CHAPTER IV

METHODOLOGY

This research consists of two primary components: (1) an evaluation of a virtual tour Web site, and (2) tests of the proposed flow model. Figure 4.1 illustrates the research process. There were four general stages: (1) evaluating the virtual tour Web pages on the Great Texas Coastal Birding Trail. The Web site is hosted by the Texas Parks and Wildlife Department, (2) administering an online survey, (3) testing the hypotheses in the flow model with the survey data, and (4) analyzing the relationships of factors and the effectiveness of the Web site.

The Geographical Area

The geographical area associated with this research was the Great Texas Coastal Birding Trail (hereafter Birding Trail) along the Gulf Coast of Texas (Figure 4.2). The Texas Parks and Wildlife Department (TPWD) and the Texas Department of Transportation sponsored the Birding Trail project. The purpose of this project is to promote awareness of the birding resources and stimulate people's interest to visit the area.

This research selected the Birding Trail as the geographical focus of my research because it represents a major state effort to promote nature tourism in Texas. It is the first of its kind in the United States. Figure 4.2 shows the geographical location of the Birding

Figure 4.1. Flow chart of the research process

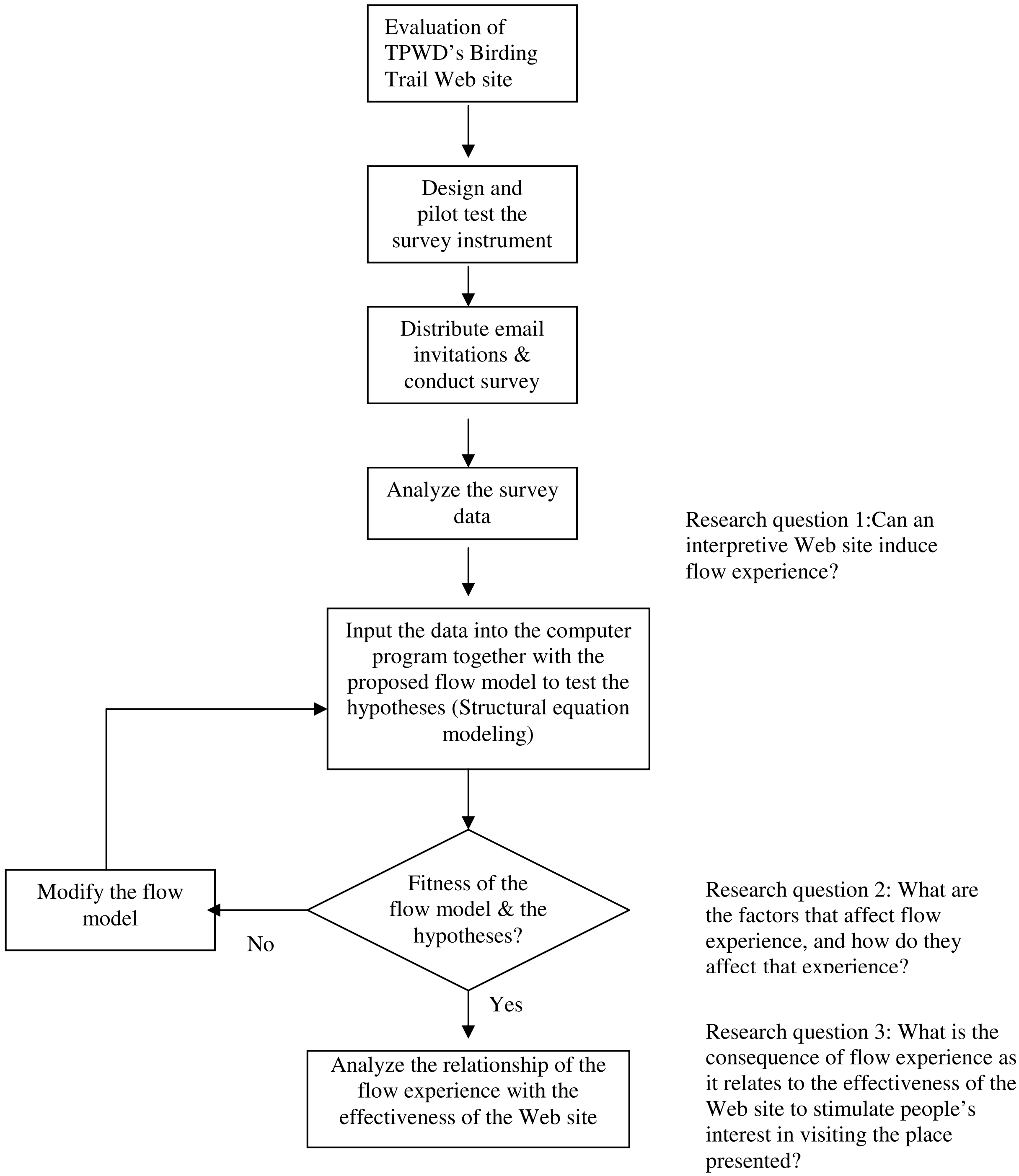
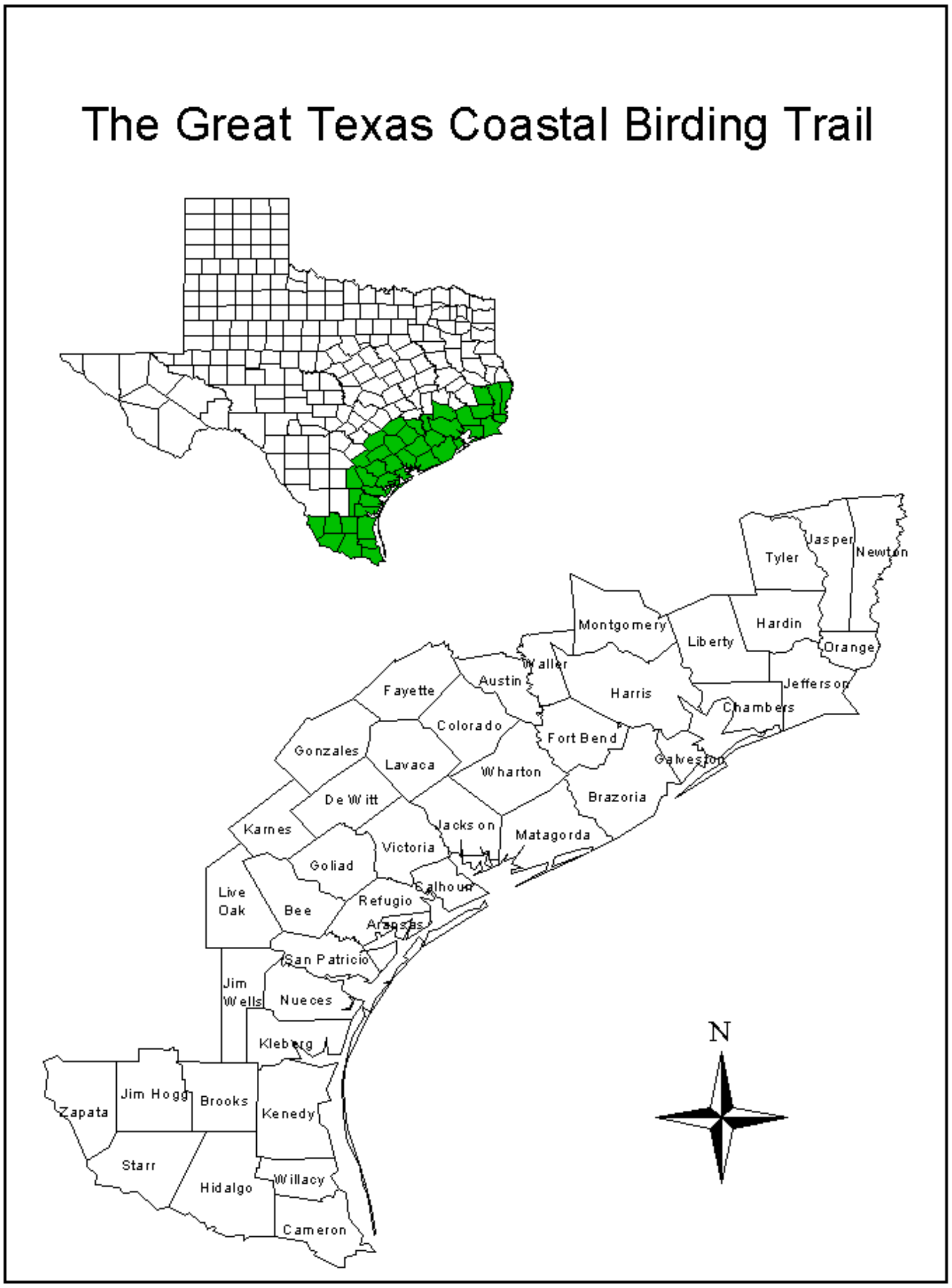


Figure 4.2. Geographical location of the Great Texas Coastal Birding Trail



Trail. It stretches over five hundred miles along the coast and runs through forty-three counties from Beaumont to the Rio Grande Valley. There are three sections in the Birding Trail, the upper coast, central coast, and the lower coast. These sections comprise more than three hundred separate birding sites. The trail's sites are organized into loops.

TPWD had created an extensive Web site for the virtual presentation of the Birding Trail. It contains comprehensive guides on birding resources and travel directions. The purpose of this Web site is the same as the Birding Trail project, that is, to inform people about the birding resources along the coast and stimulate people's interests to visit the place.

Web Site Evaluation Guidelines

The original proposal had outlined the development of a virtual tour Web site about the Birding Trail to test the proposed flow model. After considerable efforts had been devoted to developing the Web site, a teleological problem with this plan was identified. I was developing a Web site with the purpose of stimulating people's flow experience. It would not have been objective to use that Web site to test the flow model. Therefore, it was decided that it would be prudent to test the flow model using the Birding Trail site developed by TPWD. This not only addressed the teleological issue, but it provided an evaluation of a real Web site.

Prior to testing the flow model, an evaluation of the Birding Trail site was conducted. I derived the following guidelines for evaluating a virtual tour Web site from a review of the literature on interpretation and Web site design (Winett 1986; Gagne

1987; Ham 1992; Brigish 1993; Hutchins 1996; Black and Elder 1997; Beck and Cable 1998; Kanerva et al. 1998).

1. Keep initial index page short and simple.
2. Use theme titles for all the pages.
3. Use pictures to tell stories and provoke feelings and thoughts with text to support the theme.
4. Keep images small in memory storage size to reduce downloading time, thus enhancing response speed.
5. Test the Web pages on different monitors and with different browsers to ensure dependability.
6. Present the information in multimedia formats of text, images, pictures, and sound to stimulate users' multi-sensory response and to gain attention.
7. Follow a consistent presentation style.

The following criteria specify the evaluation of the factors above.

1. Keep index page short and simple.

Evaluation of this item was based on three factors a) the number of visual elements on the page, b) the number of hyperlinks, and c) whether the visitor needed to scroll down the page to see the entire page.

2. Use theme titles for all pages.

This item was evaluated by whether or not the Web pages have a theme title and whether or not that theme is consistent with the overall theme of the site.

3. Use pictures to tell stories and provoke feelings and thoughts with text to support.

The pages were evaluated based on a) whether both elements were included on the pages—pictures and text, and b) whether they were effective at portraying the message of the page.

4. Keep images small in memory storage size to reduce download time.

The Birding Trail site was evaluated and compared to four other similar Web sites that represent similar organizations as TPWD. These Web sites were a) Idaho Parks, b) Massachusetts Division of Forests and Parks, c) TPWD Main page, and d) Virginia Department of Conservation and Recreation. In general, the format of these Web pages was comparable to the Birding Trail site. They were comprised of a combination of image and text files.

The evaluation was conducted by viewing the Web pages using a telephone line modem connection. Each page was timed until all the images appeared on the computer screen. The index page and four hyperlinks to other pages in the site were selected; and the download times for each were recorded and then averaged.

5. Compatibility across different sized monitors and with different browsers.

To evaluate this item the Web pages were viewed on two monitor sizes (15 and 19 inch) and the two most popular browsers (Microsoft Internet Explorer and Netscape Navigator). The pages were evaluated as to whether or not the elements of the Web page fit on the screen and whether the pages functioned the same using the two browsers.

6. Present the information in multimedia formats of text, images, pictures and sound.

This item was evaluated based on whether or not the Web pages provided a combination of media.

7. Follow a consistent presentation style.

This item was evaluated by comparing the Birding Trail site to the main TPWD Web site. Consistent elements, navigation and presentation of content were compared between the two sites.

Developing Survey Instrument and Testing the Proposed Flow Model

This research has sought to answer three questions: 1) Can an interpretive Web site induce flow experience? 2) What are the factors that affect flow experience, and how do they affect that experience? 3) What is the consequence of flow experience as it relates to the effectiveness of the Web site in stimulating people's interest to visit the place depicted? Using data collected from an online survey, the proposed flow model was tested with structural equation modeling method.

Survey Instrument Development

The Online Survey Web site

Computer-based media open up unique opportunities for automatically collecting highly detailed data (Rice 1984; Rice and Rogers 1984). The advantages of using a Web survey include: 1) enabling point-and-click responses, 2) imposing loose time constraints, and 3) low cost.

The survey for this research was administrated as an online fill-out form. The survey form was hosted on a server in the Department of Recreation, Park and Tourism Sciences at Texas A&M University. A Web site was developed to host the survey (Figure 4.3).

The survey site had links to the first page of TPWD's Birding Trail virtual tour section, the survey form, and to survey navigational instructions. Viewers were requested to browse TPWD's Web site and then come back to the survey window to fill out the online survey. The site also contained a page with a brief introduction to the survey and its purpose. See Appendix C for information contained in the Web page.

Items in the Questionnaire

The questionnaire consisted of twenty-eight items. Respondents were asked questions about their impressions of the Web site, experience while browsing the Web site, effects of their visiting the Birding Trail Web site, and their demographics. Twenty-five questions were used to measure factors in the proposed flow model, including 1) flow, 2) response speed, 3) attractiveness, 4) ease of use, 5) challenge, 6) skill, 7) experience with virtual tour Web sites, 8) interactivity, 9) telepresence, 10) increased learning, and 11) changes of attitude and behavior. These questions were in the form of opinion statements. Respondents were asked to rate their responses on a 5-point Likert scale from strongly disagree to strongly agree. The questions and scales used to measure these items are contained in Appendix A. In addition, respondents were asked for their demographic information on age, highest level of education, gender and zip codes.

Figure 4.3. First page of the online survey Web site for this research

Database Development

A database was an essential component of the research. It was developed on the Web server at Texas A&M University before the online survey was published over the Internet. The online survey form was connected to the database through a Window's ODBC (Open Database Connection) data source. When users finished answering the survey questions and selected the submit button, the data automatically went into the database on the server. Figure 4.4 shows the structure of the survey.

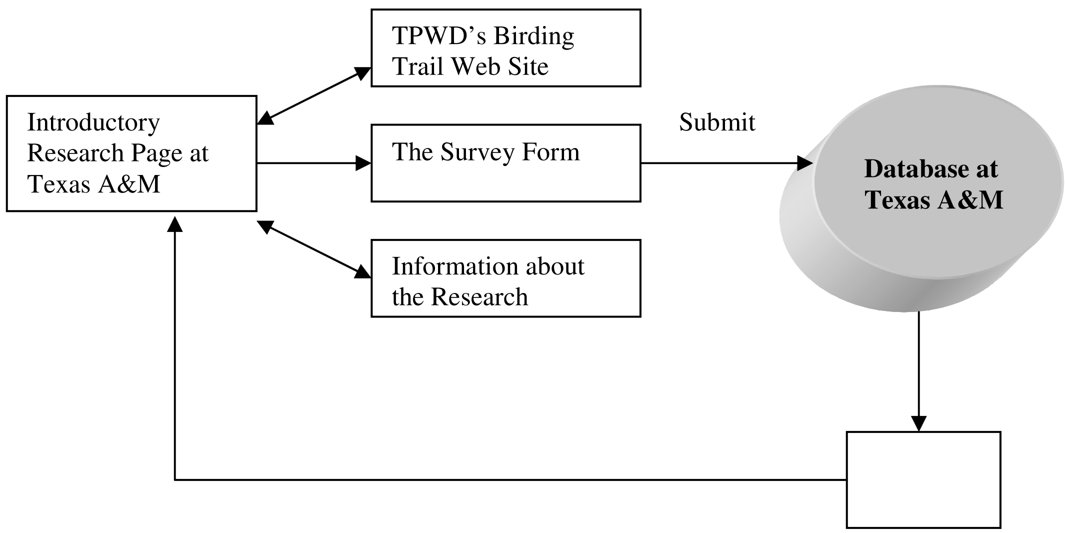
Pretest the Survey

The survey instrument was pre-tested before the emails were sent out inviting people to participate in the survey. Four professors, three recreation/tourism staff persons and two students at Texas A&M University were asked to review the survey questions and to complete the survey form using different computers. Minor modifications were made to the survey according to their suggestions.

Distribute Email Invitation to the Survey

An invitation email was sent to a list of 1842 individuals generated with the TexasTIS system. TexasTIS is an Internet client information system designed to provide access to traveler information stored in the Texas Department of Transportation's Travel Information System (TIS). Primary users of TexasTIS are members of the Texas tourism industry who has expressed interested in bird-watching activity. The email invitation explained the purpose of the survey and provided a link to the first page of the virtual tour survey (Appendix B).

Figure 4.4. Structure of the online survey system



Test the Proposed Flow Model with Structural Equation Modeling Approach

This research used the structural modeling technique to analyze the relationships among factors in the proposed flow model for the Birding Trail Web site. Rice and Rogers (1984) suggest that analyzing impacts of new media should emphasize both process and outcome and use a systematic approach. Structural equation modeling (SEM) is an ideal tool to accomplish these objectives. This method can depict the causally related network in a natural way (Schoenberg 1989). SEM represents a series of hypotheses about how the variables in the analysis are related (MacCallum 1995). The advantage of using structural equation modeling is that a factor can have multiple measures instead of a single measure used in traditional path analysis. In this way, the reliability of measurement is significantly improved. As Maruyama (1998, 131) states, "in most instances the only defensible way in which to create viable models is to use multiple measures." There are two reasons that a hypothetical construct could not be adequately measured by a single indicator. First, most measures are not completely immune from random errors, therefore, they are not perfectly reliable. Second, not all the systematic, non-error portion of an indicator's variance may reflect the construct that researchers want to assess (Kline 1998).

Independent and Dependent Variables in the Proposed Flow Model

SEM is a form of applied multiple regression that uses path diagrams to guide problem conceptualization, or to test complex hypotheses. Parameters indicating the magnitude of the effect that independent variables have on dependent variables describe the functional relationship (Byrne 1998). SEM begins with the specification of a model to be estimated, such as the proposed flow model. A model specifies statistical relationships of independent variables and dependent variables. In the proposed flow model, the four independent variables are: response speed, experience with virtual tour Web sites, knowledge of birding, and information presented in the Web site. There are seven dependent variables: ease of use, interactivity, telepresence, attractiveness, flow experience, learning about a place, and influence on attitudes and behavior.

Model Composition

Traditional statistical procedures do not offer a convenient way to differentiate between observed and latent variables. Therefore, they do not offer a way to test hypotheses at a higher level of abstraction. However, the most appealing advantage of SEM is that, unlike traditional methods using observed measurement of variables only, data analysis with SEM can incorporate both observed and unobserved (latent) variables. Latent variables are those that cannot be observed and measured directly, such as the state of flow. SEM uses manifest variables of the latent variable as indicators for regression analysis. For example, *flow* is a latent variable. Its manifest variables or indicators are *time distortion* and *enjoyment.* Table 4.1 lists the latent variables and the measuring indicators. Whenever possible, the measures were based on valid and reliable measures found in previous research. Measures of these indicators were collected through an online survey. All items were measured using a 5-point Likert scale. Figure 4.5 shows the full structural equation model for the proposed flow model.

The full structural equation flow model can be decomposed into measurement models and structural models. As illustrated in Figure 4.6, measurement models define relations between the observed variables (Xs and Ys) and unobserved latent variables (ξ,

TABLE 4.1

Measurements of variables in the proposed flow model

Factors in the Flow Model	Measurements	Survey Questions (Observed variables)
Experience with virtual tour Web sites (EP)	User's evaluation on frequency of visiting virtual tour Web sites.	I visit virtual Web sites more than once a week, once a week, once a month, once several months, never. (EP)
Attractiveness (A)	User's evaluation of attractiveness.	The Web site is interesting. (A1) The Web pages are attractive / dull. (A2)
Speed (SP)	User's evaluation of the response speed.	Interacting with the Web is slow (SP1) When I use the Web site there is very little waiting time for pages to load (SP2)
Ease of use (EU)	User's evaluation of the ease of use.	Using this Web site is easy. (EU1) Navigating the Web site frustrates me. (EU2)
Interactivity (I)	User's evaluation of the freedom to chose and on feedback.	I feel that I have the freedom to go anywhere in the Web site. (I1) Interacting with the Web pages is smooth. (I2) The response is fast / slow. (I3)
Telepresence (T)	User's awareness of the immediate surroundings.	While browsing this Web site I forget my immediate surroundings. (T1) When I browse this Web site I feel that I am in the world created by the Web site. (T2)
Challenge (CH)	User's evaluation of the content.	Does the Web site review something new? (C)
Skill (SK)	User's self-rating as a birder and the knowledge about the place.	User's self-rating as a birder. (SK1) User's knowledge about the place. (SK2)
Flow (F)	Time Distortion Enjoyment	Time seems to go by very quickly. (F1) I feel enjoyment/annoyed. (F2)

Table 4.1 – *continued*

Factors in the Flow Model	Measurements	Survey Questions (Observed variables)
Increased learning about the place (LP)	Awareness of the birding resources along the GTCBT.	After visiting the Web site I learned more about the birding resources along the Texas coast. (LP1) I gained more knowledge about the place presented. (LP2)
Change of attitude and behavior (CA)	Different indicators for changing attitudes and behavior after visiting the Web site.	I will inquire for more information about GTCBT. (CA1) I will return to the Web site for more birding information. (CA2) This Web site has stimulated my interest to visit the GTCBT (CA3)

Figure 4.5. Structural equation model for the proposed flow model (factors defined in Table 4.1)

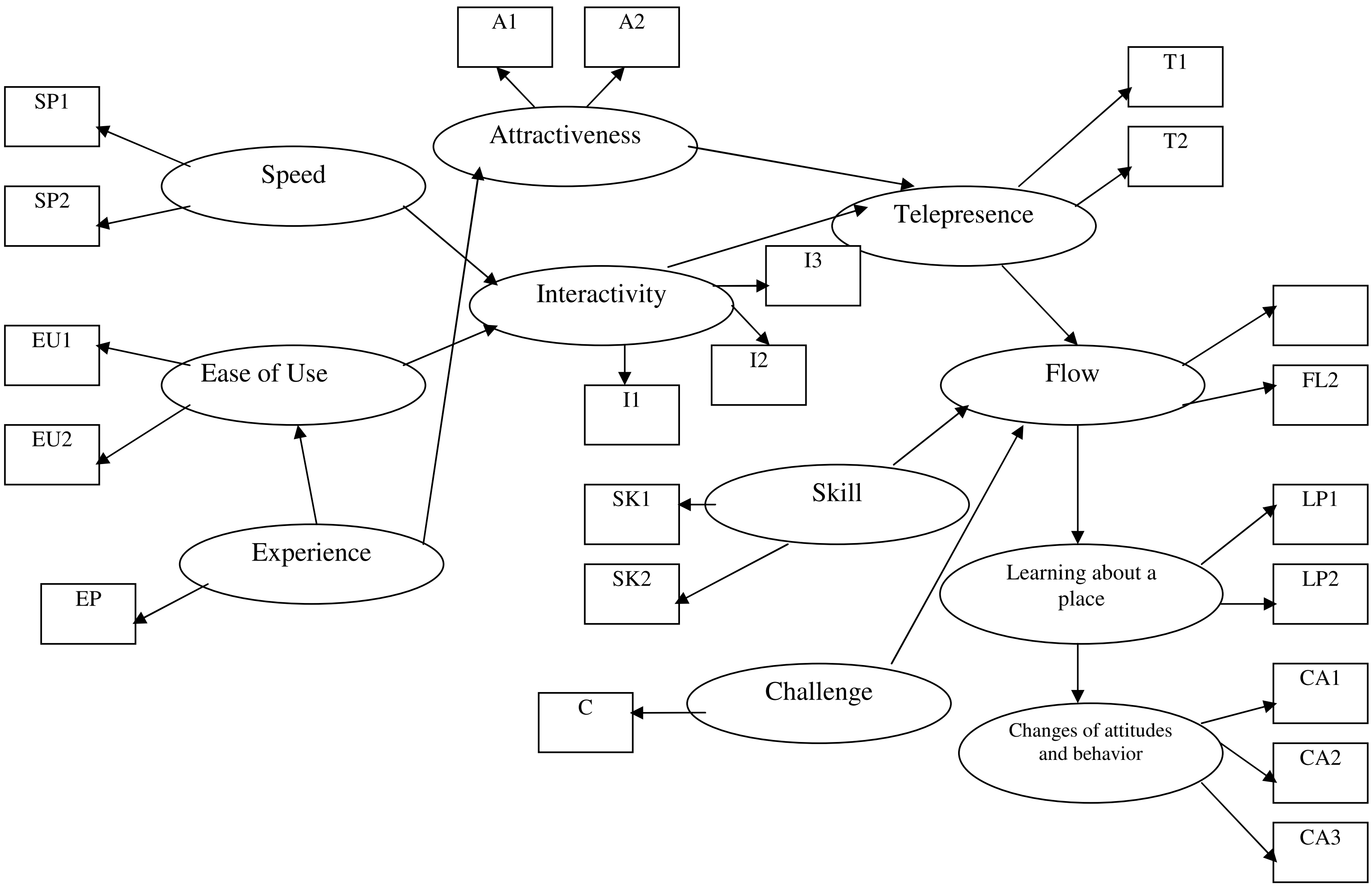
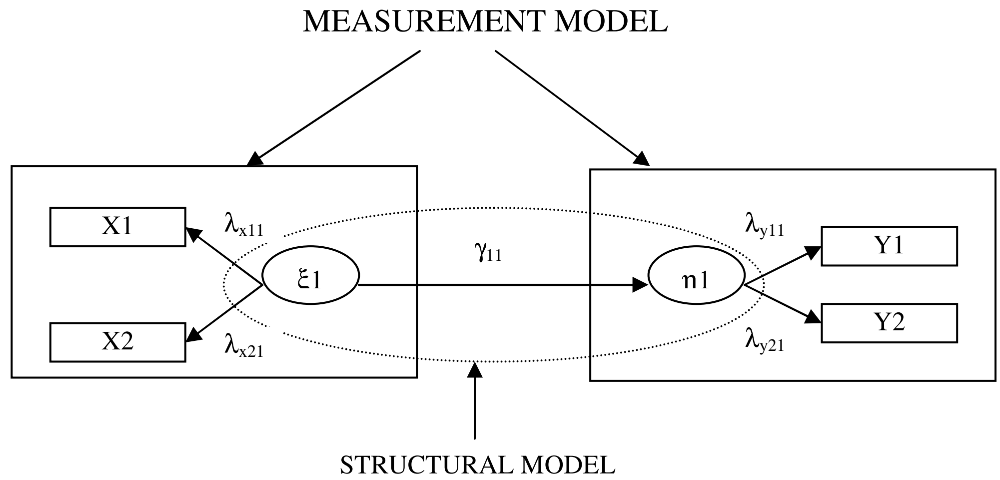


Figure 4.6. Full structural equation model (modified from Byrne 1998)



η); structural models define relationships among unobserved latent variables (Byrne 1998).

The above structural equation model can be summarized as following equations:

$$X = \Lambda_x \xi + \delta$$

$$Y = \Lambda_y \eta + \varepsilon$$

$$\eta = \Gamma \xi + \beta \eta + \zeta$$

Where:

Λ_x represents the matrix of regression coefficients related to the independent latent variables and their observed variables.

$$\Lambda_x = \begin{bmatrix} \lambda_{x11} & 0 \\ \lambda_{x21} & 0 \end{bmatrix}$$

$$\cdots \quad \cdots$$

Λ_y is the matrix of regression coefficients related to the dependent latent variables and their observed variables.

$$\Lambda_y = \begin{bmatrix} \lambda_{y11} & 0 \\ \lambda_{y21} & 0 \end{bmatrix}$$

$$\cdots \quad \cdots$$

Γ represents a regression matrix between independent and dependent latent variables.

$$\Gamma = \begin{bmatrix} \gamma_{11} \\ \gamma_{12} \end{bmatrix}$$

$\ldots$

β represents the matrix between dependent variables.

δ, ε, and ζ are error terms.

The foregoing equations describe structures of relations in a hypothesized model; thus, this approach is called *structural equation modeling* (Maruyama 1998). Because the process of estimating a model's parameters involves complex matrix algebra, it cannot be presented fully here.

Method to Test the Goodness-of-Fit of the Proposed Flow Model

This research involved two steps of testing. First, the measurement part of the flow model was tested. This step tested the relationship between latent variables and their measurement indicators. The testing of the initially proposed flow model may be meaningless unless the measurement model holds. The second step was to test the fit of the structural equation model using path analysis.

This research used SAS software to test the fitness of the measurement model and the flow model. The procedure used was SAS PROC CALIS. The CALIS procedure is designed for analysis of covariance structure models (confirmatory factor analysis), linear structural equations with latent variables, and path analysis models. The method used was maximum likelihood. It is the most commonly used technique. The program used it as the default method. With maximum likelihood, the model-fitting process was based on the fit of the hypothesized model to the sample data. The hypothetical model implied a covariance structure S(q) for the observable variables, where q = (q1, q2,…, qt) is a vector of parameters in the model. From the sample data a sample covariance matrix S was computed. The model was fitted by minimizing a fit function F[S,S(q)] of S and S(q). The fit function computed the discrepancy between S(q) and S. When there was a perfect fit, the fit function would result in zero, in which case S equals S(q). Therefore, the primary focus of the estimation process was to find parameter values that generated minimum discrepancy between S(q) and S.

SEM programs usually print out many fit statistics. The major fit measures that were used in this research in evaluating the fit of the flow model were: chi-square statistics, Bentler's Comparative Fit Index (CFI), Bentler & Bonett's Normed-Fit Index (NFI), and Bentler-Bonett's and Non-Normed Fit Index (NNFI). These are the most commonly used statistics in the constitution of evidence for a good fit.

Chi-square statistics

The chi-square test provides a statistical test of the null hypothesis that the model fits the data. It is based on the assumption that the model holds exactly in the population. This may be an unreasonable assumption in most empirical research.

$$C = (N-1)F[S, \Sigma(\theta)]$$

Where:

N is the sample size

F is the fitting function

S is the sample covariance matrix

$\Sigma(\theta)$ is model implied covariance

As shown in the above equation, chi-square measures the discrepancy between the sample covariance or correlation matrix and the fitted covariance or correlation matrix. A small chi-square corresponds to a good fit and a large chi-square would indicate a poor fit.

The chi-square will be relatively small if the model provides a good fit. However because chi-square is N - 1 times the minimum value of the fit function, with large samples and real-world data it is often significant even if the model provides a good fit (Hatcher 1994; Kline 1998). A common practice is to use the ratio of χ^2 /df. As mentioned earlier, df is the degrees of freedom. A small χ^2 /df ratio is preferred. There are no absolute criteria for how small the χ^2 /df ratio should be before the model is considered acceptable. Kline (1998) suggested that the value less than 3 is considered acceptable with large sample analyses (> 200). This is a very rough rule. Other indices must be used to supplement the assessment.

Other fit indices

Since chi-square tends to be large in large samples, a number of fit measures have been proposed to reduce its dependence on sample size (Jöreskog and Sörbom 2001). In practice, researchers generally combine other fit indices that are less sensitive to sample size than the χ^2 statistics to assess the fitness of a model. Among these are the most commonly used Bentler's Comparative Fit Index (CFI), Bentler & Bonett's Normed-Fit Index (NFI) and Bentler-Bonett's Non-Normed Fit Index (NNFI). Values of these indices theoretically range from 0 (poor fit) to 1 (perfect fit).

CFI, NFI and NNFI indicate the proportion in the improvement of the overall fit of the model relative to a null model. The null model is an independence model in which the observed variables are unrelated. CFI is less affected by sample size. NNFI includes a correction for model complexity. Calculations for CFI, NFI and NNFI are as follows:

$\tau = \text{Max}(nF\text{-}d, 0)$

$\tau_i = \text{Max}(n\,F_i - d_i, nF\text{-}d, 0)$

$f = nF/d$

$f_i = n\,F_i/d_i$

$CFI = 1\text{-}\ \tau/\ \tau_i$

$NFI = 1\text{-}F/F_i$

$NNFI = (f\text{-}\ f_i) / (f_i\text{-}1)$

Where:

F is the minimum value of the fit function for the estimated model.

F_i is the minimum value of the fit function for the independence model.

d and d_i are the degrees of freedom of the estimated model and the independent Model.

(Jöreskog & Sörbom 2001)

Root mean square error of approximation

Another fairly commonly used index is the root mean square error of approximation (RMSEA). Models with RMSEA 0.10 or more indicate a poor fit. A confidence interval can be computed for the index. Ideally, the lower value of the confidence interval is very near zero and the upper value is not very large.

Model modification

In the case of poorly fit models, the SAS program produced modification suggestions. It identified which relationships in the model misfit the data, and which relationships could be estimated and would improve the performance of the model. This research mainly examined the normalized residuals, and the tests of Lagrange multipliers on phi matrix, gamma matrix, and beta matrix for clues of modification. The model development process involved deleting the unfit relationships (path), the measurement /latent variables, adding new paths, and re-designating the measurement–latent factor relationships.