Measurement of Independent Variables – Auto Guidance Systems (-continued-)

Perceived Usefulness	Use of an auto guidance system can increase the effectiveness of performing tasks and activities Using an auto guidance system improves the quality of my work Using an auto guidance system increases my productivity If I use an auto guidance system, I increase the quality of output	1=Strongly Disagree, 5=Strongly Agree	
Image	Farmers who own an auto guidance system have more prestige than those who do not Farms who own an auto guidance system have a high profile Having an auto guidance system is a status symbol in my social environment	1=Strongly Disagree, 5=Strongly Agree	
Perceived Financial Cost	It would cost a lot to use an auto guidance system There are financial barriers to me using an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	
Newness	I consider auto guidance systems a radically new technology Adding auto guidance systems to farm machinery is very innovative Auto guidance systems are radical new products	1=Strongly Disagree, 5=Strongly Agree	
User Characteristics			
Optimism	I prefer to use the most advanced technology available I like computer programs that allow me to tailor things to fit my own needs Technology makes me more efficient in my occupation	1=Strongly Disagree, 5=Strongly Agree	
Technology Anxiety	Technical support lines are not helpful because they don't explain things in terms I understand There is no such thing as a manual for a high-tech product or service that is written in plain language When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1=Strongly Disagree, 5=Strongly Agree	
Innovativeness	I can usually figure out new high-tech products and services without help from others I enjoy the challenge of figuring out high-tech gadgets I find I have fewer problems than other people in making new technology work for me	1=Strongly Disagree, 5=Strongly Agree	

Table 5.4. Measurement of Independent Variables – Auto Guidance Systems (-continued-)

Insecurity	I do not consider it safe giving out a credit card number over a computer I do not consider it safe to do any kind of financial business online I worry that information I send over the internet will be seen by other people	1=Strongly Disagree, 5=Strongly Agree	
Knowledge	I have a lot of knowledge about auto guidance systems I am very familiar with auto guidance systems	1=Strongly Disagree, 5=Strongly Agree	
Social Factors	My colleagues will be helpful in the use of an auto guidance system My colleagues will be very supportive of the use of an auto guidance system for my job In general, my colleagues will support the use of an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	
Subjective Norm	I think that people who influence my behavior think that I should use an auto guidance system I think that people who are important to me think that I should use an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	
Behavioral Control	I have the resources necessary to use an auto guidance system We have the knowledge necessary to use an auto guidance system In light of the resources, opportunities, and knowledge required to use an auto guidance system, it would be easy for me to use an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	
Experience	I do not have much experience using auto guidance systems	1=Strongly Disagree, 5=Strongly Agree	
Facilitating Conditions	Specialized instruction concerning an auto guidance system will be available to me Assistance will be available to deal with system difficulties	1=Strongly Disagree, 5=Strongly Agree	
Affect	I would think using an auto guidance system is pleasant I would find working with an auto guidance system to be fun I would like working with an auto guidance system	1=Strongly Disagree, 5=Strongly Agree	
Product Specific Anxiety	It scares me to think I could get into problems when using an auto guidance system I hesitate to use an auto guidance system for fear of ending up with problems that cannot be corrected An auto guidance system is somewhat intimidating to me	1=Strongly Disagree, 5=Strongly Agree	

Table 5.4. Measurement of Independent Variables – Auto Guidance Systems (-continued-)

Product Specific Items	The auto guidance system yields quality output The auto guidance system will cause installation problems I will have no problems in fixing the auto guidance system in case of a breakdown Using an auto guidance system will decrease my costs associated with seed, fertilizer, and pesticides due to increased accuracy I will feel mentally and physically better at the end of a work day when using the auto guidance system The replacement costs of failed parts of the auto guidance system will be high Adopting the auto guidance system will require technical training I will incur high maintenance costs when using an auto guidance system The benefits of using the auto guidance system will compensate for its cost The auto guidance system will perform well on heavy tasks (e.g. plowing) The dependence of the auto guidance system on satellites makes it more vulnerable Diagnosing problems with an auto guidance system will be easy The auto guidance system will reduce skips and overlaps, which reduces time and fuel expenses The auto guidance system will require less labor The auto guidance system reduces operator fatigue, which allows for working longer hours	1=Strongly Disagree, 5=Strongly Agree	
Risk Attitude	I would be concerned about performance when using an auto guidance system I would be concerned about using an auto guidance system I would be willing to accept the risk of using an auto guidance system I would … willing to use an auto guidance system	1=Strongly Disagree, 5=Strongly Agree 1=…not be 5=… be	
Risk Perception	Relative to operating vehicles without an auto guidance system, operating vehicles with an auto guidance system would be… Using an auto guidance system would expose me to… I think using an auto guidance system would be risky	1=Risky, 5=Not risky 1=Much risk, 5=Not much risk 1=Strongly Disagree, 5=Strongly Agree	

In addition to the items in Table 5.3 and Table 5.4, we asked the respondents questions about their current ownership and usage of, and experience with auto guidance systems. For instance we asked how many auto guidance systems they had as a means to understand their current acceptance of this technology. Similarly, we asked how much experience they had with operating vehicles with an auto guidance system. In addition, we asked their attitude towards auto guidance systems with different prices and different levels of accuracy by giving them nine options. With this question we aim to understand how the farmers value different levels of accuracy. Moreover, we brought in universality and mobility functions and asked about their attitudinal/intentional/behavioral acceptance of universal or mobile auto guidance systems. We also asked how important they thought these functions are, and how much more they would be willing to pay for these functions. Finally, we asked demographic questions about their organization and themselves, such as the location, geographic features and size of the farm, which crops are planted in the farm, the person who works/would work most with the auto guidance system, and the degree of influence the respondent has on auto guidance system purchase decisions. The details of these and other questions and scales are in Appendix E.

Questionnaire Status

In this report, we provide only the methodology for these questionnaires along with the questionnaires themselves. Data collection for the Hybrid Report Mower Questionnaire is complete – we have a total sample of 212. Our original goal had been 100 responses per product for four products. With the decision to focus on two products the revised goal was 200 respondents per product and we have achieved that goal. The data are currently entered into spreadsheets and prepared for final analyses. The results of the analyses will be presented at the January 19th, 2007 meeting.

The Auto Guidance Questionnaire is completely prepared and has been approved by the Institutional Review Board. It is scheduled for mailing January 3, 2007. Deere personnel encouraged us to wait until January to mail the survey as this would be a less busy time for the farmers we are targeting.

Chapter 6 – Future Directions

This report details the results of the Phase II project, wherein the objective was to conduct quantitative assessments to test the validity and completeness of the qualitative model, to develop a predictive model of technology acceptance. The primary purpose of Phase III (FY07) will be to test the predictive validity of our model and assess, comparatively, communication methods for deploying new technologies.

Phase III – Validating the Quantitative Model and Testing Communication Strategies

Phase III (FY07) will have two main aspects. First, in contrast to the retrospective prediction used in Phase II, Phase III will investigate the quantitative model in a prospective manner. Instead of testing the model based on what happened in the past (Phase II), we will examine its predictive power by predicting the market performance of a technology that will be introduced by Deere & Company no earlier than the end of 2006. Ideally we would time this study pre-launch publicity and advertising of a new Deere product and use our model to predict which customers are more likely to accept it as well as the expected timing of acceptance (i.e., when they are going to accept). This would allow us to provide the study participants with an objective, detailed description of the technology and what it can do, without allowing other factors to interfere in the research process. To maximize the usability of the insights obtained in Phase II, the selected new Deere product should be comparable to one of the technologies studied in Phase II. Please note that since we would like to time this study pre-launch publicity and advertising, no market performance data on the technology will be available in Phase III of the project. To test the external predictive validity of our model, actual sales figures are needed. Since these data will not

be readily available in Phase III, we will examine the internal predictive validity instead in this phase of the project. We will elaborate upon this hereafter.

The proposed plan for Phase III is to be predictive about the (timing of the) acceptance of the selected technology in the Deere & Company target market for the selected technology. We would like to use our quantitative model, develop a survey instrument, survey ~4000 prospective customers in the target market of the new technology, and use the insights obtained to predict technology acceptance (*Please note that the ~4000 prospective customers is a conservative estimate to obtain the correct reliability. The number depends on the size of the target market, which in turn depends on the technology selected. In addition, the costs per survey highly depend on how accessible the target market is, which again depends on the technology selected.*). We will predict acceptance intervals – a reliable range of technology acceptance outcomes (e.g., between 50-60% of target market will accept), as opposed to a precise acceptance outcome (e.g., 53% of the target market will accept). As mentioned, to actually test the external predictive ability of our model, we would need actual market performance information on the technology under consideration – actual sales data on who did accept and who did not (yet). Since these data will not be readily available in Phase III, we will examine the internal predictive validity by estimating our entire model based on 60% of our sample of ~4000 prospective customers and use the outcome to predict the self-reported acceptance of the other 40% of prospective customers in our sample. Combined with the external validity information obtained in Phase II, this should give us a reasonably accurate idea about the predictive ability of our model. In addition, we would like to compare the prediction of our model with the predictions of Deere & Company made without the use of the model. To test the external

predictive validity of our model based on actual market performance data, the project would need to be extended beyond Phase III.

The second component of Phase III will be to test empirically the potential for different communication strategies to influence technology acceptance. For example, if customers perceive a high risk or threat of the technology, we would examine the extent to which different communication strategies influence perceived risk and the subsequent effect on acceptance decisions (cf., Pennings, Van Ittersum, Grossman, & Capito, 2006). We plan to conduct experiments that will differentiate the influence of different types of communication strategies. The outcomes of these experiments may be used in marketing the new technology selected. The Phase I review we conducted revealed that there has been very little research conducted on the role of communication and experience as they relate to technology acceptance.

Research Objectives

The objectives of Phase III of this project are to (1) use the quantitative model to predict technology acceptance; and (2) empirically assess communication methods for conveying product information that will increase acceptance by different customer segments.

Future Research

As written, the outcomes of Phase III will form the *basis* for the development of a final predictive model and a *Technology-Introduction Plan* for Deere & Company's introduction of new technologies in the market place. The challenge of testing the true capabilities of the quantitative model and communication strategies is time. Since most of Deere products have a long economic life time, the purchase frequency is limited. Consequently, the ultimate test of the outcome of our predictions will necessarily extend beyond Phase III. Future research efforts would allow us to collect data on the actual acceptance of the technology selected in the market.

These data would enable us to fine-tune the model. Furthermore, the insights obtained from the test market will provide a perfect basis for developing and more formally testing strategies to increase the acceptance of new technologies as well as changing the timing of the acceptance of technologies. While Phase III will focus on the predictive capability of the *entire* quantitative model, a research extension would thoroughly investigate the role of specific critical variables. For instance, we may find that specific technology-characteristics delay the acceptance of a technology in a target market. Through (field and lab) experiments, we can find out what would have to change to speed up the acceptance (which for instance would (1) increase the speed of the Return on Investment, (2) possibly establish early market leadership).

Appendix A: Georgia Tech Research Team

To accomplish our research goals and objectives, we assembled a team of individuals at Georgia Tech with complementary scientific backgrounds. We also worked closely with individuals from Deere & Company from different sectors of the organization to ensure that the results of our review and subsequent research would have broad relevance.

School of Psychology

The psychology group has expertise in the field of human factors (designing for human use). They have experience in evaluation of beliefs and attitudes towards technology by individuals of all ages (e.g., Melenhorst, Rogers, & Caylor, 2001; Mynatt, Melenhorst, Fisk, & Rogers, 2004; Rogers, Meyer, Walker, & Fisk, 1998). They have also conducted extensive research on age-related differences in needs, capabilities, and preferences that influence product use, trust in technology, and acceptance (e.g., Fisk, Rogers, Charness, Czaja, & Sharit, 2004; Hancock, Fisk, & Rogers, 2001; Sanchez, Fisk, & Rogers, 2004).

Name	Highest Degree	Research Focus
Kelly Caine	B.A. in Experimental Psychology, University of South Carolina	Understanding the capabilities and limitations of older adults with an emphasis on understanding how technology can be used to enhance one's ability to function in later life.
Arthur (Dan) Fisk	Ph.D. in Experimental Psychology, University of Illinois	Skilled performance and training; translating research to motivate technology design for older adults; application of human automatic information processing and mental workload analysis to training high performance skills.
Marita O'Brien	M.S., Telecommunications Engineering, University of Colorado	Psychological factors that facilitate or impair effective use of technologies; attention, motor control, visual search and other factors.
Sung Park	M.S., Human Computer Interaction, University of Michigan	Human computer interaction issues including information visualization, usability, social facilitation, and technology acceptance.
Wendy A. Rogers	Ph.D. in Experimental Psychology, Georgia Institute of Technology	Broad issues in skill acquisition, human factors, training, and cognitive aging; technology design and acceptance; the psychology of human-computer interaction

College of Management

The team members from the College of Management bring a background in marketing (Koert van Ittersum, Muge Capar) and marketing science (Len Parsons). Dr. Van Ittersum's research focuses on consumer decision-making and choice, and the role of risk attitude and risk perception on consumer risk behavior (e.g., Pennings & Van Ittersum, 2004). Furthermore, as part of a larger project on new product development, Van Ittersum works on improving the identification process of those product attributes consumers deem important (e.g., Van Ittersum, Pennings, Wansink, & Van Trijp, 2004a; 2004b). Dr. Van Ittersum also has an extensive practical background in agriculture and is aware of factors that influence the decision-making process of farmers. Muge Capar is a first year PhD student with an interest in drivers of the acceptance of new products and technologies. Dr. Parsons is an expert on market response models (e.g., Hanssens, Parsons, & Schultz, 2001). His current interests are in marketing productivity and benchmarking (e.g., Parsons 2002).

Name	Highest Degree	Research Focus
Muge Capar	B.S. in Management Science and Engineering, Istanbul Technical University	Technology acceptance
Leonard Parsons	Ph.D. in Industrial Administration, Purdue University	Market mix models; marketing productivity
Koert van Ittersum	Ph.D. in Marketing and Consumer Behavior, Wageningen University, The Netherlands	Consumer decision-making and choice; the role of risk attitude and risk perception on consumer risk behavior; improving the identification process of those product attributes consumers deem important

Other Students

Given the magnitude of this project, assistance was needed from many persons. We acknowledge the contributions of Kaylee Burnham, Jayme Gergen, Gillian Housman, Esther Millard, , Daniel Rice, Emily Seifert, and Amy (Na) Wen.

Appendix B: Definition of Constructs

Characteristic	Definition
Ease of Use	The degree to which the potential adopter expects a technological innovation to be free of effort (Davis, 1996; Moore & Benbasat, 1991)
Complexity	The degree to which an innovation is perceived as difficult to understand and use (Rogers, 2003)
Compatibility	The degree to which an innovation is perceived as being consistent with existing values, needs, and past experiences of potential adopters (Moore & Benbasat, 1991)
Trialability	The degree to which an innovation may be experimented with on a limited basis (Moore & Benbasat, 1991)
Observability & Visibility	The degree to which results of an innovation are visible to others (Rogers, 2003)
Result Demonstrability	The degree to which the benefits and utility of an innovation are readily apparent to the potential adopter (Moore & Benbasat, 1991)
Voluntariness	The degree to which use of an innovation is perceived as being voluntary or of free will (Moore & Benbasat, 1991)
Price	Price of technology
Usefulness	The extent to which a technology is expected to improve a potential adopter's performance (Davis, 1980, 1996)
Relative Advantage	The degree to which an innovation is perceived to be superior to current offerings (Rogers, 2003)
Image	The degree to which potential adopters believe the adoption of a technology will bestow them with added prestige in their relevant community (Moore & Benbasat, 1991)
Fun & Enjoyment	The extent to which using the technology results in enjoyment and perceived fun
Newness	The potential adopter's perception of the newness of a technology
Privacy	The perception of the privacy that the tech. provides
Network Effects	The effects of the number of customers already owning/using that technology
Value	The difference between perceived benefits and costs of a technology
Risk	Perceived risk involved in accepting a technology

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Privacy	The perception of the privacy that the tech. provides
Network Effects	The effects of the number of customers already owning/using that technology
Value	The difference between perceived benefits and costs of a technology
Risk	Perceived risk involved in accepting a tech
Demographics	
Age	Age of the (potential) user
Gender	Gender of the (potential) user
Income	Income level of the (potential) user
Education	Education level of the (potential) user
Training & Experience	Training about (using) the technology & experience with similar technologies
Knowledge & Involvement	Knowledge on the technology/ pre-existing technologies & involvement with the tech
Tenure	Tenure in the workforce
Psychographics	
Technology Readiness	People's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (Parasuraman, 2000; p. 308)
Innovativeness	The predisposition to buy new and different products and brands rather than remain with previous choices and consumption patterns (Steenkamp, Hofstede, & Wedel, 1999)

Characteristic	Definition
Trust	Trust refers to trust in the technology provider
Privacy Concerns	Consumers' concerns about whether the information they provide to the technology provider by using its product/service will be protected from others, or whether the technology provider will take advantage of the information they gather through the use of its product/service
Technophobia	The fear of or dislike for new technology
Self-Efficacy	Judgment of one's ability to use a technology to accomplish a particular job or task (Venkatesh, Morris, Davis, and Davis, 2003)
Anxiety	Evoking anxious or emotional reactions when it comes to performing a behavior" (Venkatesh, Morris, Davis, and Davis, 2003)
Subjective Norm	The person's perception that most people who are important to him think he should or should not perform the behavior in question (Fishbein and Ajzen 1975, p. 302)
Dogmatism	The extent to which a person can react to relevant information on its own merits, unencumbered by irrelevant factors in the situation (Blake, Perloff, & Heslin, 1970)
Intrinsic Motivation	The perception that users will want to perform an activity "for no apparent reinforcement other than the process of performing the activity per se (Davis, Bagozzi, and Warshaw, 1992, p.1112)

Appendix C: Questionnaire from Pre-test

Please read the information below before answering the questions.

Cell Phones with a Global Positioning System

The latest in cell phone technology concerns what is called a *Global Positioning System*, or *GPS*. GPS is a positioning system that uses satellite signals to determine the exact location of vehicles, vessels, and individuals on earth (based on longitude and latitude). Having this feature on your cell phone allows you to always determine exactly where you are and how to get where you want to go, in a city, in the countryside, or for instance on campus. It also allows you to automatically geo-locate every single call you make, picture you take, or document you create. In addition, it enables you to track friends and family and it enables friends and family to track you (with the express permission of those involved).

The system also provides emergency services with location information – e.g., a 911 call can be quickly located (no express permission required). The side-effect, invoking a sense of "big-brother" in its darker manifestation but a life-saving tool in the lighter, is that you can be tracked wherever you are on the planet as long as you have you cell phone with you. The likelihood that your location information falls in the wrong hands and breaches your privacy is 1 in 1,000.

The price of a cell phone with a Global Positioning System, a GPS cell phone, will be highly comparable to existing cell phones. The costs to use the GPS are approximately $5.00 per month. The cell phone industry will introduce this new technology in the coming 36 months.

1. Please indicate what your attitude is towards a cell phone with GPS technology by circling the appropriate responses?

Bad	1	2	3	4	5	6	7	**Good**
Unfavorable	1	2	3	4	5	6	7	**Favorable**
Negative	1	2	3	4	5	6	7	**Positive**

2. Please indicate what is your intention is to buy a cell phone with GPS technology by circling the appropriate responses?

No intention	1	2	3	4	5	6	7	**Strong intention**
Unlikely	1	2	3	4	5	6	7	**Likely**

3. Will you buy a cell phone with GPS technology? ☐ **Yes** ☐ **No**

4. How likely is it that you will buy a cell phone with GPS technology?

Unlikely										**Very Likely**
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

5. Considering the likelihood that my location information falls into the wrong hands, breaching my privacy, for me, owning a cell phone with GPS would be……

Risky	1	2	3	4	5	6	7	**Not risky**

6. Considering the likelihood that my location information falls into the wrong hands, for me, owning a cell phone with GPS would be worth the privacy risk.

Strongly disagree	1	2	3	4	5	6	7	**Strongly agree**

7. Considering the likelihood that my location information falls into the wrong hands, breaching my privacy, I would . . .

…not be willing to own a cell phone with GPS	1	2	3	4	5	6	7	**…be willing to own a cell phone with GPS**

8. Considering the likelihood that my location information falls into the wrong hands, breaching my privacy, owning a cell phone with GPS would expose me to. . .

Much privacy risk	1	2	3	4	5	6	7	**Not much privacy risk**

9. Considering the likelihood that my location information falls into the wrong hands, breaching my privacy, please circle the appropriate responses:

	Strongly Disagree						**Strongly Disagree**
a. I would be concerned with owning a cell phone with GPS	1	2	3	4	5	6	7
b. I think owning a cell phone with GPS would be risky	1	2	3	4	5	6	7
c. I would be willing to accept the privacy risk of owning a cell phone with GPS	1	2	3	4	5	6	7

10. What do you think is the chance that *your location information* falls into the wrong hands, breaching your privacy?

Very small 1 2 3 4 5 6 7 **Very large**

11. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree						**Strongly Disagree**
Using a GPS cell phone in my life would enable me to accomplish tasks more quickly	1	2	3	4	5	6	7
Using a GPS cell phone would improve my life performance	1	2	3	4	5	6	7
Using a GPS cell phone in my life would increase my productivity	1	2	3	4	5	6	7
Using a GPS cell phone would enhance my effectiveness	1	2	3	4	5	6	7
Using a GPS cell phone would make my life easier	1	2	3	4	5	6	7
I would find a GPS cell phone useful in my life	1	2	3	4	5	6	7
Use of a GPS cell phone will have no effect on my life performance	1	2	3	4	5	6	7
Use of a GPS cell phone can decrease the time needed for my important responsibilities in life	1	2	3	4	5	6	7
Use of a GPS cell phone can significantly increase the quality of my output	1	2	3	4	5	6	7
Use of a GPS cell phone can increase the effectiveness of performing tasks and activities	1	2	3	4	5	6	7
Use of a GPS cell phone can increase the quantity of output for the same amount of effort	1	2	3	4	5	6	7
Using a GPS cell phone improves the quality of the work I do	1	2	3	4	5	6	7
Using a GPS cell phone increases my productivity	1	2	3	4	5	6	7
If I use a GPS cell phone...							
I will increase my effectiveness	1	2	3	4	5	6	7

I will spend less time on routine tasks	1	2	3	4	5	6	7
I will increase the quality of output	1	2	3	4	5	6	7
I will increase the quantity of output for the same amount of effort	1	2	3	4	5	6	7
My friends will perceive me as competent	1	2	3	4	5	6	7
I will increase my chances of being rewarded	1	2	3	4	5	6	7
I will increase my chances of getting a raise	1	2	3	4	5	6	7
Learning to operate a GPS cell phone would be easy for me	1	2	3	4	5	6	7
I would find it easy to get a GPS cell phone to do what I want it to do	1	2	3	4	5	6	7
My interaction with a GPS cell phone would be clear and understandable	1	2	3	4	5	6	7
I would find a GPS cell phone to be flexible to interact with	1	2	3	4	5	6	7
It would be easy for me to become skillful at using a GPS cell phone	1	2	3	4	5	6	7
I would find a GPS cell phone easy to use	1	2	3	4	5	6	7

	Strongly Disagree						**Strongly Disagree**
Using a GPS cell phone would take too much time from my normal activities	1	2	3	4	5	6	7
Working with a GPS cell phone would be so complicated, it would be difficult to understand what is going on	1	2	3	4	5	6	7
Using a GPS cell phone would involve too much time doing mechanical operations (e.g., data input)	1	2	3	4	5	6	7
It will take too long to learn how to use a GPS cell phone to make it worth the effort	1	2	3	4	5	6	7
I think that people who influence my behavior think that I should use a GPS cell phone	1	2	3	4	5	6	7
I think that people who are important to me think that I should use a GPS cell phone	1	2	3	4	5	6	7
I will use a GPS cell phone because of the proportion of friends and family who use a GPS cell phone	1	2	3	4	5	6	7
My friends and family will be helpful in the use of a GPS cell phone	1	2	3	4	5	6	7
My friends and family will be very supportive of the use of a GPS cell phone for my job	1	2	3	4	5	6	7
In general, my friends and family will support the use of a GPS cell phone	1	2	3	4	5	6	7
People who own a GPS cell phone have more prestige than those who do not	1	2	3	4	5	6	7
People who own a GPS cell phone have a high profile	1	2	3	4	5	6	7
Having a GPS cell phone is a status symbol in my social environment	1	2	3	4	5	6	7
I would have control over using a GPS cell phone	1	2	3	4	5	6	7
I have the resources necessary to use a GPS cell phone	1	2	3	4	5	6	7
I have the knowledge necessary to use a GPS cell phone	1	2	3	4	5	6	7
Given the resources, opportunities and knowledge it takes to use a GPS cell phone, it would be easy for me to use a GPS cell phone	1	2	3	4	5	6	7
A GPS cell phone is not compatible with other systems I use	1	2	3	4	5	6	7

	Strongly Disagree						Strongly Disagree
Guidance will be available to me in the selection of a GPS cell phone	1	2	3	4	5	6	7
Specialized instruction concerning a GPS cell phone will be available to me	1	2	3	4	5	6	7
A specific person (or group) will be available for assistance with system difficulties	1	2	3	4	5	6	7
Using a GPS cell phone is compatible with all aspects of my life	1	2	3	4	5	6	7
I think that using a GPS cell phone fits well with the way I like to live	1	2	3	4	5	6	7
Using a GPS cell phone fits into my life style	1	2	3	4	5	6	7
Using a GPS cell phone is a good idea	1	2	3	4	5	6	7
Using a GPS cell phone is a foolish idea	1	2	3	4	5	6	7
I dislike the idea of using a GPS cell phone	1	2	3	4	5	6	7
Using a GPS cell phone is pleasant	1	2	3	4	5	6	7
Using a GPS cell phone will be enjoyable	1	2	3	4	5	6	7
The actual process of using a GPS cell phone will be pleasant	1	2	3	4	5	6	7
I will have fun using a GPS cell phone	1	2	3	4	5	6	7
A GPS cell phone makes life more interesting	1	2	3	4	5	6	7
Working with a GPS cell phone is fun	1	2	3	4	5	6	7
A GPS cell phone is okay for some jobs, but not the kind of job I want	1	2	3	4	5	6	7
I would like working with a GPS cell phone	1	2	3	4	5	6	7
I look forward to those aspects of my life that require me to use a GPS cell phone	1	2	3	4	5	6	7
Using a GPS cell phone would be frustrating for me	1	2	3	4	5	6	7
Once I start working on a GPS cell phone, I will find it hard to stop	1	2	3	4	5	6	7
I will get bored quickly when using a GPS cell phone	1	2	3	4	5	6	7
I feel apprehensive about using a GPS cell phone	1	2	3	4	5	6	7
It scares me to think I could lose location information using a GPS cell phone	1	2	3	4	5	6	7
I hesitate to use a GPS cell phone for fear of ending up with problems that cannot be corrected	1	2	3	4	5	6	7
A GPS cell phone is somewhat intimidating to me	1	2	3	4	5	6	7
A GPS cell phone is a novel product	1	2	3	4	5	6	7
I consider cell phones with GPS radically new products	1	2	3	4	5	6	7

17. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree						**Strongly Disagree**
Technology gives people more control over their daily lives	1	2	3	4	5	6	7
Products and services that use the newest technologies are much more convenient to us	1	2	3	4	5	6	7
I like the idea of doing business via computers because I am not limited to regular business hours	1	2	3	4	5	6	7
I prefer to use the most advanced technology available	1	2	3	4	5	6	7
I like computer programs that allow me to tailor things to fit my own needs	1	2	3	4	5	6	7
Technology makes me more efficient in my occupation	1	2	3	4	5	6	7
I find technologies to be mentally stimulating	1	2	3	4	5	6	7
Technologies give me more freedom of mobility	1	2	3	4	5	6	7
Learning about technology can be as rewarding as the technology itself	1	2	3	4	5	6	7
I feel confident that machines will follow through with what I instructed them to do	1	2	3	4	5	6	7
Other people come to me for advice on new technologies	1	2	3	4	5	6	7
It seems my friends are learning more about the newest technologies than I am	1	2	3	4	5	6	7
In general, I am among the first in my circle of friends to acquire new technology when it appears	1	2	3	4	5	6	7
I can usually figure out new high-tech products and services without help from others	1	2	3	4	5	6	7
I keep up with the latest technological developments in my areas of interest	1	2	3	4	5	6	7
I enjoy the challenge of figuring out high-tech gadgets	1	2	3	4	5	6	7
I find I have fewer problems than other people in making new technology work for me	1	2	3	4	5	6	7
Technical support lines are not helpful because they don't explain things in terms I understand	1	2	3	4	5	6	7
Sometimes, I think that technology systems are not designed for use by ordinary people	1	2	3	4	5	6	7
There is no such thing as a manual for a high-tech product or service that is written in plain language	1	2	3	4	5	6	7
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1	2	3	4	5	6	7
If I buy a high-tech product or service, I prefer to have the basic model over one with a lot of extra features	1	2	3	4	5	6	7
It is embarrassing when I have trouble with a high-tech gadget while people are watching	1	2	3	4	5	6	7
There should be caution in replacing important people-tasks with technology because new technology can breakdown or get disconnected	1	2	3	4	5	6	7

	Strongly Disagree						**Strongly Disagree**
Many new technologies have health or safety risks that are not discovered until after people have used them	1	2	3	4	5	6	7
New technology makes it too easy for governments and companies to spy on people	1	2	3	4	5	6	7
Technology always seems to fail at the worst possible time	1	2	3	4	5	6	7
I do not consider it safe giving out a credit card number over a computer	1	2	3	4	5	6	7
I do not consider it safe to do any kind of financial business online	1	2	3	4	5	6	7
I worry that information I send over the internet will be seen by other people	1	2	3	4	5	6	7
I do not feel confident doing business with a place that can only be reached online	1	2	3	4	5	6	7
Any business transaction I do electronically should be confirmed later with something in writing	1	2	3	4	5	6	7
Whenever something gets automated, you need to check carefully that the machine or computer is not making mistakes	1	2	3	4	5	6	7
The human touch is very important when doing business with a company	1	2	3	4	5	6	7
When I call a business, I prefer to talk to a person rather than a machine	1	2	3	4	5	6	7
If you provide information to a machine or over the internet, you can never be sure it really gets to the right place	1	2	3	4	5	6	7
I feel apprehensive about using technology	1	2	3	4	5	6	7
Technical terms sound like confusing jargon to me	1	2	3	4	5	6	7
I have avoided technology because it is unfamiliar to me	1	2	3	4	5	6	7
I hesitate to use most forms of technology for fear of making mistakes I cannot correct	1	2	3	4	5	6	7
Even though certain products are available in a number of different formats, I tend to buy the same format all the time	1	2	3	4	5	6	7
I would rather stick with a brand I usually buy than try something I am not very sure of	1	2	3	4	5	6	7
I think of myself as a brand-loyal consumer	1	2	3	4	5	6	7
When I see a new brand on the shelf, I am not afraid to give it a try	1	2	3	4	5	6	7
When I go to a restaurant, I feel it is safer to order dishes I am familiar with	1	2	3	4	5	6	7
If I like a brand, I rarely switch from it just to try something different	1	2	3	4	5	6	7
I am very cautious in trying new or different products	1	2	3	4	5	6	7
I enjoy taking chances in buying unfamiliar brands just to get some variety in my purchases	1	2	3	4	5	6	7

	Strongly Disagree						**Strongly Disagree**
I rarely buy brands about which I am uncertain how they will perform	1	2	3	4	5	6	7
I like being exposed to new ideas	1	2	3	4	5	6	7
I hate any change in my routines and habits	1	2	3	4	5	6	7
I constantly find new ways of living to improve over my past ways	1	2	3	4	5	6	7
I enjoy the novelty of owning new products	1	2	3	4	5	6	7
Purchasing new products takes too much time and effort	1	2	3	4	5	6	7
I relish the gamble involved in buying new products	1	2	3	4	5	6	7
Products are getting shoddier and shoddier	1	2	3	4	5	6	7
Others often ask me for advice about new products	1	2	3	4	5	6	7
Many new products allow firms or governments to spy on individuals	1	2	3	4	5	6	7
New products have an unacceptable high price	1	2	3	4	5	6	7
I am eager to buy new products as soon as they come out	1	2	3	4	5	6	7
I have a lot of knowledge about GPS technology	1	2	3	4	5	6	7
I am very familiar with GPS technology	1	2	3	4	5	6	7
I think that paying $5 per month to use the GPS technology on my cell phone is a great value	1	2	3	4	5	6	7
I would be concerned about my privacy when using a cell phone with GPS technology	1	2	3	4	5	6	7
Adding GPS to cell phones is very innovative	1	2	3	4	5	6	7
GPS cell phones are radical new products	1	2	3	4	5	6	7

22a. What is your gender? ☐ Female ☐ Male

22b. What is your age? _____ years

Appendix D: Scales not Included in the Survey

	Strongly Disagree						Strongly Disagree
TRIABILITY							
Meuter, Bitner, Ostrom, & Brown (2005)							
I can use the [technology] on a trial basis to see what it can do.	1	2	3	4	5	6	7
It is easy to try out the [technology] without a big commitment.	1	2	3	4	5	6	7
I've had opportunities to try out the [technology].	1	2	3	4	5	6	7
Plouffe, Hulland, & Vandenbosch (2001)							
Before deciding whether to use the [technology], I was able to properly try it out.	1	2	3	4	5	6	7
I was permitted to use a [technology] on a trial basis long enough to see what it could do.	1	2	3	4	5	6	7
RESULT DEMONSTRABILITY							
Venkatesh & Davis (2000)							
I have no difficulty telling others about the results of using a [technology].	1	2	3	4	5	6	7
I believe I could communicate to others the consequences of using a [technology].	1	2	3	4	5	6	7
The results of using a [technology] are apparent to me.	1	2	3	4	5	6	7
I would have difficulty explaining why using the [technology] may or may not be beneficial.	1	2	3	4	5	6	7
OBSERVABILITY/VISIBILITY							
Plouffe, Hulland, & Vandenbosch (2001)							
In my organization, one sees [technology] on many desks.	1	2	3	4	5	6	7
[Technology] is not very visible in my organization/community.	1	2	3	4	5	6	7

HYBRID RIDING MOWER QUESTIONNAIRE

What do we mean by a hybrid riding mower?

A hybrid riding mower typically has a gas or diesel engine that not only powers the riding unit, but also runs an alternator. This alternator powers the cutting units independently of propulsion speed. The hybrid approach eliminates all the hydraulics in the cutting units.

1. How do you cut your ……. greens? ☐ Walk-behind ☐ Riding
……. fairways? ☐ Walk-behind ☐ Riding

2. Please answer the following questions regarding your company's riding mowers.

	Regular	**Hybrid**
a. How many of the following mowers does your organization have?	_____	_____
b. What is the average age of the riding mowers?	_____	_____
c. What is the age of the oldest riding mower you have?	_____	_____
d. What is the average age for replacement of a riding mower?	_____	_____

3. Were you aware of hybrid riding mowers prior to this survey?

☐ **No** ☐ **Yes, I first learned about hybrid riding mowers _____ months ago, through…**
☐ the Media
☐ the Distributor
☐ Other - namely ……

4. Do you currently own a hybrid riding mower?

☐ **No** ☐ **Yes, we bought our first hybrid riding mower _____ months ago**.

5. Please indicate how much experience you have with the following items.

	I have no experience				I have a lot of experience
Operating regular riding mower	1	2	3	4	5
Operating hybrid riding mower	1	2	3	4	5
Operating electrical equipment (e.g. hybrid cars)	1	2	3	4	5
Mower maintenance	1	2	3	4	5

6. Please indicate what your attitude is towards a hybrid riding mower, relative to a regular riding mower, by circling the appropriate responses.

Bad	1	2	3	4	5	**Good**
Unfavorable	1	2	3	4	5	**Favorable**
Negative	1	2	3	4	5	**Positive**

7. Please indicate what your intention is to buy a hybrid riding mower.

No intention	1	2	3	4	5	**Strong intention**
Unlikely	1	2	3	4	5	**Likely**

8. Will you buy a hybrid riding mower, and if so, how many will you buy?

☐ **No** ☐ **Yes, … I expect to buy _____ hybrid riding mowers as replacements**
… I expect to buy _____ hybrid riding mowers as additions

9. When do you expect you will have bought a hybrid riding mower?

_____ months from now ☐ **We will never buy one**

10. Below you find eleven moments in time, ranging from "This month" to "5 years from now." Please indicate for each moment the probability that you will have bought a hybrid riding mower by circling the appropriate response.

	I will not have bought one										**I will have bought one**
This month	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
6 months **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 year **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 ½ years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
5 years **from now**	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

11. Please indicate for each statement about hybrid riding mowers to what extent you agree with it or feel it applies to you by circling the appropriate response (relative to regular riding mowers).

	Strongly Disagree				**Strongly Agree**
Use of a hybrid riding mower can increase the effectiveness of performing tasks and activities	1	2	3	4	5
I would be concerned about performance when using a hybrid riding mower	1	2	3	4	5
Using a hybrid riding mower increases our productivity	1	2	3	4	5
It would cost a lot to use a hybrid riding mower	1	2	3	4	5
Learning to operate a hybrid riding mower would be easy for us	1	2	3	4	5
I am not required to use the hybrid riding mower	1	2	3	4	5
We would find a hybrid riding mower easy to use	1	2	3	4	5
Using a hybrid riding mower would take too much time from our normal activities	1	2	3	4	5
In my organization, one sees a hybrid riding mower on many courses	1	2	3	4	5
Using a hybrid riding mower would involve too much time doing mechanical operations	1	2	3	4	5
Using a hybrid riding mower is compatible with all aspects of our work	1	2	3	4	5
I believe I could communicate to others the consequences of using a hybrid riding mower	1	2	3	4	5
Using a hybrid riding mower fits into our work	1	2	3	4	5
I consider hybrid riding mowers radically new products	1	2	3	4	5

	Strongly Disagree				Strongly Agree
The use of the hybrid riding mower is voluntary	1	2	3	4	5
We can use a hybrid riding mower on a trial basis to see what it can do	1	2	3	4	5
Using a hybrid riding mower improves the quality of our work	1	2	3	4	5
We have had opportunities to try out the hybrid riding mower	1	2	3	4	5
I have no difficulty telling others about the results of using a hybrid riding mower	1	2	3	4	5
Adding hybrid technology to riding mowers is very innovative	1	2	3	4	5
The results of using a hybrid riding mower are apparent to me	1	2	3	4	5
Using a hybrid riding mower fits well with the way we like to work	1	2	3	4	5
I would have difficulty explaining why using the hybrid riding mower may or may not be beneficial	1	2	3	4	5
Working with a hybrid riding mower would be so complicated, it would be difficult to understand what is going on	1	2	3	4	5
The hybrid riding mower is not very visible in my organization	1	2	3	4	5
It would be easy for us to become skilful at using a hybrid riding mower	1	2	3	4	5
Although it might be helpful, using a hybrid riding mower is certainly not compulsory in our job	1	2	3	4	5
Hybrid riding mowers are radical new products	1	2	3	4	5
If we use a hybrid riding mower, we will increase the quality of output	1	2	3	4	5
There are financial barriers to me using hybrid riding mower	1	2	3	4	5
It is easy to try out the hybrid riding mower without a big commitment	1	2	3	4	5

12. Please respond to the following statements regarding your beliefs about the performance of the hybrid riding mower (relative to regular riding mowers).

	Strongly Disagree				Strongly Agree
The hybrid riding mower yields quality output	1	2	3	4	5
The hybrid riding mower will cause maintenance problems	1	2	3	4	5
We will have no problems in fixing the hybrid riding mower in case of a breakdown	1	2	3	4	5
The replacement costs of failed parts of the hybrid riding mower will be high	1	2	3	4	5
Adopting the hybrid riding mower will require training of technical staff	1	2	3	4	5
We will incur high maintenance costs when using a hybrid riding mower	1	2	3	4	5
The benefits of using the hybrid riding mower will compensate for the increasing cost of fuel	1	2	3	4	5
The hybrid riding mower will perform well in heavy tasks (e.g. thick, long, wet grass)	1	2	3	4	5
The electrical component of the hybrid riding mower will fail in a wet environment	1	2	3	4	5
Diagnosing problems with a hybrid riding mower will be easy	1	2	3	4	5
The hybrid riding mower will reduce leak problems	1	2	3	4	5
The hybrid riding mower will be less noisy	1	2	3	4	5
Using a hybrid riding mower will be good for the environment	1	2	3	4	5

13. Considering the potential advantages and disadvantages of the hybrid riding mower, please circle the appropriate responses:

	Risky				**Not risky**
a. Relative to regular riding mower, using a hybrid riding mower would be…	1	2	3	4	5

	…not be willing to use a hybrid riding mower				**…be willing to** use a hybrid riding mower
b. I would …	1	2	3	4	5

	Much Risk				**Not much Risk**
c. Using a hybrid riding mower would expose me to…	1	2	3	4	5

	Strongly Disagree				**Strongly Agree**
d. I would be concerned about using a hybrid riding mower	1	2	3	4	5
e. I think using a hybrid riding mower would be risky	1	2	3	4	5
f. I would be willing to accept the risk of using a hybrid riding mower	1	2	3	4	5

14. The following statements are about your general thoughts and feelings regarding technology. Please indicate for each statement to what extent you agree with it.

	Strongly Disagree				**Strongly Agree**
I prefer to use the most advanced technology available	1	2	3	4	5
There is no such thing as a manual for a high-tech product or service that is written in plain language	1	2	3	4	5
Technology makes me more efficient in my occupation	1	2	3	4	5
I can usually figure out new high-tech products and services without help from others	1	2	3	4	5
I do not consider it safe to do any kind of financial business online	1	2	3	4	5
I find I have fewer problems than other people in making new technology work for me	1	2	3	4	5
Technical support lines are not helpful because they don't explain things in terms I understand	1	2	3	4	5
I like computer programs that allow me to tailor things to fit my own needs	1	2	3	4	5
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1	2	3	4	5
I do not consider it safe giving out a credit card number over a computer	1	2	3	4	5
I enjoy the challenge of figuring out high-tech gadgets	1	2	3	4	5
I worry that information I send over the internet will be seen by other people	1	2	3	4	5

15. The following statements are about your thoughts about the hybrid riding mowers, relative to regular riding mowers. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
I have a lot of knowledge about hybrid riding mowers	1	2	3	4	5
My colleagues will be very supportive of the use of a hybrid riding mower for our job	1	2	3	4	5
I am very familiar with hybrid riding mowers	1	2	3	4	5
I think that people who influence my behavior think that we should use a hybrid riding mower	1	2	3	4	5
My colleagues will be helpful in the use of a hybrid riding mower	1	2	3	4	5
We have the knowledge necessary to use a hybrid riding mower	1	2	3	4	5
In general, my colleagues will support the use of a hybrid riding mower	1	2	3	4	5
Golf courses which own a hybrid riding mower have more prestige than those who do not	1	2	3	4	5
We do not have much experience using hybrid riding mowers	1	2	3	4	5
Having a hybrid riding mower is a status symbol in my social environment	1	2	3	4	5
We have the resources necessary to use a hybrid riding mower	1	2	3	4	5
Specialized instruction concerning a hybrid riding mower will be available to us	1	2	3	4	5
In light of the resources, opportunities, and knowledge required to use a hybrid riding mower, it would be easy for us to use a hybrid riding mower	1	2	3	4	5
I think that people who are important to me think that we should use a hybrid riding mower	1	2	3	4	5
Assistance will be available to deal with system difficulties	1	2	3	4	5
Golf courses which own a hybrid riding mower have a high profile	1	2	3	4	5

16. The following statements are about your feelings about the hybrid riding mowers, relative to regular riding mowers. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
Operators would think using a hybrid riding mower is pleasant	1	2	3	4	5
It scares me to think I could get into problems when using a hybrid riding mover	1	2	3	4	5
Operators would find working with a hybrid riding mower is fun	1	2	3	4	5
I hesitate to use a hybrid riding mower for fear of ending up with problems that cannot be corrected	1	2	3	4	5
Operators would like working with a hybrid riding mower	1	2	3	4	5
A hybrid riding mower is somewhat intimidating to me	1	2	3	4	5

Please answer the following questions about your organization:

17. In which state of the country is your golf course located? _____

18. Which of the following best describes the location of your organization?

☐ **Desert** ☐ **Near coast** ☐ **Mountains** ☐ **None applicable**

19. Which time of the year is your golf course open? (Please select as many as needed.)

☐ **Spring** ☐ **Summer** ☐ **Fall** ☐ **Winter**

20. Please indicate which one(s) of the following best describe the terrain of your golf course.

☐ **Hilly** ☐ **Flat** ☐ **Woods** ☐ **Water** ☐ **Rock** ☐ **Sandy**

21. Please indicate the quality of your course. ☐ **Tournament level** ☐ **Non-tournament level**

22. Which description is most appropriate for your organization?

☐ **Golf course at housing development** ☐ **Separate golf course**

23. How would you classify your golf course? ☐ **Private** ☐ **Daily fee** ☐ **Municipality** ☐ **Other**

24. Do you charge monthly dues? ☐ **Yes** ☐ **No**

If **no**, do you charge fee? ☐ **Yes** ☐ **No**

If **yes**, how much is fee? ☐ ≤ $25 ☐ $26 – $50 ☐ $51 – $75 ☐ $76 – $100 ☐ > $100

25. Please indicate how many of the following holes your organization has and how many yards long these holes are (total yards).

Number of Holes	**Total yards**
_____ Regular holes	_____ yards
_____ Executive holes	_____ yards
_____ Par 3 holes	_____ yards

26. How much influence do the following people have regarding riding mower purchases?

	Not much influence				**Much influence**
Superintendent	1	2	3	4	5
Mechanical Staff	1	2	3	4	5
Operator	1	2	3	4	5
Others _____	1	2	3	4	5

27. What is the size of your maintenance staff? _____

28. What is your annual budget for mechanics? **$**_____

29. If a regular riding mower costs $30,000, how much are you willing to pay for a hybrid riding mower?

$_____

Please answer the following questions about yourself:

30. What is your current position in the organization? _____

31. Please indicate how much influence you have regarding the riding mower purchase for your organization.

- ☐ **I make the final decision.**
- ☐ **I do not make the final decision, but I have a significant influence on the final decision.**
- ☐ **I have some influence on the final decision, but others have more influence than I do.**
- ☐ **I do not have any influence on the final decision.**

32. What was your prior job position?

- ☐ **Mechanic** ☐ **Operator**
- ☐ **Assistant superintendent at the same golf course**
- ☐ **Superintendent at another golf course**
- ☐ **Assistant superintendent at another golf course**
- ☐ **Other _____**

33. How many years have you been working in the golf course industry? _____ **years**

34. Describe your educational history. Check as many as needed and please describe your major.

Level of education	**Major**
☐ No formal education	_____
☐ Less than high school graduate	_____
☐ High school graduate/GED	_____
☐ Vocational training	_____
☐ Some college/Associate's degree	_____
☐ Bachelor's degree (BA, BS)	_____
☐ Master's degree (or other post-graduate training)	_____
☐ Doctoral degree (PhD, MD, EdD, DDS, JD, etc.)	_____

35. What is your gender? ☐ **Female** ☐ **Male**

36. What is your age? _____ **years**

37. Please describe any factors that made you decide (not) to buy a hybrid riding mower.

……
……
……
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Thank you for your participation!!

AUTO GUIDANCE SYSTEM QUESTIONNAIRE

What do we mean by an auto guidance system?

An auto guidance system is a technology that automatically steers farm machinery via Global Positioning Systems (GPS) satellites.

**** Different auto guidance systems are available on the market and different available systems have different features. We are less interested in specific features different systems may have. We are primarily interested in your opinion about the one thing that all auto guidance systems share – the ability to automatically steer farm machinery using GPS satellites. Most of the questions that you will be asked to answer deal with the auto guidance system. For instance, when we ask you whether were aware of auto guidance systems prior to this survey, we are interested in your awareness of any auto guidance system. Towards the end of the questionnaire, you will be asked some questions about specific features associated with some auto guidance systems.*

1. Were you aware of auto guidance systems prior to this survey?

☐ **No**

☐ **Yes, I first learned about auto guidance systems _____ months ago,**
through… ☐ the Media
☐ the Distributor
☐ Other - namely ……

2. Do you currently own an auto guidance system?

☐ **No** ☐ **Yes, I bought my first auto guidance system_____ months ago**.

If **Yes:**

a. How many auto guidance systems do you own?	_____ systems
b. What is the average age of your auto guidance systems?	_____ years

c. On how many vehicles do you actually use the auto guidance system? _____ vehicle(s)

3. How many vehicles do you own that might be equipped with an auto guidance system? _____ vehicles

4. Please indicate how much experience you have with the following items.

	I have no experience				**I have a lot of experience**
Operating vehicles without an auto guidance system	1	2	3	4	5
Operating vehicles with an auto guidance system	1	2	3	4	5
Installing auto guidance systems	1	2	3	4	5
Global Positioning Systems (GPS)	1	2	3	4	5

5. Please indicate what your attitude is towards auto guidance systems, relative to traditional steering, by circling the appropriate responses.

Bad	1	2	3	4	5	**Good**
Unfavorable	1	2	3	4	5	**Favorable**
Negative	1	2	3	4	5	**Positive**

6. Please indicate what your intention is to buy an auto guidance system.

No intention	1	2	3	4	5	**Strong intention**
Unlikely	1	2	3	4	5	**Likely**

7. Will you buy an auto guidance system, and if so, how many will you buy?

☐ **No** ☐ **Yes, … I expect to buy _____ auto guidance systems as replacements**
… I expect to buy _____ auto guidance systems as additions

8. When do you expect you will have bought an auto guidance system?

_____ months from now ☐ **I will never buy one**

9. Below you see eleven moments in time, ranging from "This month" to "5 years from now." Please indicate for each moment the probability that you will have bought an auto guidance system by circling the appropriate response.

	I will not have bought one										**I will have bought one**
This month	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
6 months from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 year from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
2 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
3 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
4 ½ years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
5 years from now	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

10. Please indicate for each statement about auto guidance systems to what extent you agree with it or feel it applies to you by circling the appropriate response (relative to traditional steering).

	Strongly Disagree				**Strongly Agree**
Use of an auto guidance system can increase the effectiveness of performing tasks and activities	1	2	3	4	5
I would be concerned about performance when using an auto guidance system	1	2	3	4	5
Using an auto guidance system increases my productivity	1	2	3	4	5
It would cost a lot to use an auto guidance system	1	2	3	4	5
Learning to operate an auto guidance system would be easy for me	1	2	3	4	5
I am not required to use the auto guidance system	1	2	3	4	5
I would find an auto guidance system easy to use	1	2	3	4	5
Using an auto guidance system would take too much time from my normal activities	1	2	3	4	5
One sees auto guidance systems on many farms	1	2	3	4	5
Using an auto guidance system would involve too much time doing mechanical operations	1	2	3	4	5
Using an auto guidance system is compatible with all aspects of my work	1	2	3	4	5
I believe I could communicate to others the consequences of using an auto guidance system	1	2	3	4	5
Using an auto guidance system fits into my work	1	2	3	4	5
I consider auto guidance systems a radically new technology	1	2	3	4	5
The use of the auto guidance system is voluntary	1	2	3	4	5
I can use an auto guidance system on a trial basis to see what it can do	1	2	3	4	5
Using an auto guidance system improves the quality of my work	1	2	3	4	5

I have had opportunities to try out the auto guidance system	1	2	3	4	5
I have no difficulty telling others about the results of using an auto guidance system	1	2	3	4	5
Adding auto guidance systems to farm machinery is very innovative	1	2	3	4	5
The results of using an auto guidance system are apparent to me	1	2	3	4	5
Using an auto guidance system fits well with the way I like to work	1	2	3	4	5
I would have difficulty explaining why using the auto guidance system may or may not be beneficial	1	2	3	4	5
Working with an auto guidance system would be so complicated, it would be difficult to understand what is going on	1	2	3	4	5
The auto guidance system is not very visible on my farm	1	2	3	4	5
It would be easy for me to become skilful at using an auto guidance system	1	2	3	4	5
Although it might be helpful, using an auto guidance system is certainly not compulsory in my job	1	2	3	4	5
Auto guidance systems are radical new products	1	2	3	4	5
If I use an auto guidance system, I increase the quality of output	1	2	3	4	5
There are financial barriers to me using an auto guidance system	1	2	3	4	5
It is easy to try out the auto guidance system without a big commitment	1	2	3	4	5

11. Please respond to the following statements regarding your beliefs about the performance of the auto guidance system (relative to traditional steering).

	Strongly Disagree				**Strongly Agree**
The auto guidance system yields quality output	1	2	3	4	5
The auto guidance system will cause installation problems	1	2	3	4	5
I will have no problems in fixing the auto guidance system in case of a breakdown	1	2	3	4	5
Using an auto guidance system will decrease my costs associated with seed, fertilizer, and pesticides due to increased accuracy	1	2	3	4	5
I will feel mentally and physically better at the end of a work day when using the auto guidance system	1	2	3	4	5
The replacement costs of failed parts of the auto guidance system will be high	1	2	3	4	5
Adopting the auto guidance system will require technical training	1	2	3	4	5
I will incur high maintenance costs when using an auto guidance system	1	2	3	4	5
The benefits of using the auto guidance system will compensate for its cost	1	2	3	4	5
The auto guidance system will perform well on heavy tasks (e.g. plowing)	1	2	3	4	5
The dependence of the auto guidance system on satellites makes it more vulnerable.	1	2	3	4	5
Diagnosing problems with an auto guidance system will be easy	1	2	3	4	5
The auto guidance system will reduce skips and overlaps, which reduces time and fuel expenses	1	2	3	4	5
The auto guidance system will require less labor	1	2	3	4	5
The auto guidance system reduces operator fatigue, which allows for working longer hours	1	2	3	4	5

12. Considering the potential advantages and disadvantages of auto guidance systems, please circle the appropriate responses:

	Risky				**Not risky**
a. Relative to operating vehicles without an auto guidance system, operating vehicles with an auto guidance system would be…	1	2	3	4	5

	…not be willing to use an auto guidance system				**…be willing to** use an auto guidance system
b. I would …	1	2	3	4	5

	Much Risk				**Not much Risk**
c. Using an auto guidance system would expose me to…	1	2	3	4	5

	Strongly Disagree				**Strongly Agree**
d. I would be concerned about using an auto guidance system	1	2	3	4	5
e. I think using an auto guidance system would be risky	1	2	3	4	5
f. I would be willing to accept the risk of using an auto guidance system	1	2	3	4	5

13. The following statements are about your general thoughts and feelings regarding technology. Please indicate for each statement to what extent you agree with it.

	Strongly Disagree				**Strongly Agree**
I prefer to use the most advanced technology available	1	2	3	4	5
There is no such thing as a manual for a high-tech product or service that is written in plain language	1	2	3	4	5
Technology makes me more efficient in my occupation	1	2	3	4	5
I can usually figure out new high-tech products and services without help from others	1	2	3	4	5
I do not consider it safe to do any kind of financial business online	1	2	3	4	5
I find I have fewer problems than other people in making new technology work for me	1	2	3	4	5
Technical support lines are not helpful because they don't explain things in terms I understand	1	2	3	4	5
I like computer programs that allow me to tailor things to fit my own needs	1	2	3	4	5
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do	1	2	3	4	5
I do not consider it safe giving out a credit card number over a computer	1	2	3	4	5
I enjoy the challenge of figuring out high-tech gadgets	1	2	3	4	5
I worry that information I send over the internet will be seen by other people	1	2	3	4	5

14. The following statements are about your thoughts about auto guidance systems, relative to traditional steering. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
I have a lot of knowledge about auto guidance systems	1	2	3	4	5
My colleagues will be very supportive of the use of an auto guidance system for my job	1	2	3	4	5
I am very familiar with auto guidance systems	1	2	3	4	5
I think that people who influence my behavior think that I should use an auto guidance system	1	2	3	4	5
My colleagues will be helpful in the use of an auto guidance system	1	2	3	4	5
We have the knowledge necessary to use an auto guidance system	1	2	3	4	5
In general, my colleagues will support the use of an auto guidance system	1	2	3	4	5
Farmers who own an auto guidance system have more prestige than those who do not	1	2	3	4	5
I do not have much experience using auto guidance systems	1	2	3	4	5
Having an auto guidance system is a status symbol in my social environment	1	2	3	4	5
I have the resources necessary to use an auto guidance system	1	2	3	4	5
Specialized instruction concerning an auto guidance system will be available to me	1	2	3	4	5
In light of the resources, opportunities, and knowledge required to use an auto guidance system, it would be easy for me to use an auto guidance system	1	2	3	4	5
I think that people who are important to me think that I should use an auto guidance system	1	2	3	4	5
Assistance will be available to deal with system difficulties	1	2	3	4	5
Farms who own an auto guidance system have a high profile	1	2	3	4	5

15. The following statements are about your feelings about the auto guidance systems, relative to traditional steering. Please indicate for each statement to what extent you agree with it or feel it applies to you by circling the appropriate response.

	Strongly Disagree				**Strongly Agree**
I would think using an auto guidance system is pleasant	1	2	3	4	5
It scares me to think I could get into problems when using an auto guidance system	1	2	3	4	5
I would find working with an auto guidance system to be fun	1	2	3	4	5
I hesitate to use an auto guidance system for fear of ending up with problems that cannot be corrected	1	2	3	4	5
I would like working with an auto guidance system	1	2	3	4	5
An auto guidance system is somewhat intimidating to me	1	2	3	4	5

Please answer the following questions about your organization:

16. In which of the 50 states in the USA is your farm located? _____

17. Please indicate which of the following geographic features apply to the location of your farm (Please check as many as needed).

☐ **Mountains** ☐ **Wooded Area** ☐ **River** ☐ **Hills** ☐ **Rocks**

18. What is the total size of your farm? _____ **Acres (owned and rented)**

19. How many employees are employed in your farm per year?

Full time _____ employees **Part time** _____ employees

20a. Who works most or would work most with the auto guidance system?

☐ **Owner of the farm**
☐ **Supervisor/Foreman**
☐ **Workers**
☐ **Other _____**

20b. How much influence does this person have on the purchase decision of an auto guidance system?

Not much influence 1 2 3 4 5 **Much influence**

21. Please indicate how much influence you have regarding the auto guidance system purchase for your farm.

☐ **I make the final decision.**

☐ **I do not make the final decision, but I have a significant influence on the final decision.**

☐ **I have some influence on the final decision, but others have more influence than I do.**

☐ **I do not have any influence on the final decision.**

22. Please indicate which crops you plant and how many acres of these crops are planted.

Crops	**Acres**
1.	
2.	
3.	
4.	
5.	
Total acres	

23. Please indicate for which activities you use or would use the auto guidance system, and for which ones you do not use or would never use the system.

I (would) use it for……	**I (would) NOT use it for……**
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Example

Auto Guidance System:										
accuracy: xxxxxxx										
price: xxxxxxx										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

24. Below you will find 9 different auto guidance systems.
These auto guidance systems are described on two aspects:
1. their accuracy (the systems reduce skips and overlaps to: 1 inch, 6 inches, or 12 inches)
2. their price (the systems cost $10,000, $17,5000, or $25,000)

You may assume that all nine auto guidance systems are equal on any other aspects that you can think of.

Please indicate your attitude towards *each* auto guidance system by circling the most appropriate response (0 = negative – 100 = positive) (see example right top corner).

Auto Guidance System 1:										
accuracy: 1 inch										
price: $10,000										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 2:										
accuracy: 6 inches										
price: $10,000										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 3:										
accuracy: 12 inches										
price: $25,000										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 4:										
accuracy: 1 inch										
price: $17,500										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 5:										
accuracy: 6 inches										
price: $25,000										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 6:										
accuracy: 12 inch										
price: $10,000										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 7:										
accuracy: 1 inch										
price: $25,000										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 8:										
accuracy: 6 inches										
price: $17,500										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Auto Guidance System 9:										
accuracy: 12 inches										
price: $17,500										
negative										**positive**
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Please answer the following questions in light of the following information about possible features of an auto guidance system:

- A **universal** auto guidance system can be installed on different vehicles (but is not mobile).
- A **mobile** auto guidance system is universal *and* has a mobility function that allows *you* to move the system between vehicles.

25. Do you currently own a universal auto guidance system?

☐ **No** ☐ **Yes, I bought my first universal auto guidance system_____ months ago**.

If **Yes:**

a. How many universal auto guidance systems do you own	_____ systems
b. What is the average age of your universal auto guidance systems	_____ years
c. On how many vehicles do you actually use the universal auto guidance system	_____ vehicle(s)

26. Please indicate what your attitude is towards a universal auto guidance system, relative to an auto guidance system which is not universal, by circling the appropriate responses.

Negative	1	2	3	4	5	**Positive**

27. Please indicate what your intention is to buy a universal auto guidance system.

No intention	1	2	3	4	5	**Strong intention**

28. Will you buy a universal auto guidance system, and if so, how many will you buy?

☐ **No** ☐ **Yes _____ system(s)**

29. Do you currently own a mobile auto guidance system?

☐ **No** ☐ **Yes, I bought my first mobile auto guidance system_____ months ago**.

If **Yes:**

a. How many mobile auto guidance systems do you own	_____ systems
b. What is the average age of your mobile auto guidance systems	_____ years
c. Do you use its mobility function?	☐ **Yes** ☐ **No**
d. On how many vehicles do you actually use the mobile auto guidance system	_____ vehicle(s)
e. How often do you move the auto guidance system from one vehicle to another in a year?	_____ in a year

30. Please indicate what your attitude is towards a mobile auto guidance system, relative to an auto guidance system without mobility function, by circling the appropriate responses.

Negative	1	2	3	4	5	**Positive**

31. Please indicate what your intention is to buy a mobile auto guidance system.

No intention	1	2	3	4	5	**Strong intention**

32. Will you buy a mobile auto guidance system, and if so, how many will you buy?

☐ **No** ☐ **Yes _____ system(s)**

33. How important is the **universality** function to your decision to buy an auto guidance system?

Not important 1 2 3 4 5 **Very important**

34. How important is the **mobility** function to your decision to buy an auto guidance system?

Not important 1 2 3 4 5 **Very important**

35. If a regular auto guidance system costs $10,000, how much would you be willing to pay for a

…..universal auto guidance system?	$_____
…..mobile auto guidance system?	$_____

Please answer the following questions about yourself:

36. How many years have you been working in agriculture? _____ **years**

37. Please describe your educational background.
Check as many as needed and please describe your major (when applicable)

Level of education	**Major**
☐ No formal education	
☐ Less than high school graduate	
☐ High school graduate/GED	
☐ Vocational training	
☐ Some college/Associate's degree	
☐ Bachelor's degree (BA, BS)	
☐ Master's degree (or other post-graduate training)	
☐ Doctoral degree (PhD, MD, EdD, DDS, JD, etc.)	

38. What is your gender? ☐ **Female** ☐ **Male**

39. What is your age? _____ **years**

40. Please describe any factors that made you decide to buy or not to buy an auto guidance system.

……
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Thank you for your participation!!

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