NOTICE

The quality of this microform is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30, and subsequent amendments.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30, et ses amendements subséquents.

Canada

UNIVERSITY OF ALBERTA

"TIPS"
FOR
SUCCESSFUL IMPLEMENTATION
OF
TECHNOLOGY

PRESENTED AS A
TECHNOLOGY TRANSFER ISSUE
FROM THE PERSPECTIVE OF THE
ROAD TRANSPORTATION INDUSTRY

BY

Ray M. Filipiak

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master Of Science.

IN

Engineering Management

DEPARTMENT OF Mechanical Engineering

EDMONTON, ALBERTA

Spring, 1994

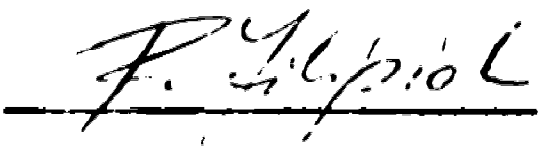
ISBN 0-612-11206-3

Canada

UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR:	Ray (Rajmund) M. Filipiak
TITLE OF THESIS:	"TIPS" for SUCCESSFUL IMPLEMENTATION of TECHNOLOGY
DEGREE:	Master of Science Degree in Engineering Management (Mechanical Engineering)
YEAR DEGREE GRANTED:	1994



12 Coachman Court
Sherwood Park, Alberta, Canada
T8H 1B6

April 12, 1994

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled

"TIPS" FOR SUCCESSFUL IMPLEMENTATION OF TECHNOLOGY

submitted by

RAY (RAJMUND) M. FILIPIAK

in partial fulfilment of the requirements for the degree of Master Of Science in Engineering Management.

Professor J.D. Whittaker	
Supervisor's Name (Type)	Supervisor's Signature
Professor S. Teply	
Committee Member Name (Type)	Committee Member Signature
Professor S.M. AbouRizk	
Committee Member Name (Type)	Committee Member Signature
Committee Member Name (Type)	Committee Member Signature
Committee Member Name (Type)	Committee Member Signature
Committee Member Name (Type)	Committee Member Signature

Date: 29 MAR 94

DEDICATED TO

JMF

ABSTRACT

There is significant uncertainty ass[illegible] new technology. By default the primary concern, in both the pr[illegible]ess sectors, is with determining whether the technology has a poter[illegible]ted successfully. This may be even more important than the magnitu[illegible]t or benefit.

The research work described herein [illegible] the consolidation of expert knowledge, and experience into an industry consensus [illegible]. The background information originates from practicing professionals. It is packaged in a neat, concise and easy understandable methodology for assessing the technology implementation potential for success.

The objective of this research was to develop a methodology to aid in the analysis and decision making related to technology implementation. This was achieved by identifying thirty one factors which have been determined to influence the final outcome. By considering these factors, during the analysis of a given scenario, it is possible to identify key driving factors and predict the outcome based on these key factors.

The primary product of this research consists of a database of knowledge on the subject of technology investment and the associated uncertainty. The knowledge is encapsulated in a model (coined the TIPS or the Technology Implementation Potential for Success model) which is the heart of the analysis process (referred to throughout this document as the TIPS System, the system, or the method). The computational requirements of the model are handled by a spreadsheet template developed in LOTUS 1.2.3. V.1 for Windows. The implementation / adoption of Expert Systems Technology, into the operations of a department of transportation, is used as the case scenario.

TIPS is a methodology for assisting individuals dealing with technology transfer decision issues. It is presented in a manner specific to transportation concerns, however, the TIPS method is capable for generic application. TIPS assists in the assessment of a candidate technology on all relevant factors, identifies potential weaknesses or problematic areas, recommends remedial action (as an option) to improve the potential and it facilitates for better implementation decisions.

ACKNOWLEDGEMENTS

The research work presented within this document could not have been possible without the help of the following:

Alberta Transportation and Utilities for sponsoring my graduate work in Engineering Management.

Mr. Zach Zacharia, MBA., P.Eng., my colleague at work and my principal sounding board, devils advocate and guinea pig.

Mr. Jan Konarzewski, P.Eng., my supervisor at work and a key supporter for my career development initiatives.

Janice Filipiak, who helped with all the graphic work contained in this document.

Ms. Mary McOuat and Ms. Robyn Corrigal, who reduced the survey data into electronic format.

Professor J.D. Whittaker, Ph.D., my thesis supervisor, for all his assistance and guidance.

All the survey participants and anyone else who contributed and I have missed mentioning.

!!!! A special thank you to all of you !!!!

TABLE OF CONTENTS **PAGE NO.**

FIGURES

1.0 INTRODUCTION

1.1 DOCUMENT STRUCTURE

This document contains seven sections comprising of five chapters, a bibliography and an appendix.

The introduction provides general information regarding the research work. It contains a description of the resulting end product of the research effort and provides the context.

In the second chapter, the objective, scope and work plan for the research work are formalized.

The third chapter contains details for the TIPS System structure and the TIPS Model, the heart of the system used in determining the success potential for technology implementation. Information sources are presented along with details regarding data collection and reduction, the systems functional specifications and operational processes.

Chapter four contains the key observations that where made during the research work. The survey responses and the application of statistics are examined. Another technology transfer model which is used in the Architectural-Engineering-Construction (AEC) industry is presented. Also, an actual case scenario is examined involving Expert Systems technology implementation.

In chapter five some thoughts are expressed with regards to further research and possible improvements to the existing TIPS System. Also, some direction is provided for integrating the TIPS approach into an overall technology transfer strategy.

Citations are found through out this document. However, the highest frequency of this is in Subsection 3.2. It is in this part of the document where the foundation of the TIPS Model is defined. The extensive referencing to the bibliography provides an information sourcing trail for those readers who may be interested in further investigating the information provided.

The appendix contains all the supporting information referred to through out this document. The user documentation for the TIPS Model spreadsheet template is located in the appendix.

1.2 BACKGROUND

1.2.1 THE "TIPS" SYSTEM

An increasingly hostile business environment is forcing organizations to invest in technology in order to improve their position in the marketplace. The survival of any company requires it to be competitive. This need to be competitive forms the fundamental basis for adjudicating acquisition of new or innovative technology (Noori). This is also true from the public agency perspective where the focus is on expenditure restraint rather than competitiveness.

From a fundamental technology transfer perspective it is important for technology implementation decisions to be made in an overall context of the "business battle arena". A need for being able to define this context resulted in the need for research on the subject of technology implementation and the eventual development of the TIPS System. The system is a method of classification and provides an orderly way for evaluating all factors that are pertinent to defining the context.

The primary product of this research work is the knowledge base which is encapsulated in the TIPS Model. The model is the analysis module of the overall TIPS System. The system incorporates the analysis along with other operational procedures required to perform an implementation success potential assessment. A secondary product consists of a spreadsheet program template (LOTUS 1.2.3 V.1 for Windows) which automates the computational requirements of the model.

The TIPS System is basically an analysis tool designed for use during the technology investment / implementation decision process. For new technology to be viable the organization must establish a proper foundation for implementation (i.e., skills, resources, culture). In fact, there are six major areas for consideration, these are:

- Communications
- Financial
- External Influence
- Human Factors
- Corporate Characteristics
- Technology Attributes

The TIPS System evaluates thirty-one consideration factors, which fall into one or another of these six major areas (categories), and rates the technology

implementation potential for success based on these factors. Over two hundred factor supporting attributes have been identified from literature review and surveys. During an evaluation, a case technology is assessed in the context of the environment in which it will be implemented. These attributes will define the context by being identified as either catalysts or barriers to effective technology implementation.

Technology transfer, which encompasses technology implementation, is not an exact science. Subjectivity is inherent in the process. As a more effective surrogate to intuitive decision making, the TIPS System attempts to facilitate a more objective approach. However, it is based on heuristics (observations, opinions, intuition, guessing) and even though quite comprehensive in terms of scope, it is, in fact, subjective and should be used in conjunction with sound judgement.

Ensuring the successful implementation of technology into an organization is complicated and the end result is neither definitive nor certain. Still, this system can play a vital role in the overall technology transfer process. The TIPS System can be used to assist decision makers in making "go" or "no go" decisions regarding investment in technology where the investment magnitude warrants so and where the consequence of failure is significant. The TIPS System can also assist in deciding between alternatives. For this, TIPS can be used on its own or it can be fully or partially incorporated, or it can be used as a precursor, with Utility Theory (Gibson, 1981, Wolf, 1983) or other Multi-Attribute Decision Analysis methodologies (Gibson, 1981, Wolf, 1983, Anandalingam and Olson, 1988, Falkner and Benhajla, 1990, Datta, 1992, Noori) such as the Analytic Hierarchy Process (Datta, 1992, Noori). Additionally, this system provides information as to where changes can be made (within the technology or the environment) to improve the implementation success potential. Technology implementation has a greater likelihood of success to the degree that barriers to adoption are lowered (Fichman and Kemerer, 1993).

1.2.2 CONTEXT

The marketing of new technologies within the transportation industry requires a knowledge of the potential market, the technology's capability (whether it is a product or process), the user's needs and the current state-of-the-industry. Understanding this context is critical (Betsold and Rosenbaum, 1988). The adoption of many new technologies occurs through technology transfer. To that end technology transfer efforts are aimed at surmounting barriers to efficient adaptation of technologies, and to the acceptance and implementation of new and

innovative technologies by organizations.

Betsold and Resnbaum (1988) expand on this context as follows:

First costs, rather than service life costs, are often the primary basis for capital expenditures. In some cases, there are no reliable methods for determining service life. In other situations limited funds must be stretched to meet immediate needs. Regional environmental conditions, as well as the application of local specifications and materials, cause "market" entry by an innovation or new technology, to be time-consuming and costly, thus, often discouraging to its' acceptance. Large, multilevel agencies, such as provincial or state departments of transportation, may pass an innovation from level to level within the organization, requiring a "sales" effort at each level. Delays may be encountered between planning, design, and actual construction stages of a highway project sometimes creating uncertainty as to whether and when an innovation will be accepted and used. Additionally, many new or unique technologies are proprietary and are difficult to introduce because of competitive procurement and rigid specifications set by the agencies.

The most serious problem faced by many new technologies is the lack of acceptable performance evaluation. The type of documentation language used in research is usually laden with cumbersome technical jargon which is difficult for lay persons to assimilate, thus, also frustrating the evaluation process. Several years of field testing and evaluation may also be necessary for acceptance. Most agencies tend to require their own field tests and varying degrees of formal or informal evaluation. Many agencies do not have accelerated testing procedures which would permit the use of performance specifications and invite new and proprietary technologies to compete effectively for the highway market. New products, such as roadside hardware, can present various logistic problems in their method of operation (which may differ from the status quo). It is easier for maintenance forces to work with familiar general-use technologies (products) than with new materials, equipment or design configurations.

For many new innovations, particularly those involving pavements and structures, the engineer cannot risk failure on the inservice highway system because of safety, liability, publicity, and political sensitivity. Thus, there is a continued reliance on traditional, well-tested processes, designs, materials and equipment and a reluctance to experiment with technologies which are outside the normal transportation engineering field.

In many agencies, the rewards for innovation do not balance the risks involved. Although introduction of a successful new innovation is often viewed as part of the job, failure can lead to criticism or loss of public confidence. This institutional

problem increases the natural resistance to change.

1.2.3 PROBLEM DESCRIPTION

Technology transfer is of key importance in the road transportation industry. It has been observed that after locating a potentially viable technological solution (or possibly a number of them) to a particular problem, a standard economic (benefit/cost) analysis is usually performed. This analysis determines which technologies are economically viable.

Typically, transportation organizations are forced to ration resources. Also, these organizations tend to be conservative and cautious in nature, which is a reflection of the industry that they are a part of (Betsold and Resnbaum, 1988). Although not explicitly expressed, failure is not well accepted and a philosophy of avoiding risky ventures prevails. Therefore, it becomes very important to make the correct decision as to which technologies are selected. Since there is uncertainty associated with new technologies, the primary concern is with selecting the one which has the greatest probability of being implemented successfully. It has been suggested by many technology transfer practitioners that this may be even more important than the magnitude of the potential benefit.

1.3 QUESTION

Once the initial economic viability is established how can it be determined if a new or innovative technology is an acceptable risk for contemplated exploitation? Or, what are the chances that the technology willbe implemented successfully?

The significance arises in being able to determine, as objectively as possible, the potential for successful implementation before an actual commitment is made. By the same token, being able to decide between alternatives is also critical.

1.4 HYPOTHESIS

There are a number of factors which influence the implementation of any new technology. These factors should be evaluated in the decision analysis. For any given scenario, it should be possible to identify which factors contribute or hinder successful implementation. Having established this, it should be possible not only to assess the technology implementation potential for success, but, also to identify where remedial action should be initiated to improve the success potential.

1.5 METHODOLOGY

The methodology employed for knowledge extraction and compilation is similar to that used in developing a computer based Knowledge Base Systems (KBS) or as more commonly known Expert Systems (which incidently is the case scenario technology used in Chapter 4). The knowledge was extracted from recent transportation journals and supplemented with information acquired from literature, surveys and interviews. The analysis module (the TIPS Model) that was eventually developed is not a KBS program per se, as originally intended. However, the knowledge has been encapsulated and resides within a conventional spreadsheet program template.

The primary task was to identify as many factors (and supporting attributes) as possible. After completing the identification process, a rating scheme was established for evaluating case scenarios. Validation data collected through the survey process was then analyzed, incorporated into the template and used to establish a baseline for the model. The combined knowledge base and validation data represent the consensus of over one hundred and thirty technology transfer practitioners within the transportation industry with respect to technology implementation. This Industry Consensus Baseline (ICB) can be applied as a control for any case scenario.

2.0 RESEARCH CONDUCT

2.1 OBJECTIVE AND SCOPE

The objective of this research was to develop a methodology (or process) to aid in the analysis and decision making process.

The scope of the research is limited to:

1) the technology transfer process;

2) the import of innovative technology and its' adaptation to an organization's operations;

3) the highway/road engineering industry (Departments of Transportation, Agencies, Academic Institutions and private companies) as the primary source for data collection, hypothesis testing, analysis and evaluation (however, generalized as much as possible to develop a generic model which can be applied for any industry).

Although implicit reference is made to Utility Theory (UT) and Multi-Attribute Decision Analysis (MADA), in depth exploration of these topics are considered to be beyond the scope of this research. The primary intent is to develop a simple linear approach to decision analysis using a broad global approach which focusses on factor identification, explanation and the construction of context. However, a proposal for future integrating of TIPS with UT and MADA is presented in section 4.2.4.

2.2 WORK PLAN

The work plan included the following steps in more or less the sequence presented:

1) Conduct a literature search to establish factors.

2) Identify survey candidates.

3) Initiate a survey to validate information extracted through literature review.

4) Develop a process for analyzing the survey results. Reduce all the information collected. Develop a model based on statistical analysis of data collected. Develop an algorithm for assessing success potential.

5) Define suitable representative case characteristics. Identify interview candidates for trial case scenario.

6) Conduct case scenario interview(s). Experiment with different interview formats to establish the most practical method for data extraction.

7) Trial run a case scenario to test the system and the model. Document observations.

8) Fine tune the system and model based on feedback received during the case scenario test (iterative process may require a number of cycles).

9) Prepare a user guidelines for system and model.

10) Present the concept to select field practitioners for critique. Collect the feedback and use it to fine tune system.

11) Document the evaluation of results, observations, make recommendations and provide conclusion.

12) Submit the documented work for review and incorporate changes resulting from review.

The work plan was initiated in November, 1992 and concluded in December 1993.

3.0 THE SYSTEM

3.1 INFORMATION AND DATA COLLECTION

3.1.1 LITERATURE SEARCH

Much of the information about factors, presented in section 3.2.2, originates from observations and documented experiences dealing specifically with the topic of road transportation technology transfer. However, in all cases the factors are seen not to be unique to this one industry, and thus, it is suggested that they can be treated generically. The complementary information extracted from literature reinforces this claim. It was found necessary to also supplement these factors in order to have this more generic and representative base for proper assessment of technology implementation. To this end the literature search served two purposes. It identified additional factors, and it validated those factors which were already identified. The approach taken was designed to extract, for each factor, only the most important details from the literature and then to interrogate the industry (i.e., via survey) for verification.

3.1.2 SURVEY

The survey was executed between May 1993 and August 1993. The participants of this survey were individuals involved with the function of technology transfer within the road transportation industry. These individuals were selected because of their familiarity and knowledge of the industry and because their fundamental mandate is to deliver technology to the point of adoption / implementation. Also, a few surveys were sent to individuals that have knowledge or expertise related to technology implementation and/or management, however, not necessarily within the road transportation industry. The latter where treated as a quasi control group for comparing the survey results to determine if they are generically representative.

Selecting this group of individuals automatically established a bias within the sample. The bias occurred at a macro and at a micro level. At the macro level, the survey was considered only within the context of the transportation industry. Yet the author is trying to extrapolate the results to a generic application. At the micro level, the survey sample actually consists of a number of subgroups within the sample that have different tasks and objectives. The perspectives of these sample subgroups may be quite different.

The primary objective of the survey was to verify to what degree the identified factors are relevant in assessing technology implementation. The survey was designed to rate the importance of these factors and establish a baseline which could be used in case scenario assessments. A very secondary objective was to identify if bias existed within the sample.

3.1.2.1 Sample Size

A survey was sent to two hundred and eighteen individuals. This group was divided into eight subgroups.

3.1.2.2 Sample Description

Although the premise was to get an overall consensus, the surveyees were grouped in order to determine whether there were in fact any significant differences of opinion between individuals with similar job tasks/functions.

The eight groups of survey targets were:

Group A:

Fifty-two people were contacted at the divisional offices of the Federal Highways Administration (FHWA) in the United States. These offices are responsible for coordinating federal transportation related funding at the state level. The individuals that were contacted are responsible for technology transfer related activities within the respective states.

Group B:

Fifty people were contacted at the FHWA Local Transportation Assistance Program (LTAP) Technology Transfer Centers in the United States. These individuals are center directors and are responsible for technology transfer to local road authorities.

Group C:

Forty-nine people were contacted at the State Departments of Transportation. These individuals are responsible for research and development and/or technology transfer functions for the respective departments.

Group D:

People were contacted at the road authority offices of sixteen major Alberta municipalities. These individuals are identified as technology transfer representatives through which Alberta Transportation and Utilities conducts a passive technology transfer function.

Group E:

Twelve people were also contacted from miscellaneous areas which included the Transportation Association of Canada (TAC), other provincial departments of transportation (only two other Canadian Department's of Transportation have our identified Technology Transfer Mandate), academia, technology transfer information clearing houses in the United States, the FHWA International Cooperation Division (responsible for international technology transfer).

Group F:

Ten people were contacted at the regional offices of the FHWA. The individuals contacted are primarily responsible for coordinating funding to the LTAP centers within their regions.

Group G:

Fourteen people were contacted within the head office of Alberta Transportation and Utilities. These individuals are designated technology transfer agents who represent specific branches (or operational business units i.e., planning, design, etc.) within the head office of the department.

Group H:

Fifteen people were contacted within the field offices of Alberta Transportation and Utilities. These individuals are designated technology transfer agents who represent district offices (i.e., responsible for actual construction and maintenance of the infrastructure).

A copy of the survey form used is located in Appendix A.1.

3.2 FACTORS

3.2.1 EXPLANATION - CATEGORIES, FACTORS AND ATTRIBUTES

3.2.1.1 Overview of Classifications

All the pertinent research information and data collected, relating to technology investment and implementation (i.e., the knowledge base), are broken down into three levels. Each level is progressively more specific.

The knowledge base is divided into six thematic groupings. This is the first level. The groupings are referred to as Factor Categories. These categories address a basically common subject area. The knowledge base is further subdivided into thirty-one yet smaller groupings referred to as Factors. It is at this level that the system performs the success potential analysis. Factor Attributes define the next and final level. Each factor has a varying number of factor attributes. Although not necessarily interrelated, these attributes support the theme of the respective factor and better define the context for the factor. There are over two hundred attributes identified in the model.

3.2.1.2 Numbering Scheme

The numbering scheme was chosen to facilitate factor identification. The factor ID is used for sorting and other types of data manipulation during analysis.

The numbering scheme subscribes to the following alphanumeric standard:

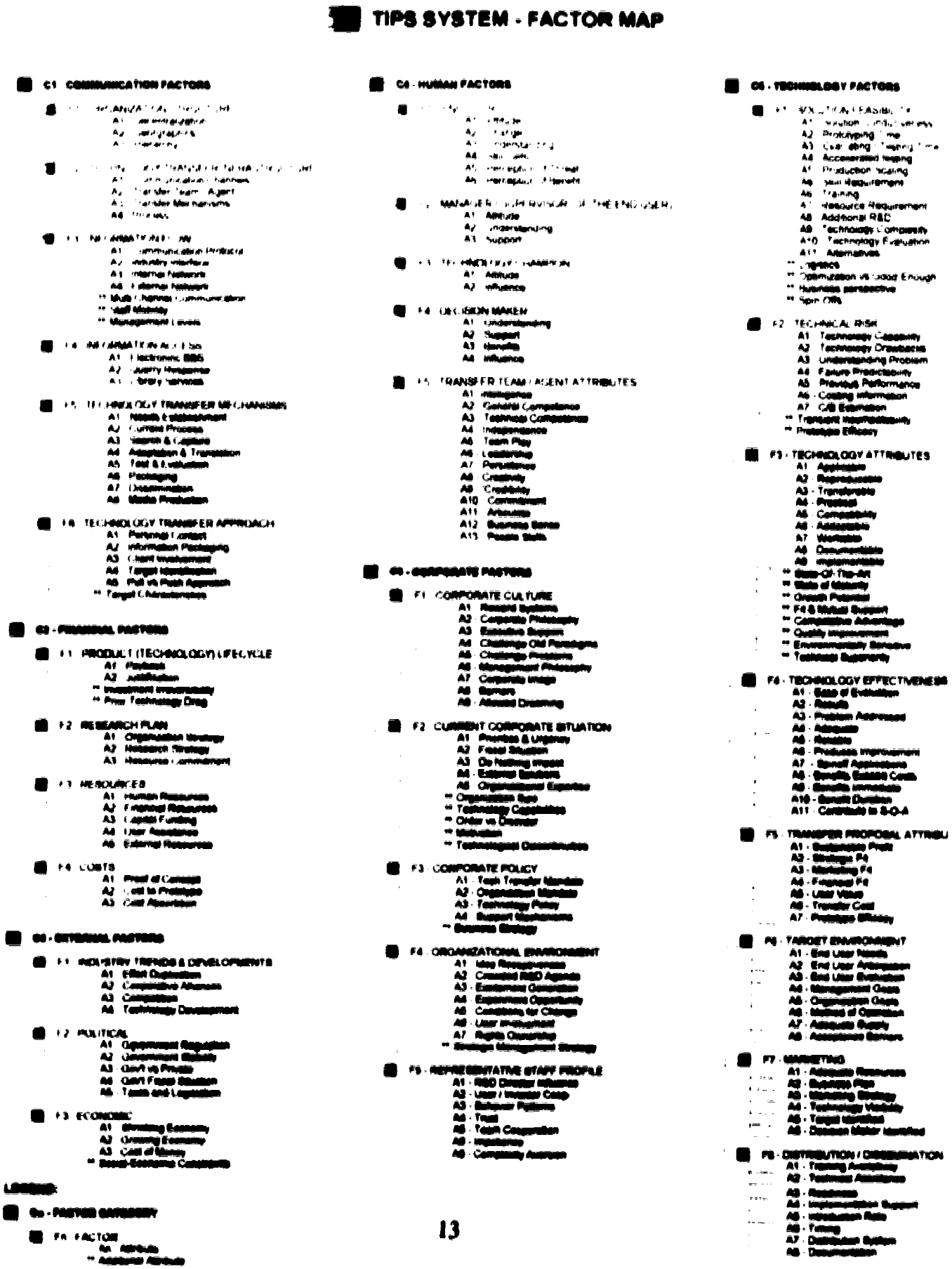
C4 = factor category => Human Factors

F1 = factor => End User

A1 = factor attribute => Attitude (towards technology).

Refer to the Factor Reference Map in Figure 1.

FIGURE 1 FACTOR REFERENCE MAP



3.2.2 DETAILED DESCRIPTION AND DEFINITION

Each factor will be described in some detail in the following chapters. The expert system scenario (Chapter 4) will be examined using sample questions and/or statements that should be used in a typical interview forum when extracting data about a particular case scenario (this was actually done during the case scenario test).

Before reviewing these factors it should be noted that there is some repetition of factor attributes, however, the context does differ in each case. Also, the validity of the overall success potential rating is subject to the ability to estimate the level of these attributes (only if they apply) with a reasonable amount of understanding and confidence.

3.2.2.1 Communications Factors

Diffusion of information about new technology is predominantly a process of communication (Fichman and Kemerer, 1993). Anything that impedes communication within the organization, as well as within the environment it interacts in, will jeopardize the successful implementation of the technology within the organization (Katz, 1988, p403).

3.2.2.1.1 Organizational Structure

The structure of an organization will either facilitate or impede communication. Effective decision making regarding implementation strategies and procedures will becomes increasingly frustrated with increased decentralization of decision making authorities. Closely related to this is the degree of geographic dispersement of corporate offices (Noori, Filipiak, 1990, Katz, 1988, p691). Hierarchical nesting of authorities/decision makers can also frustrate communication as each level may present its own agenda which may or may not be conducive to the implementation strategy.

3.2.2.1.2 Technology Transfer Infrastructure

The existence of a technology transfer infrastructure which facilitates communication channels for delivering information regarding new technology will certainly increase the success potential of the contemplated implementation. A contingent of staff (or possibly one individual) designated as a transfer team/agent charged with a technology transfer mandate would be fundamental to this infrastructure (Large and Baclay, 1992). The process should encompass transfer

mechanisms (Filipiak, 1990) and processes (Schmitt, Mulroy and Beimborn, 1994) designed to facilitate effective transfer and integration of technology into the organization's operations.

3.2.2.1.3 Information Flow

Effective technology transfer (conducive to successful implementation) is best done through multiple communication channels, both internal and external to the organization (Schmitt, Mulroy and Beimborn, 1994). Technology related information should be allowed to flow freely through these channels and should not be stifled by formal communication protocols (Rubough Jr., 1993). Informal contact through mobility of staff in the organization, and sometimes within the industry as a whole, is also conducive to information sharing and technology adoption (Katz, 1988, p442, Tushman and Moore, 1988, p565). So is the ability by different management levels to articulate concepts (Burgleman and Maidique, 1988, p348). The existence of an internal network of gatekeepers which are not aligned with the organizational hierarchy also supports informal information flow (FHWA-RD-91-010, 1990, Filipiak, 1990, Katz, 1988, p691).

The existence of an industry interface is critical for an organization to remain in touch with the environment within which it interacts (Filipiak, 1990). The interface should be with an existing external network through which technology transfer occurs within the industry (FHWA-RD-91-010, 1990, Filipiak, 1990).

3.2.2.1.4 Information Access

Part and parcel with information flow is the access to information. Obviously, the more facilities there are through which to obtain information, especially information outside the organization, the more qualified will the final implementation decision be (Katz, 1988, p691). The facilities could include electronic bulletin boards, which provide virtually boundary-less electronic communication capabilities (Jones and Lockhart, 1990). They could include other query response systems such as libraries services which can, for example, provide information searches on world wide research databases. Certainly, the existence of training facilities, demonstration and circuit rider programs would constitute effective supplemental means for information access by all organization staff (FHWA Video, 1992).

3.2.2.1.5 Technology Transfer Mechanisms

The technology transfer mechanisms encompass the task of dealing with an

overabundance of information and selecting the right (pertinent) information and delivering it to the right target (FHWA Video, 1992). To accomplish this, transfer agents should have an understanding of the current processes employed within the operations of the organization. This is critical for establishing the organization's technological needs. Once the needs are established, a mechanism must be in place for the search and capture of the technology. This involves thoroughly interrogating the industry/market for technological solutions.

The next phase of the process would involve adapting and translating usually highly technical information into a form that can be assimilated by the organization. This would include testing and evaluating the technology to determine its' attributes and how they may fit into the operations.

The final phase of the process involves mechanisms for packaging or preparing the information on the technology for distribution. This may involve the use of various media production methods to appropriately package the information into a format that is target specific. The dissemination of this information would involve targeting and delivering the packaged information to specific individuals within the organization (Filipiak, 1990).

3.2.2.1.6 Technology Transfer Approach

The approach taken basically addresses the issue of how the organization, and the individuals in it, are exposed to the technology that is being contemplated for implementation (Schmitt, Mulroy and Beimborn, 1994).

The initial awareness and eventual acceptance of the technology are a function of the conciseness and clarity in which the information is packaged (Schmitt, Mulroy and Beimborn, 1994). The information must be communicated in a palatable manner taking into consideration possible biases or special interests of the targets. The biases will vary for each target. Proper target identification is also an important consideration (Jones and Lockhart, 1990).

The relationship between the source and the target offers a unique opportunity to gain valuable insights into the characteristics of the target audiences and the potential barriers which might prevent adoption of a new technology (Noori and Radford, 1990, p91). Informal relationships, formed through personal contact (Schmitt, Mulroy and Beimborn, 1994) or "face to face" interaction (Katz, 1988, p691, Rubough Jr., 1993, FHWA Video, 1992), tend to be most effective. Involving the client (Jones and Lockhart, 1990) or the end-user in the evaluation process (Noori and Radford, 1990, Jones and Lockhart, 1990) will win them over,

hence improving the chances for successful implementation. Also, new knowledge is inherent to new technology which usually presents a requirement for new or updated skills. Therefore, facilitating the training requirements is very important (Shrieves, 1992, Noori and Radford, 1990, p91).

Finally, consideration should be given to identifying what is driving the technological need and then appropriately adapting the technology transfer approach (i.e., bottom-up versus top-down) (De La Garza and Mitropoulos, 1993, p436). Both pull and push approaches should be examined (Large and Baclay, 1992). For example, a grass roots needs driven scenario will pull the acceptance of the technology but will require a bottom-up push approach targeted at senior management to achieve their concurrence.

3.2.2.2 Financial Factors

3.2.2.2.1 Product (Technology) Lifecycle

A primary concern is the fiscal justification in terms of returns on the investment and the irreversibility of the investment, where adoption requires investments in unsalvageable products (Fichman and Kemerer, 1993). The payback period and the significance of the payback are intrinsic to the justification (Noori). The life of the technology, in terms of economic returns to the organization, will certainly have impact on the adoption decision. Also, prior technology drag, where a prior technology provides a significant network benefit because of large and mature installed base, may drastically affect the economic viability of the new technology if the supporting infrastructure has to be modified or replaced (Fichman and Kemerer, 1993).

3.2.2.2.2 Research Plan

A resource commitment is absolutely essential for proper adoption of new technology. Resource availability, allocation (Noori and Radford, 1990, p91, Burgleman and Maidique, 1988, p39, p41 tables) and financial backing (Noori and Radford, 1990, p91) will be required. To that end there should exist a research strategy, in which research funding is planned for, and which is congruent to an overall organizational strategy which covers fiscal planning.

3.2.2.2.3 Resources

The availability of human, financial and capital resources should be considered prior to implementation. Resources for providing user assistance may also be

required for various things, such as training. Sourcing of resources should be established beforehand (FHWA-RD-91-010, 1990). The availability of external resources through cooperative ventures or other arrangements may enhance the success potential for adoption (Shrieves, 1992).

3.2.2.2.4 Costs

A Chief Executive Officer should care about which technologies are likely to succeed because the cost of choosing an unsuccessful one can be substantial and recovery very difficult (Fichman and Kemerer, 1993). Areas that should be investigated are the ability to determine the costs for developing a proof of concept as well as for developing prototypes. The ability to absorb costs associated with preliminary development should also be looked at (Noori). These types of economic evaluations will identify the point of diminishing returns regarding the investment in particular technology (Tushman and Moore, 1988, p215).

3.2.2.3 External Factors

The decision to adopt technology is heavily influenced by environmental factors (De La Garza and Mitropoulos, 1993). These are the events occurring in the industry, market, country and the world in general, within which the organization interacts.

3.2.2.3.1 Industry Trends and Developments

It is important for an organization to be in touch with what is going on in the industry (FHWA Video, 1992). Being in touch allows for continuous awareness of the state of industry growth (Tushman and Moore, 1988, p689) and provides indication as to what forces are driving the implementation of the new technology (Noori and Radford, 1990, p495). The organization can then anticipate future technology changes in the industry, thus allowing it to position itself accordingly in the market (Tushman and Moore, 1988, p215). The avoidance of effort duplication may be one reason. Development of cooperative alliances may be possible on the other hand. Understanding the state of technology development, the competitor's innovative strategies and the multi-industry evolution will assist in directing investment in proper new technologies which will maintain the organization competitiveness (Burgleman and Maidique, 1988, p39 & 41).

3.2.2.3.2 Political

Government intervention (Noori and Radford, 1990, p449) can influence the

technology implementation success potential by supporting an organization's initiative through subsidies (i.e., grants and tax incentives) or by hindering it through regulation (Schmitt, Mulroy and Beimborn, 1994) (i.e., environmental sensitivity/impact (FHWA Video, 1992)). The very type of organization, whether it is a government agency or a private corporation, may be reason for different treatment by government. The state of current taxes and legislation will reflect the government's philosophy toward new technology (FHWA-RD-91-010, 1990). Other social political factors such as unemployment (usually regulated by government or have union influence) can influence implementation decisions (Noori and Radford, 1990, p408 & p487). The government's political stability and the current government fiscal situation will have some bearing.

3.2.2.3.3 Economic

Social-economic constraints, a shrinking or growing economy (i.e., recessional versus inflationary economy) and the current cost of money or capital financing will most certainly affect the adoption decision (Noori and Radford, 1990, p495). These considerations define the current economic reality and will determine the economic viability of a new technology.

3.2.4.1 Human Factors

Ultimate users of new technology must do something different from what they have done in the past. They must change their behaviour patterns. A consequence of this is that it cannot be expected that the recipients will respond to new technology quickly. They must not only assimilate facts relevant to the technology, but also change behavioral patterns that would lead them to use the technology. Also, it is human nature to resist ideas, especially those originating from outside of the organization, and this can lead to myopia or tunnel vision (Katz, 1988, p442). A clear implication is that technology transfer requires time, patience and opportunities to experiment (become familiar with) a new technology (Bunting, p17).

3.2.2.4.1 End User

It is evident that the success of technology implementation efforts depends on knowing the users and their needs, and being able to identify potential opportunities or barriers which will influence a user's decision to adopt a new technology (FHWA-RD-91-010, 1990, p21).

The successful implementation of technology depends on the end user actually using or applying the subject technology. In evaluating whether this will be the eventual case we need to determine what the end user's attitude is toward

technology and how the end user feels about the change which usually accompanies implementation of new technology (FHWA-RD-91-010, 1990, FHWA Video, 1992). The level of understanding of the technology that the end user possesses is also important. The more familiar the end-user is with the concepts of the technology the more likely one is to be accepting of it. We also need to know what skills, if any, the end user possesses that are directly applicable to the subject technology (Noori and Radford, 1990, p91). Finally, it is critical to establish how the end user perceives the technology with respect to their work, whether as a threat or a benefit (Schmitt, Mulroy and Beimborn, 1994).

3.2.2.4.2 Manager/Supervisor (of the End User)

The decision to adopt technology is influenced by management's attitude toward technology (Katz, 1988, p280, De La Garza and Mitropoulos, 1993). Also, like the end user, management should have a clear understanding of the technology and a defined goal of what they want to achieve. Sincere commitment, backed by support, in the form of resource investment, is necessary if the technology is to have a chance at all (Noori and Radford, 1990, p91).

3.2.2.4.3 Technology Champion

Sponsorship by a single entity (person, consortium), in other words a technology champion, helps to define the technology, set standards, subsidize early adopters, and promote adoption of a technology (Katz, 1988, p442, Fichman and Kemerer, 1993). The attitude of this entity must also be one that is conducive to successful implementation. The technology champion may or may not be a gatekeeper within an organization. Regardless, the level of the position occupied in the hierarchy has a great bearing on the ability to influence the final outcome (Katz, 1988, p691, De La Garza and Mitropoulos, 1993, p436, Tushman and Moore, 1988, p565).

3.2.2.4.4 Decision Maker

The decision makers, usually senior managers, should exhibit visionary leadership (Burgleman and Maidique, 1988, p568 Tushman and Moore, 1988, p689). They need to possess an intuitive feel for the future in a changing world. They should possess the power to influence the direction the organization embarks by supporting technologies that will become fundamental to their organization's future existence (Tushman and Moore, 1988, p565). As it is with the other key players, it is critical for decision makers to have an understanding of the possible

implications resulting from the implementation of the technology. They must believe technology choices are business decisions that have potential to realize benefits to the organization if executed properly (Tushman and Moore, 1988, p236).

3.2.2.4.5 Transfer Team/Agent Attributes

The individuals within an organization charged with executing technology transfer should possess certain character traits for effecting successful implementation(Large and Baclay, 1992). They should possess intelligence (Gibson, 1981, Schmitt, Mulroy and Beimborn, 1994) without being overly intellectual, thus, possibly jeopardizing their credibility (Large and Baclay, 1992) in the eyes of the other key players. They must be able to project themselves and view the technology from the user's perspective (Tushman and Moore, 1988, p565).

They should possess general competence (Gibson, 1981) in the form of business empathy or business sense (Large and Baclay, 1992). As well, they should possess technical competence (Gibson, 1981, Shrieves, 1992) or a certain level of cursory expertise regarding the candidate technology to be able to articulate (Schmitt, Mulroy and Beimborn, 1994) between information source groups and target groups.

Effective agents should exhibit independence (Gibson, 1981) in planning and executing actions. In terms of effectively interacting with people, they should possess people skills (Schmitt, Mulroy and Beimborn, 1994) which include leadership, as well as team play (Gibson, 1981), or the ability to work in a team environment with individuals with diverse backgrounds.

Since technology implementation is fraught with obstacles and resistance, persistence will be the order of the day for the agents. This will challenge the agents' creativity in developing new strategies to overcome these barriers (Gibson, 1981). The agent will have to be fully committed to the implementation initiative (Large and Baclay, 1992).

In summary, the agents play multiple roles within the organization. They may find themselves as the technology champions and/or the technology gatekeepers. Whatever the role or roles, interpersonal skills such as oral communication and the ability to overcome technical language and local language coding schemes will greatly assist in transcending organizational boundaries. These skills will also be important when linking to external sources of information (Katz, 1988, p403).

3.2.5.1 Corporate Factors

The decision to adopt technology is also heavily influenced by organizational factors (De La Garza and Mitropoulos, 1993, Noori). Organizations are more likely to be willing and able to adopt technologies that offer clear advantages, do not drastically interfere with existing practices, and are easier to understand. Adopters look unfavourably on innovations that are difficult to evaluate or which benefits are difficult to see or describe (Fichman and Kemerer, 1993).

3.2.2.5.1 Corporate Culture

Corporate culture is an intangible yet powerful influence on an organization. This influence purveys itself into all operational and functional areas. The free flow of ideas, trust among staff, sense of common purpose and the ability to integrate (i.e., overcome functional barriers are examples of culture based characteristics) (Tushman and Moore, 1988, p689). The culture defines the character of the organization and is expressed by the behaviour of its staff, how they interact, react and influence each other. The culture tends to be an intrinsic, although not always obvious, part of the end products produced by the organization.

Many things contribute to the overall culture of the organization. The primary influences are the overall corporate (Filipiak, 1990) and individual management philosophies (Katz, 1988, p442, Tushman and Moore, 1988, p236) toward technology. This can be determined by observing whether there exists true executive support (Filipiak, 1990). The support can take many forms, it can be in the form of allowed dreaming (Coates, 1984) or allowed slack time (Katz, 1988, p442) for creative experimentation (Katz, 1988, p201). Another indicator may be the existence of reward systems designed to incite innovation (Filipiak, 1990, Katz, 1988, p403 & 442, Burgleman and Maidique, 1988, p137).

Another good indicator is the way the organization challenges problems (Kepner and Tenque, 1981, LES Video, 1988) by way of proactively versus reactively challenging existing paradigms (Coates, 1984). Yet another is the organization's openness to methods used successfully by other organizations and its' willingness to abandon old ways (Tushman and Moore, 1988, p689). Another is the way the organization goes about removing barriers such as outdated policy. Another external indicator would be the corporate image and reputation within the industry.

In summary, business focus, entrepreneurship, excellent communications, ethics policies, fierce activism for promoting change, encouraged risk taking and failure

tolerance are all the basics of a culture conducive to technology adoption. A "hands-on" top management who understand the fundamentals of the operations and who are involved in projects with strategic impact potential will instill a sense of integrity, self understanding and pride within the organization (Tushman and Moore, 1988, p689).

3.2.2.5.2 Current Corporate Situation

The current fiscal situation of the organization will likely be a consideration when arguments are presented for adoption of a new technology. This situation will be tempered by a dualism effect or a need to balance resources to support today's production and the new technologies that will support business in the future (Katz, 1988, p442). This will determine the current priority and urgency of the technological needs in the context of the available resources (Noori). The ideal situation would be if an organization can except failures and/or can handle failures that are not fiscally fatal (Noori and Radford, 1990, p495).

A a new technology will depend on an adequate existing infrastructure (Noori and Radford, 1990, p495). The infrastructure may be required within and outside of the organization (Katz, 1988, p280). This will affect the way the technology should be implemented. The organization size (Noori and Radford, 1990, p91, Tushman and Moore, 1988, p565) and the technology capabilities (De La Garza and Mitropoulos, 1993, p436) will suggest different rates and styles of implementation. A technology adoption process will be necessary, with proper assignment of critical staff who have been identified to carry out the process (including idea generation, entrepreneuring, championing, project leading, gatekeeping, sponsoring and coaching) (Tushman and Moore, 1988, p310).

The availability of organizational expertise versus outsourcing for external solutions is another consideration. The organization should be able to facilitate at least one of the two. Of course the organization has the option of not adopting the new technology if expertise is not available. Then, the impact of doing nothing should be explored (Noori).

Organizations cycle through alternating states of order (stability) and disorder (change) (Tushman and Moore, 1988, p689). This may happen in harmony with greater external influences such as economic cycles or it may happen due to forces occurring strictly internally. It is usually the "change" cycle which will create motivation for adopting a new technology by identifying potential technological discontinuities (Tushman and Moore, 1988, p215). Under the new reality (resulting from the change) these discontinuities, if not addressed, can be

potentially fatal to the organization.

3.2.2.5.3 Corporate Policy

It is important to determine how technological issues within the organization are recognized by senior management (Noori). Maybe more importantly, it should be determined whether management uses technology to implement strategic objectives (Burgleman and Maidique, 1988, p137). For example, is technology development part of the corporate (business) strategy (Tushman and Moore, 1988, p229, Burgleman and Maidique, 1988, p137)? Is technology treated as a resource? Is the technology investment strategy in line with the business strategy? The answer to these questions will constitute the corporate technology policy on innovation and adoption. As part and parcel of this policy, there should exist a corporate technology transfer mandate which supports an overall organizational mandate . The policy should also facilitate support mechanisms (i.e., budgets (Katz, 1988, p442)) required to execute the mandate and controls which are conducive to successful technology adoption (Noori).

3.2.2.5.4 Organizational Environment

If an organization is flexible, heeds rigidity and control, or does not suffer from organizational inertia, then there is more likelihood of successful implementation (Tushman and Moore, 1988, p565). Rigid organizational bureaucracy (i.e., strategic overplanning, redundant or untimely policy, a tendency toward paper studies in lieu of immediate decision making, etc.) will impede technology adoption (Katz, 1988, p433). An understanding of the political nature within the organization is necessary, as at times, manipulation of it will be required to achieve a successful outcome (Burgleman and Maidique, 1988, p348).

Management should have a good understanding of the corporate technical environment (Large and Baclay, 1992, Burgleman and Maidique, 1988, p39 & 41). They must be aware of technological threats and opportunities (Tushman and Moore, 1988, p236) and should anticipate or have a good sense of timing for technology evolution (Tushman and Moore, 1988, p229). They should possess receptiveness toward ideas generated outside of the organization and be prepared to exploit them when appropriate (Large and Baclay, 1992). Management should ask the question "Is the organization based on technology?", and act accordingly (Noori and Radford, 1990, p486). Management should facilitate conditions for change by providing the opportunity to experiment and fail (Bunting). They should generate excitement (Large and Baclay, 1992, Bunting) around the new technology and support user involvement as much as possible (a truism of Total

Quality Management). This can be termed as strategic management capacity to deal with entrepreneurial behaviour (Burgleman and Maidique, 1988, p39 & 41).

An organization should have a crowded R&D agenda requiring rationing of resources (Large and Baclay, 1992). This will motivate a proper assessment of the candidate technologies.

The issue of rights ownership regarding patents, copyrights, industrial designs and alike, should be resolved at the onset of the implementation process if the issue arises at all, a win-win strategy will be most conducive to successful implementation in all cases (Bunting).

3.2.2.5.5 Representative Staff Profile

The influence of the R&D Director is a key considertion in the adoption process (Large and Baclay, 1992). The role of this position is fundamental to building the necessary organizational culture. The staff, on the other hand, make the organization and embrace the culture. If an atmosphere of trust exists between these people, especially the parties involved in a technology transfer process, greater potential for successful implementation will be apparent (Bunting). This trust will lend itself to use-inventor cooperation as well as team cooperation and a consensus among organizational teams or business units (Large and Baclay, 1992). Also, trust will dispel the perceived threat (as often associated with new technology) and will facilitate the necessary behavioral changes that are sometimes required to accommodate new technology.

In general, a positive staff profile within the organization will accommodate anticipation and impatience for realizing results and will lessen the aversion to complex technologies (Bunting).

3.2.6.1 Technology Factors

The decision to adopt technology is influenced by the technology itself (De La Garza and Mitropoulos, 1993, Noori). This is a fundamental truth. All other factors being equal, if the technology fails to live up to the expectations of the eventual users, then its implementation will not be successful.

3.2.2.6.1 Solution Feasibility

Feasibility suggests that the new technology will be a conducive solution for the problem at hand (Noori). To ensure this is so, a thorough technology evaluation

using performance measuring criteria, testing schedules and follow-up procedures will likely be necessary (FHWA-RD-91-010, 1990). Adequate prototype development time and testing time may be required (Noori). Accelerated testing procedures may also be required (Filipiak, 1990). Provisions may have to be planned for things such as additional R&D (FHWA-RD-91-010, 1990) that may be required to adapt/customize the technology, training (Noori) to address any skill requirements (FHWA-RD-91-010, 1990) for users of the technology, or any other resource requirements (FHWA-RD-91-010, 1990, Tushman and Moore, 1988, p236) required to support implementation. Within the evaluation, the possibility of existing viable alternatives should be examined as well (Noori).

Logistics is another key consideration (FHWA Video, 1992). This may involve issues such as integrating the technology into an existing infrastructure or possibly the need for establishing a new one. For example, in a manufacturing setting the existence for new production scaling processes (i.e., new tooling for robotic automation) may be required prior to technology implementation (Noori). These kinds of operational factors must be examined (Noori and Radford, 1990, p368). Pursuit of perfection or optimization versus good enough end product quality and the level of technology complexity (i.e., appropriate for given application) are possible considerations as well (Katz, 1988, p433, Noori and Radford, 1990, p495).

A business perspective analysis should be performed and should include a technical and commercial feasibility study (Burgleman and Maidique, 1988, p348), a cost-benefit analysis (Noori and Radford, 1990, p487), an impact analysis and competitive pressures analysis. The technology should be congruent with corporate goals and should support areas central to future objectives of the organization (Gibson, 1981, p163, 164). The possibility of spinoffs such as sale or leasing of proprietary technology (licensing) should also be investigated (Fichman and Kemerer, 1993).

3.2.2.6.2 Technical Risk

The size of risk is an important consideration especially when investment is large and failure may be financially fatal to the organization (Hillier). Unfortunately, determining the risk in many cases is a subjective estimation of probability for successful implementation (Gibson, 1981, p315). Success potential is a secondary consideration as the potential profitability is what usually outweighs the risk (Fichman and Kemerer, 1993). To that end the ability to obtain accurate costing information is important to be able to perform representative Cost-Benefit estimation (FHWA-RD-91-010, 1990).

From the technical perspective, a previous performance history (FHWA-RD-91-010, 1990) of the technology should greatly assist in assessing the risk. Information on the capability of the technology (Filipiak, 1990) to solve similar problems and any drawbacks (FHWA-RD-91-010, 1990) or side effects should be readily available. Issues such as risk of stranding or the failure of the technology to achieve critical mass of adoption, in past implementation attempts, may become apparent. This may also bring to the forefront issues of transient incompatibility as related to the existence of networks of early adopters of the technology necessary to achieve that critical mass (Fichman and Kemerer, 1993).

Also, from a technical perspective, there is the issue of prototype efficacy which refers to several dimensions of technical risk (i.e., will the prototype work, will it work in the expected range of design conditions, will it produce a significant user benefit, will it appear producible, and is it safe) (Large and Baclay, 1992, p20).

Of course, to begin with, the technology broker must understand the problem (Noori) being addressed to properly monitor or track (Burgelman and Maidique, 1988, p137) the technology, assess whether it is proven or radically different (Noori and Radford, 1990, p91), and be able to make qualified comparisons. The broker should also have a technical understanding of technology benefits, limitations, fit or capability for integration (Katz, 1988, p442, Tushman and Moore, 1988, p215). The final result of this type of assessment should be a qualified failure predictability (Noori) assessment of the contemplated technology.

3.2.2.6.3 Technology Attributes

The state-of-the-art (Noori and Radford, 1990, p91) and state of maturity (De La Garza and Mitropoulos, 1993, p436, Tushman and Moore, 1988, p215) of the technology are important considerations in timing for exploitation. So too, is the technology growth potential (Katz, 1988, p442). An assessment of the candidate technology's fit and mutual support of existing technologies (both internal and external) may be important if there is interdependence on other technologies (this is really the infrastructure issue again) (Noori and Radford, 1990, p91).

Other attributes that influence the potential for adoption include the degree to which the technology is:

- Applicable to the problem at hand;
- Reproducible and Transferable, thus addressing the economies of knowledge leveraging (FHWA-RD-91-010, 1990);

- Practical in terms of triability (i.e., experimenting without great investment of resources) (Noori);
- Compatible with existing procedures, existing values, skills, work practices and existing technologies (Katz, 1988, p442);
- Adaptable in terms of customization (Filipiak, 1990);
- Workable in terms of complexity and relative difficulty to understand and use;
- Documentable in terms of communicating observable results and benefits (Fichman and Kemerer, 1993);
- Implementable, possibly incrementally, thus, not overextending the amount of up-front investment (FHWA-RD-91-010, 1990);
- Competitively advantageous (Burgleman and Maidique, 1988, p31);
- Improves quality of product, service, life and safety (FHWA Video, 1992);
- Sensitive to the environment, for example, through energy conservation (FHWA Video, 1992);
- Technically superior over the technology that was superseded (Fichman and Kemerer, 1993).

3.2.2.6.4 Technology Effectiveness

To be adopted the technology must be effective (Noori). To be adopted the technology must be of real value where benefits exceed the costs to the organization (De La Garza and Mitropoulos, 1993). The immediacy and the duration of the benefits are also important considerations. The technology must be technically correct and reliable to be properly utilized by the end users (FHWA-RD-91-010, 1990). Also, transition to new technology should result in superior performance improvements over the current situation within the organization (Filipiak, 1990, Tushman and Moore, 1988, p215).

Primary indicators of the effectiveness of the technology are the degree to which the technology adequately and directly addresses the problem and to which the results are tangible and quantifiable (Noori).

Other considerations, possibly of lesser significance, could include:

- the degree to which the technology is easy to evaluate (Filipiak, 1990);
- the possibility of spinoff applications to other problems or support of other research efforts (FHWA-RD-91-010, 1990, Noori);
- contribution to the State-Of-The-Art (Noori).

3.2.2.6.5 Transfer Proposal Attributes

The successful implementation of a technology will also depend on the arguments presented for its' justification. The role of the proposal (Large and Baclay, 1992) is to define how adopting a technology will affect other components of the organization such as marketing function, human resources, finance and accounting, the overall structure, and the balance between flexibility and control (Noori and Radford, 1990, p 321).

Many questions need to be answered in the proposal, for example, "Why is the technology needed (i.e., displacement of old technology (Noori and Radford, 1990, p483, 484))? When should it be introduced (i.e., timing)? Where should it be introduced first? How should it be introduced (i.e., multi phased implementation allowing enough time for proper assimilation by end user while still maintaining a cognisance of the rapid pace of technology evaluation) (Noori and Radford, 1990, p91)?"

The proposal should address the issue of profit, whether it is both sustainable and substantial. Also, whether the technology fits strategically at all levels of the organization that it affects. It should address the marketing fit - whether marketing plans can accommodate the technology being transferred, and the financial fit - whether fiscal requirements (i.e., type of funding - phased versus one-time) can be accommodated in the organizations fiscal planning. Basically, it needs to establish the technology's fit into the overall organizational context. It should also address issues already elaborated upon earlier in the document such as user-value, transfer cost and prototype efficacy (Large and Baclay, 1992, Fichman and Kemerer, 1993).

Finally, even if the new technology is as good as it is built up to be, the proposal should explain what needs to happen before implementation is initiated. It should explain in detail how much leverage the new technology will exert on the total system (Noori and Radford, 1990, p495)?

3.2.2.6.6 Target Environment

The characteristics of target market will, to a greater extent, determine the type of approach taken during implementation (Burgleman and Maidique, 1988, p419, Noori). To determine whether the appropriate target has been identified, we need to reflect upon the technology and establish to what degree the end user's needs are being addressed. Then, when we refocus on the end-user we should establish if anticipation exists for the technology to be a solution to their problem (FHWA-

RD-91-010, 1990). To be able to assess these two issues properly, the potential end users should be involved in the evaluation process from the conceptual stage and onwards.

In the greater context, an examination of the management goals of various business units as well as the overall organizational goals should assist in establishing proper targeting of the technology.

In preparation for technology deployment, the method of operation of the potential target environment should be reviewed. If required, modification should be planned for. Possible acceptance barriers should be anticipated and planned for as well. If the technology lends itself to this, an adequate number of technology units should be available to supply all who have indicated a need or interest (Filipiak, 1990, FHWA-RD-91-010, 1990).

3.2.2.6.7 Marketing

The fundamental and most important concept in marketingis to understand and satisfy the intended target's need. The other important aspect is the marketing plan itself (Large and Baclay, 1992, p16). Therefore, a marketing strategy should be part of the organization business plan with adequate resources reserved for technology promotion. The promotion should focus on raising the visibility of the technology and bringing about awareness throughout the organization. Closer relationships should be established with identified targets, such as the potential end users as well as the eventual decision makers (Tushman and Moore, 1988, p565, FHWA-RD-91-010, 1990, Shrieves, 1992, Large and Baclay, 1992).

Execution of the marketing strategy and technology promotion can be tempered with the fact that implementation efforts will benefit from an extended period of widespread expectations, by the targets, that the technology will be adopted in the future (Fichman and Kemerer, 1993).

3.2.2.6.8 Distribution/Dissemination

The deployment of the technology should begin only when every aspect of implementation is ready. Provisions should be arranged for training, technical assistance and any other resource requirements anticipated for supporting implementation. Appropriate implementation timing and an appropriate technology introduction rate should have been established with sufficient warning provided for intended targets. All supporting documentation should have been prepared (in target specific formats) and an adequate distribution system should be

in place at time of distribution (FHWA-RD-91-010, 1990, Shrieves, 1992, Schmitt, Mulroy and Beimborn, 1994).

3.3 SYSTEM DETAILS

3.3.1 FUNCTIONAL SPECIFICATION

3.3.1.1 System Users

The intended users of the TIPS System are individuals within an organization that are in one way or another involved in technology implementation. These individuals need to make sound decisions regarding the investment in technology. In some cases the proper decision may be critical to the future health of the organization. The TIPS System can provide objectivity and rational to these decisions. An example of possible users include the following:

Technology transfer agents who are responsible for the search, adaptation or translation, packaging and dissemination, training and ensurement that a new technology is properly implemented, accepted and used to its full potential by a target user.

Managers within research related areas who are responsible for technology transfer functions.

Managers or those charged with the responsibility of making decisions as to whether a technology is considered for implementation within the organization.

Managers or those charged with budgeting responsibilities which encompass evaluating the cost of new technology.

Those charged with strategic and business planning responsibilities within the organization.

Individuals who are being trained to perform any of the above noted functions.

3.3.1.2 System Operation

3.3.1.3.1 Basic Requirements

The user of the TIPS System is required to be familiar with the particular scenario being analyzed and should have access to financial information regarding the technology under consideration. The user is also required to be familiar with the financial methodologies used within the organization. Finally, the user should be familiar with the organization's culture. This background is required in order to properly rate the factors.

3.3.2.3.2 Input

There are thirty-one factors in the TIPS Model (template). The user will review and assess each factor within the context of the scenario (i.e., technology) being evaluated. In evaluating these factors, the user will provide numeric ratings for:

- factor applicability (to the scenario);
- contribution type (supportive or hindering to successful implementation);
- degree of contribution; and
- level of confidence (of the ratings assessed on all of the above).

The numeric ratings have counterpart subjective ratings.

The input user-interface also provides a facility for textual annotation.

Refer to Figure 6 in section 4.3.1.4 for an example of input for a typical factor assessment.

3.3.1.3.3 Output

The output will include a summary of the inputs provided by the user. The output will provide the following:

- a list of the key driving factors influencing the final outcome;
- a potential success rating (or risk of failure rating) and a sensitivity range (also confidence rating) for each key driving factor;
- an overall value rating of the potential for successfully implementing the technology under consideration;
- recommended actions for each factor, factor category and overall scenario;

- a suggested estimate of a discount rate to be used in an economic analysis (using the discounted cashflow method).

Refer to Figure 7 in section 4.3.1.4 for an example of typical output.

3.3.1.3 System Limitations

This system is designed to operate as a "one-run-system" where only one technology evaluation scenario can be analyzed at a time.

The system, as it stands, was designed within the boundaries identified in the research scope in Chapter 2. Some modification of the system may be required for generic application.

3.3.2 TEMPLATE

The template (filename: MODELRAW.WK3) was designed using LOTUS 1.2.3 for Windows V.1. It is fully automated and dynamically linked to the database containing the raw survey results (filename: SURV_RAW.WK3). This template uses the sophisticated functions only available on Windows versions of the spreadsheet program and therefore may not work properly with older versions of the software.

The template has five functional areas:

1) Factor Details - This area contains information related to the factors used in the analysis process. The factor identification number, factor description and reduced survey data (i.e., statistical results based on the collective consensus of industry experts) are presented. This information is used to graphically define the model. This area represents the knowledge base of the system and can be updated over time as required.

2) Scenario Details - This is the data input area of the template. Case scenario information, translated into numeric ratings, is keyed into the template in this area. An algorithm is used to manipulate this numeric data into a final actual rating (ACT RATE) for each factor. The actual ratings are automatically transposed onto the graphic component of model.

3) Model Details - This area basically represents the first two functional areas in graphical form. Graph # 1 is the actual Success Potential. Graph # 2 is the Factor Sensitivity. Both of these graphs are dynamically linked to the data in the first two functional areas. Any updates to the factors or to the case scenario will be automatically updated on the graphs. This area

represents the inference engine of the model.

4) Action Details - This area automatically provides recommendations for actions based on the comparison of the case scenario results (functional area 2) with those of the knowledge base (functional area 1). This area represents the advisor part of the model.

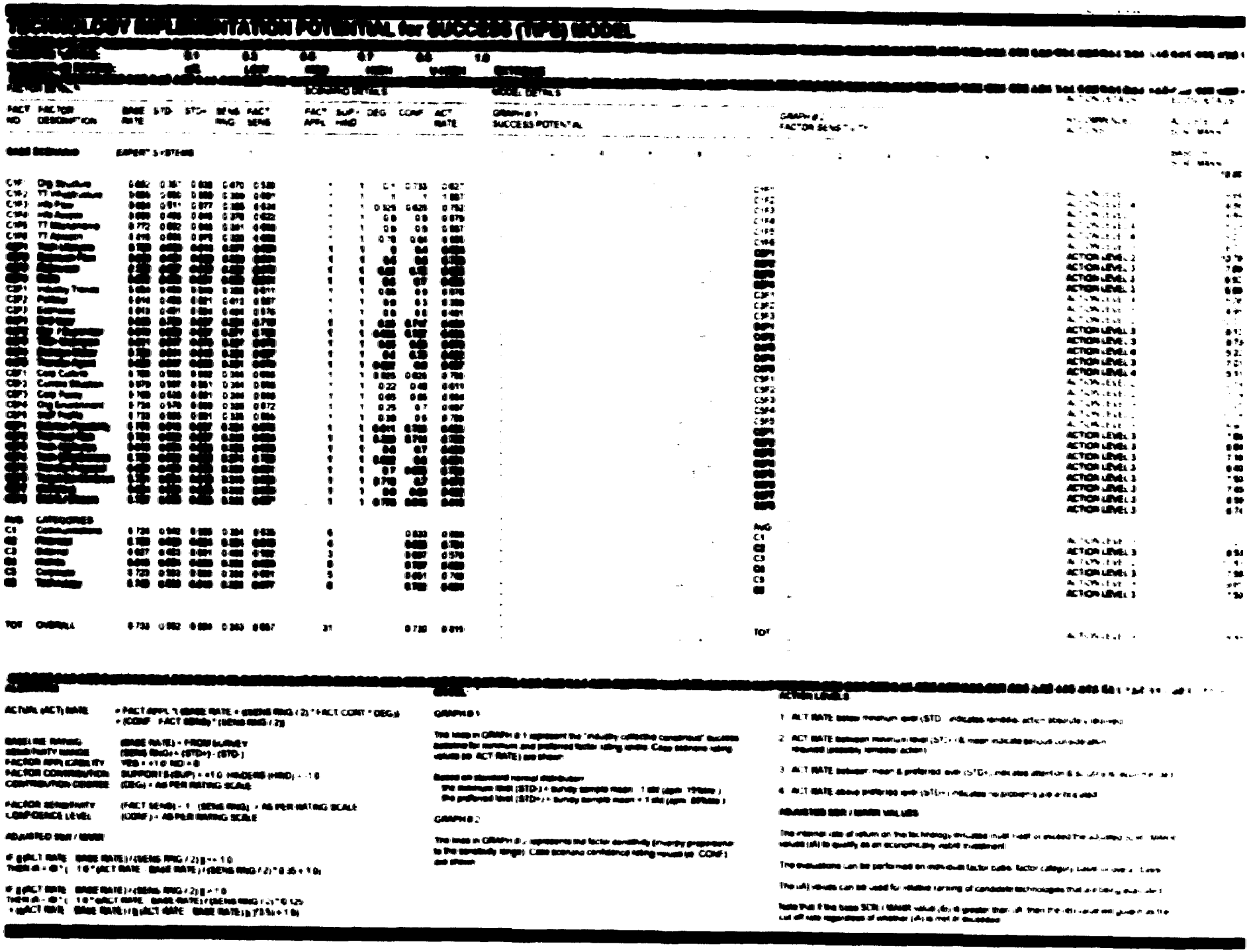
5) Economic Details - This area automatically provides a recommended internal rate of return values that should be used in an economic (benefit-cost) evaluation. This area also represents the advisor part of the model.

This template is in essence the TIPS Model. This model is part of the overall TIPS System proposed for technology implementation assessment.

Figure 2 shows the base perspective of the template where all the factors are depicted in category groupings. Figures 8 through 11 in Appendix A.6 show the template in its entirety from four different perspectives (explained in the next section). The perspectives are based on the Expert System case scenario.

Refer to Appendix A.3 for more detailed template user documentation.

FIGURE 2 BASE PERSPECTIVE OF TEMPLATE AND TIPS MODEL



3.3.3 MODEL DESCRIPTION

3.3.3.1 Structure

The TIPS Model is represented in numeric and graphical formats. It presents information on the survey results (i.e., the baseline) as well as the results of a particular case scenario. The information in the template can be manipulated and presented from either the perspective of baseline factor importance or the degree of baseline factor sensitivity. It can also be presented from the perspective of the case scenario factor rating for both success potential and confidence.

The model can also present the information from a birds-eye-view of all factors or in the context of any one of the factor categories (typically useful in closer examination of individual categories, factors and attributes).

3.3.3.2 Working Process

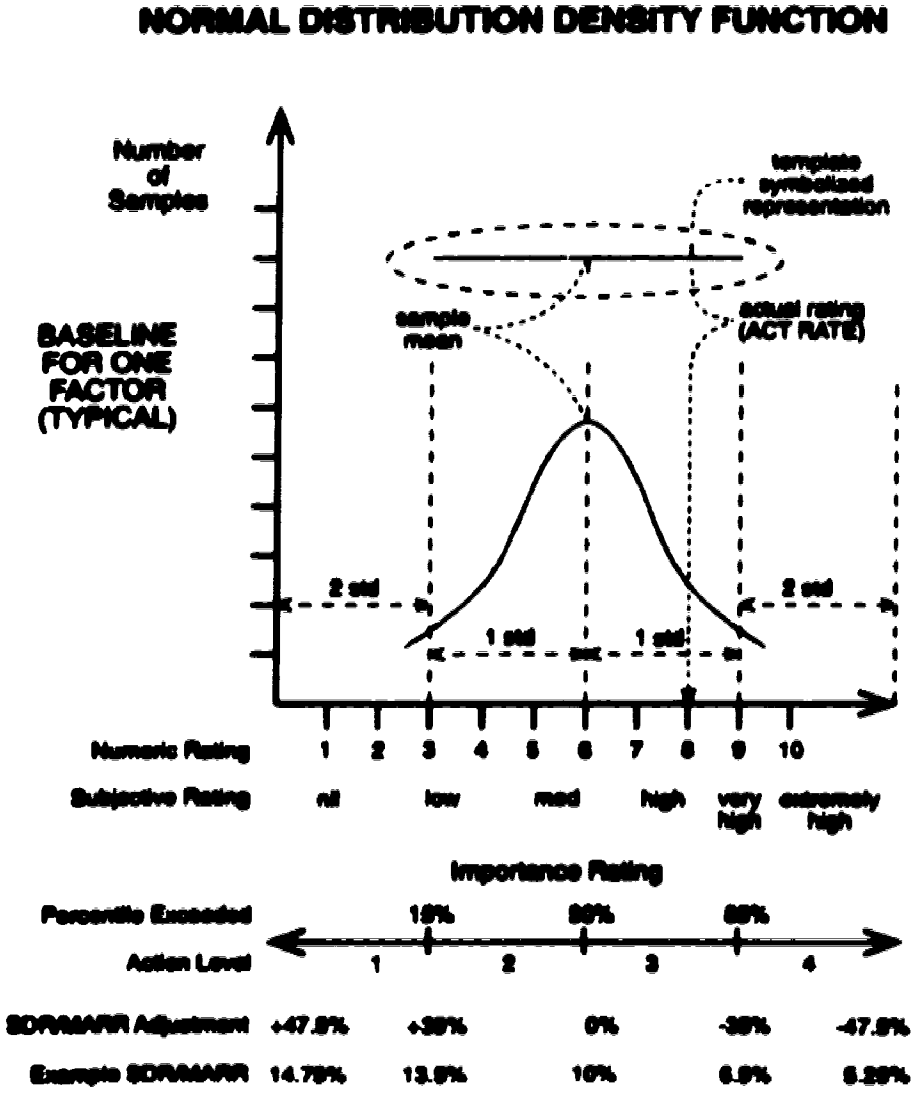
Statistical information regarding the factors is extracted from the survey database and transcribed into the template (via a dynamic link between spreadsheets). A normal distribution is used for establishing the baseline (Hillier). This information is reduced to provide four success potential levels. This is the "collective consensus of industry", or the Industry Consensus Baseline (ICB), against which all case scenarios are assessed. Figure 3 explains the symbolism used in the graphs within the template and the statistical aspects used for analysis.

Data pertaining to a particular case scenario is input directly into the template. An algorithim calculates a rating for each factor (ACT RATE) that is applicable in the given case scenario. This rating is then compared numerically and graphically to the baseline rating. Depending on the case scenario rating, relative to the baseline rating, an action plan is automatically recommended through a pseudo macro (actually, a conditional formula) within the template.

The template also calculates an overall rating for the baseline and both the case scenario success potential and sensitivity ratings. This information provides a quantified (and hopefully objective) estimate of the success potential of the technology in question.

The TIPS ratings are the final product of the template after all numeric processing is completed. During processing the template and database are dynamically linked together. Upon completion of the processing the template spreadsheet is delinked from the database before final perspective selection and report generation.

FIGURE 3 TEMPLATE (TIPS MODEL) SYMBOLISM AND STATISTICS



3.3.4 SYSTEM PROCESS & EXECUTION

The factors were established upon completing the literature search. However, they can be updated or improved upon, if necessary, as more information is collected. This process would work in a similar way to that of updating a knowledge base within an expert system. However, the need to update will likely be infrequent and for most practical purposes the knowledge base can be treated as a static part of the system.

The baseline was established through the survey. It constitutes the foundation for the entire system. Without it there is no system. It is static as well. However, it can be treated as an interchangeable module within the system. In other words the baseline used in this application was established within the context of the road transportation industry. In the future it can be replaced with baselines established in other contexts. This facility lends the system to generic application.

The other static part of the system involves the template and the algorithm that drive it. This can be effectively compared to the inference engine of an expert system.

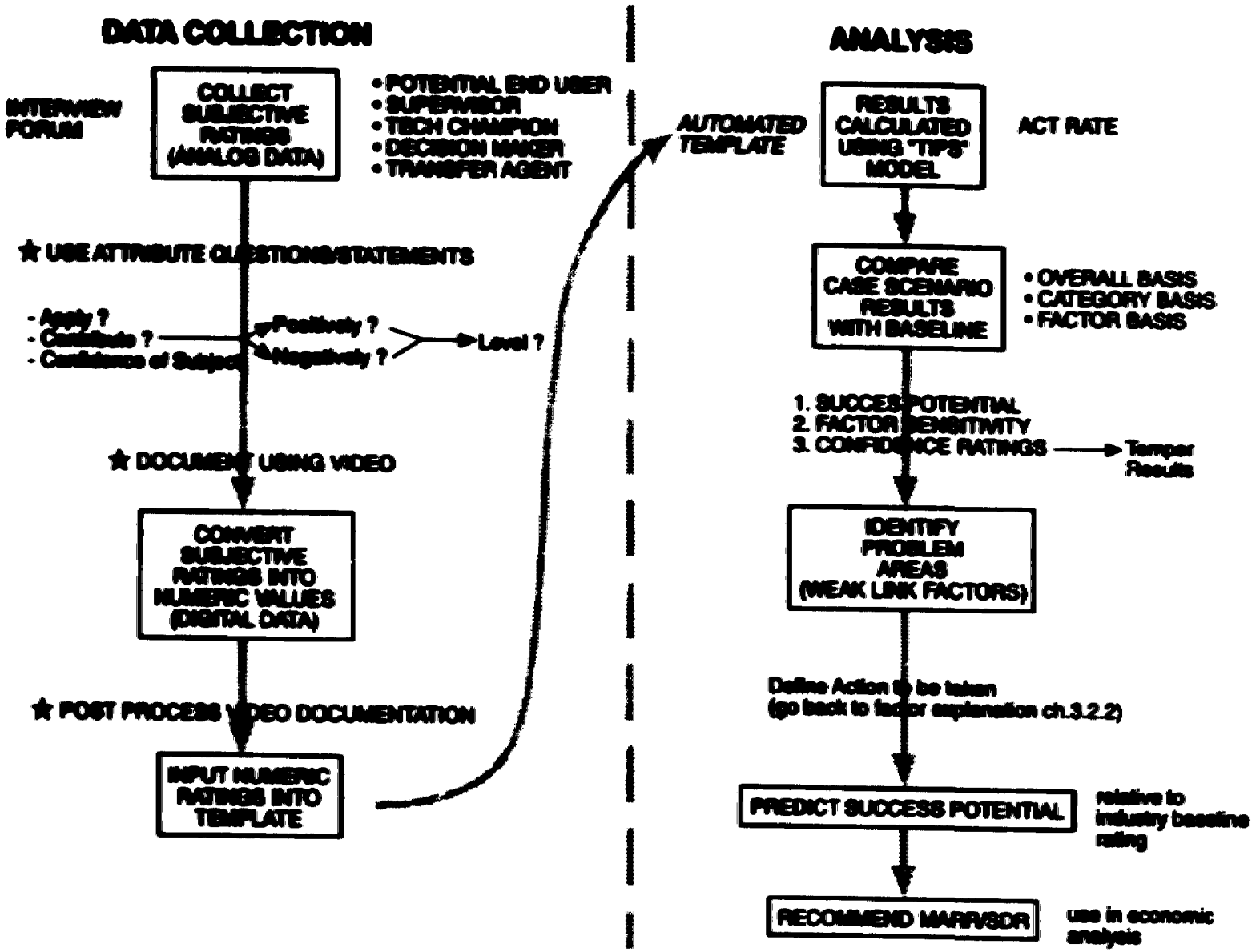
The dynamic part of the system involves case scenario data input and analysis. This is the working memory and user interface of the system. The scenarios will be different in each case, therefore, data collection will be required for each analysis. This process is an important part of the system and good results are dependent on the data that is fed into the system. "Garbage in equals garbage out" truly does apply here. It is critical to properly execute the case scenario data collection process.

Although it had not actually been done as part of the case scenario test, a data extraction process using interviews should involve all parties with a vested interest in the technology implementation process. The group of key players would include:

- the potential end user
- the potential end user's superior
- the technology champion
- the final decision maker
- the transfer agent or team (the only group examined in the case scenario test).

Figure 4 depicts the processes employed when using the system for success potential analysis.

FIGURE 4 TIPS SYSTEM PROCESS FLOW CHART



Different approaches were examined in case scenario data collection with varying degrees of success. The best way to describe this process is to apply the terms analog and digital to the methods evaluated.

The TIPS system requires the user (i.e., any individual as identified in section 3.3.1.2) to collect subjective ratings during interviews with key players and to convert them into numeric data. Throughout all data collection aspects of this research work the same subjective rating scale has been used. This scale has a decimal based numeric scale as a counter part. The process of extracting subjective data, say through an interview forum, involves translating that subjective data (or analog data) into numeric data points (or digital data) so that they can be manipulated by a mathematical algorithm. This cannot be done effectively in real time, neither by the individual being interviewed nor by the individual performing the interview. The best method for capturing and translating this information involves video recording the interview. The responses to questions and statements related to factors and their attributes are documented and can be post processed more effectively at a later time. Tape recording the interview is an option, but, the body language (which conveys nonverbal information and innuendo) is not captured, thus, making the estimation of confidence more difficult.

The post processing involves reviewing the video document (repeatedly if necessary - a luxury not afforded in real time) and one by one numerically rating each factor on the basis of the following criteria:

1) Does the factor/attribute apply?
   Yes = +1.0, No = 0.0

2) Does the factor/attribute contribute in a positive or a negative manner to the final outcome?
   Positive = +1.0, Negative = -1.0

3) What is the level of the contribution?
   Nil = 0.1, Low = 0.3, Medium = 0.5, High = 0.7, Very-high = 0.9, Extreme = 1.0 (intermediate ratings also possible)

4) Level of confidence exhibited by subject when discussing factor related issues.
   Nil = 0.1, Low = 0.3, Medium = 0.5, High = 0.7, Very-high = 0.9, Extreme = 1.0 (intermediate ratings also possible)

3.3.4.1 The Analysis

Once the data input is complete, the template automatically initiates the calculations and produces the results which are used in the analysis.

The analysis includes the following:

1) comparing actual case scenario factor ratings with the industry consensus baseline factor ratings to determine the influence of the particular factor on the success potential;

2) comparing the case scenario confidence ratings against the baseline factor sensitivity ratings to determine the degree of confidence in the predicted success potential.

A specific example of the analysis of one factor is presented in Figure 7 in section 4.3.1.4. A global view of the analysis of all factors is shown in Figure 2 in section 3.3.2.

3.3.4.1.1 Success Potential

The baseline mean values for each factor are used as a starting point for determining the case scenario actual ratings. In other words, it is assumed that each factor for a case scenario meets or exceeds 50% of the ratings determined by the collective consensus of industry experts. Factored into the mathematical algorithm, which will determine the actual rating, are:

- this baseline rating;
- whether a particular factor applies to the case scenario;
- whether it will contribute in a positive or negative manner to the final outcome;
- the degree of this contribution. Refer to Figure 2 for details.

The baseline also establishes three levels (four zones) for comparing actual case scenario ratings. They are the mean level as mentioned above (or average industry rating), the preferred level (the mean plus one standard deviation which is roughly equivalent to the 85th percentile) and, the minimum level (the mean minus one standard deviation which is roughly equivalent to the 15th percentile). These levels define which of the four recommended actions should be considered for each factor, factor category and overall case scenario. These actions include:

Action Level 1 - recommending that remedial action be initiated to improve the factor rating before implementation proceeds if the actual rating is below the

minimum baseline level;

Action Level 2 - recommending serious consideration which may include remedial action if the actual rating is between the minimum and the mean levels;

Action Level 3 - recommending attention and scrutiny of the factor, factor category or overall scenario if the actual rating is between the mean and the preferred levels;

Action Level 4 - suggesting that no problems are anticipated if the actual rating is above the preferred level.

A pragmatic approach was taken to establishing the action level zones. Since a normal distribution density function (refer back to Figure 3 in section 3.3.3.2) was used to represent the baseline for each factor, it naturally followed that well understood and accepted parameters, such as the mean and standard deviation, be used to define the model. Hence, the zone boundaries were chosen at the mean and at plus and minus one standard deviation because it facilitated:

- simplicity in visualizing and understanding the model;
- close representation of real case observations (i.e., minus one standard deviation represents roughly the 15th percentile where approximately fifteen percent of cases would rate below that observation, similarily for the mean (fifty percent) and plus one standard deviation (eighty five percent));
- simplified calculations within the model.

The action levels are used to temper the potential rating that was calculated. They allow for the identification of possible problem areas that may not be as obvious as those factors rated with nil or low success potential ratings. For example even though a particular factor rating may be high it may fall below the minimum baseline level because the mean baseline is very high. This may suggest that the factor could be a possible weak link even though the overall rating for the case scenario may lean toward a relatively high potential for success. What this also means then, is that even though an overall case scenario potential for success may be rated high, each factor category and each factor should be reviewed on its own merits. These " weak link" factors (which also include the low rated factors) are the key driving factors and are most important to consider during the analysis as they are critical to predicting the final outcome.

3.3.4.1.2 Factor Sensitivity and Confidence

The sensitivity range, which is determined by calculating the difference between the preferred level rating and the minimum level rating, indicates two things:

- the degree of outcome sensitivity for each factor (i.e., a narrow range may suggest that a relatively minor remedial action may be required to change the potential outcome from a negative to a positive one - the converse is true as well).

- the level of confidence in the baseline rating (i.e., the larger the range the less consensus among the industry experts, thus suggesting that the baseline itself may not be very accurate).

The case scenario confidence rating is compared with the factor sensitivity (or industry confidence) rating. If the scenario rating is significantly lower than the industry rating this may suggest another weak link and the factor should be examined more closely.

3.3.4.1.3 Proposed Application to Economic Analysis

In real life situations, whether in the public sector or the private sector, resource rationing is a certainty. The primary resource for consideration is available funding. Rarely, if ever, is there enough funding available to pursue all projects that have demonstrated potential benefits greater than estimated costs. To economically rationalize the choices for which technologies do or do not make the cut, the following is one proposed possible methodology.

For the purpose of illustration we will consider the Discounted Cash Flow method (Noori and Radford, 1990, p266, Hertz, 1964, Sprague and Whittaker, 1986). We will look at the Social Discount Rate (SDR, the rate which represents the opportunity cost to society of resources used in public sector investment projects) or the Minimum Acceptable Rate of Return (MARR, the after tax lower limit of investment acceptability in private sector projects). The proposed method suggests incremental adjustment to each value based on the ratings resulting from the analysis performed using the TIPS model.

The recommended adjustment values are directly proportional to the amount of Actual Rating deviation from the mean of the baseline. They are adjusted upwards if the technology exhibits risk and conversely they are adjusted downwards if they exhibit great success potential. This adjusted value is used as

the cutoff rate for the particular technology being considered.

In other words if the baseline mean is 6 and the standard deviation is 3 and:

- the Actual Rating is 8, then the SDR or MARR values would be adjusted:

  -2/3*35%*MARR or -2/3*35%*SDR

- the Actual Rating is 5, then the SDR or MARR values would be adjusted:

  +1/3*35%MARR or +1/3*35%*SDR

- the Actual Rating is 2, then the SDR or MARR values would be adjusted:

  +(35% + 1/3*12.5%)*MARR or +(35% + 1/3*12.5%)*SDR

The 35% represents the range (of the area within the normal distribution density function) bounded by the mean and one standard deviation. The 12.5% represents the range bounded within one and two standard deviations. It is not anticipated that actual ratings will fall outside two standard deviations, and if they do, the adjustment to SDR or MARR will remain constant from two standard deviations outward. Note that throughout this document the standard deviation values are rounded. Since all aspects of this analysis are estimates, absolute accuracy is not deemed critical.

Two or more technologies can be compared either on an individual factor basis, or factor category basis or overall basis. During this evaluation the SDR or MARR values can be adjusted to reflect the success potential (or inherent risk) for each case scenario. The actual economic analysis (or benefit-cost analysis) should be performed based on calculating the rate of return for each technology. After this is completed, the technologies which exceeded the adjusted SDR or MARR values should be laddered in descending order of rate of return. The base MARR or the available funds would then determine the absolute cutoff rate.

4.0 RESULTS AND OBSERVATIONS

4.1 SURVEY RESPONSES

The survey was one of the most difficult aspects of this research. The objective was to design a comprehensive form that would cover a large amount of information yet would not be onerous for the subjects to complete. To this end, all that the survey respondent was requested to do was provide a numeric rating. All thirty-one factors were listed. They were grouped thematically and had their supporting attributes listed to better define the respective factors.

4.1.1 LEVEL OF RESPONSE

One hundred thirty-one responses were received. This represents 60.1% of the survey sample. The breakdown for responses is as follows:

Group A: 28 responses
Group B: 26 responses
Group C: 30 + 1 rejected
Group D: 9 + 2 rejected
Group E: 5 responses
Group F: 14 + 1 rejected
Group G: 6 responses
Group H: 9 responses

Refer back to section 3.1.2.2 for a description of each group type. Refer to Appendix A.2 for actual survey results.

4.1.2 COMPARISON OF SURVEY SUBGROUPS

Overall, the subgroup ratings varied less than one point from the success potential and factor sensitivity ratings of the total survey sample. At the category level, the ratings varied slightly more and even more so at the individual factor level. This was primarily due to the difference in size of the sample subgroups. However, it is interesting to note that the largest variance was observed on factor C1F1 (Organizational Structure) between subgroups G and H. This is an interesting observation because of the origins of the technology transfer agents (i.e., head offices and field offices within a department of transportation, respectively). In any case the ratings did not vary enough to suggest overly influencing biases within the subgroups.

4.1.3 COMMENTS FROM SURVEY RESPONDENTS

Twenty-six of the repondents provided additional comments. Refer to Appendix A.2 for comment details.

The survey was squeezed into four pages (three of which actually contained the questions). This forced the use of a smaller fonts size, thus, resulting in a number of complaints. Another complaint indicated that the survey was not simple (that each factor warranted substantial thought) and took much longer to complete then the five or ten minutes suggested in the survey instructions.

Other than identifying two additional factors (or potential attributes), those being environmental impact and safety, the additional comments did not offer new insight on the subject of technology implementation.

4.2 SYSTEM / MODEL

4.2.1 THE BASELINE

Upon examining the "transportation" industry consensus baseline, two observations were made:

1) The factor success ratings are clustered around the high rating suggesting that:

- the thirty-one factors that were identified should be considered in order to make a qualified and somewhat confident technology implementation decision;

2) The factor sensitivity range is narrow (i.e., = < 2 rating points) and is clustered around the medium-high rating suggesting:

- that the general consensus of industry experts on technology implementation is good, therefore, supporting confidence in the use of the baseline for case scenario examination;

- that changing the TIPS rating for any subject technology is possible with remedial actions, some times it may be without great effort or drain on resources, and an attempt to do so should be encouraged so to significantly improve the chances for successful implementation.

4.2.2 DATA EVALUATION

The design of the analysis process used in the model attempted to emulate a classical statistical inference for an engineering decision-making process (Ang and Tang, 1975). This involved:

i) observing real world situations

The process involved extracting information from observations made on how technology implementation is executed in large organizations.

ii) collecting data

Information from various sources was consolidated and validated to ensure that the design of the model would be truly representative.

iii) estimating parameters and choosing a representative distribution (the statistical inference in this case is the Gaussian normal probability density function)

Because the data was subjective (heuristically based) absolute accuracies were not critical. The author's objective was to determine general representations. Therefore, simplicity was the key. The appropriate distribution was determined by visual fit and validated. Histograms of survey responses were plotted on a few randomly selected factors. Then the simplest best fit distribution which represented the histogram was adopted. This was done without further statistical examination (i.e., best fit using Chi-Squars, Kolmogorov-Smirnov, etc.) because discrete data points were used (i.e., ratings) rather than floating ranges. The most commonly used distribution, the normal density function, represented the data adequately (except at the tails). There did exist an ever so slight skewness in the occasional histogram. A normal probability paper was constructed for a select number of factors to validate normality.

iv) calculating the probabilities

Calculation of probabilities does not actually apply here as simulation is not part of the process. Determining the potential rather than the probability was the focus. The potential is readily determined by directly comparing the actual rating (ACT RATE), as calculated by the TIPS model, with the normal probability density function representing the

consensus of industry experts. This provides a percentile value.

v) using the results to make a decision.

The model computes results and reports the status of a given case scenario in terms of implementation success potential. It also identifies areas where actions can be taken to improve this potential. The resulting information that the model provides facilitates informed decision making.

4.2.3 COMPARISON TO ANOTHER TECHNOLOGY TRANSFER MODEL

Of all the literature reviewed during this research, only one source provided a definitive technology transfer model (De La Garza and Mitropoulos, 1993, p435) for the implementing of new technology. Coincidentally, the subject of the model was the implementation of Expert Systems in the Architectural-Engineering-Construction (AEC) industry. Figure 5 provides a crude schematic copy of this model. The shaded boxes represent the combination of alternatives for the highest probability for successful implementation of expert systems technology.

The De La Garza model explains the adoption process through alternative/recommended "actions" (equivalent to TIPS attributes) which should be to be taken at each implementation "stage" (equivalent to TIPS factors). The TIPS system (and model) include the considerations presented in the De La Garza model.

4.2.4 MULTI-ATTRIBUTE DECISION ANALYSIS AND UTILITY THEORY

Although there are a number of Multi-Attribute Decision Analysis (MADA) methodologies (Gibson, 1981, Anandilingam and Olson, 1988, Falkner and Benhajla, 1990, Datta, 1992, Noori), the one most relevant to this problem is the Analytic Hierarchy Process (AHP) (Datta, 1992, Noori). The AHP method is an interactive eliciting decision model which was designed to facilitate effective decision making in unstructured problem-solving environments. This method breaks down a decision problem into three levels and structures it into a hierarchy with the objective at the top level, the criteria at the intermediate levels and the solution alternatives at the lowest level. In this hierarchical structure every element of a given level functions as criterion for all the elements of the level below. The decision process is divided into two parts. The first involves ranking criteria with regards to importance in the final decision. The second involves ranking the set of alternatives against the set of criteria. This ranking process involves extensive use of paired comparisons of elements with respect to their

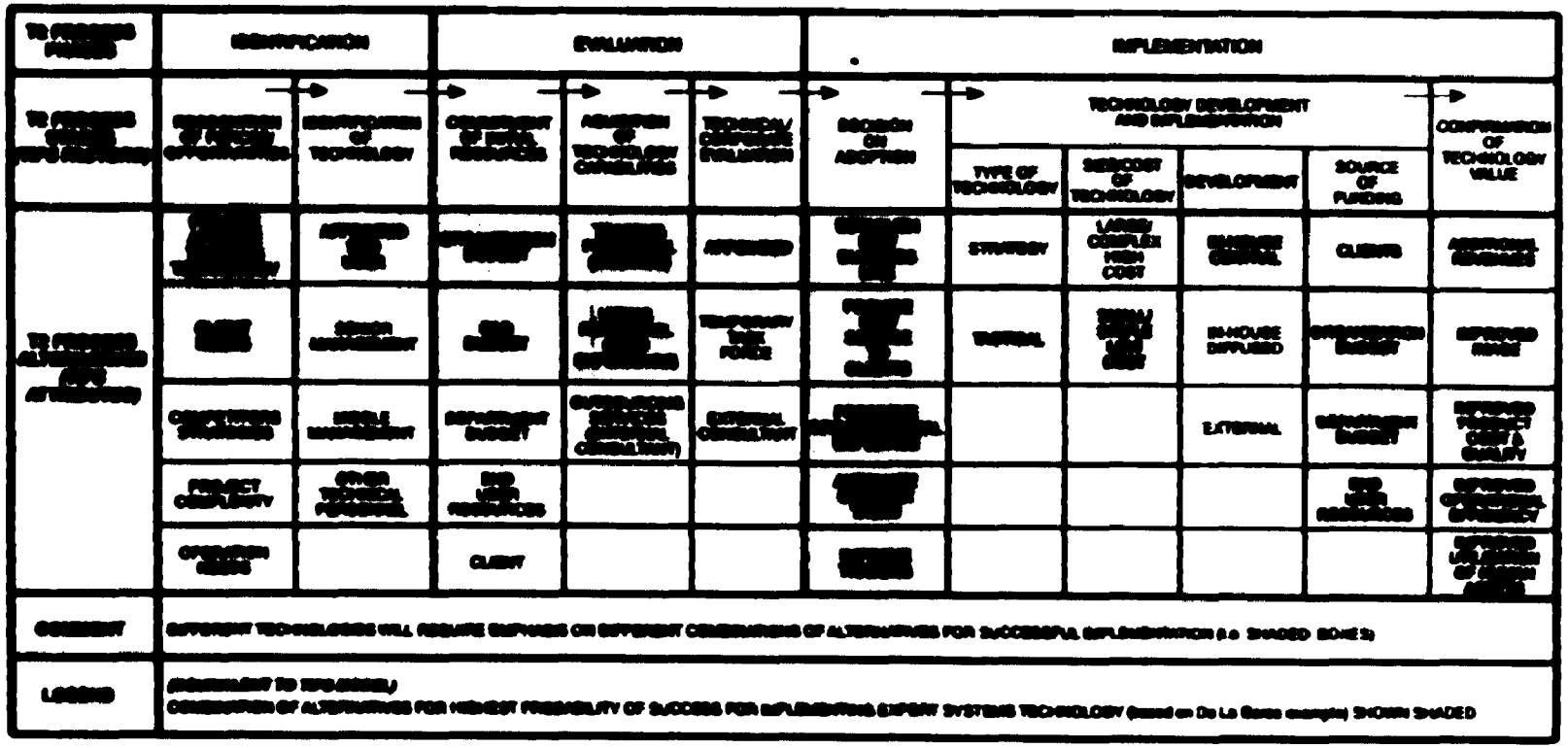
relative impact on a property they share in common. Matrix manipulation is used for the numerical calculations required to arrive at a result that consists of a relative ranking of the alternatives.

The AHP method is most applicable when there are many technology alternatives to be considered. In this situation, the objective would be to select the best alternative (i.e., the technology with the greatest potential for successful implementation). The criteria would be the TIPS factors and the alternatives would be the different technologies. The results would consist of a ranking order for the technology alternatives.

TIPS provides a potential rating based on a relative percentile scale established by the Industry Consensus Baseline. It does not provide probabilities for failure consequence costs or the success benefit magnitude. However, if these can be determined and if the risk / gamble profile for the decision maker can also be determined, then we have the components required to build utility curves. In this regard, TIPS compliments the Utility Theory (Gibson, 1981, Wolf, 1983) approach by providing another dimension for consideration in a decision analysis process.

Although TIPS can stand on its own for the purpose of an analysis, its effectiveness as a tool can be leveraged if it is incorporated with other well-established methodologies.

FIGURE 5 De La GARZA TECHNOLOGY TRANSFER MODEL



4.3 CASE SCENARIO TEST

The test case scenario involved the assessment of Expert System technology implementation within a large public organization. It is noted that the actual implementation of this technology was near completion at the time of this assessment.

In performing the TIPS assessment a retrospective review was initiated for all implementation related events. Once this was completed a prediction was made based on the results of the analysis of all applicable factors. As a final step, a comparison was made to the actual results of the implementation effort. The following sections provide details on the technology, the organization, the implementation process and the results of the assessment.

4.3.1 The Contemplated Technology

Consideration of Expert Systems was the example used to test the model. Relevant questions in defining this technology include:

> What is an Expert System? What does it do? Who should use this technology? How should it be applied? When and where should it be applied? Why should it be considered as a solution? (Zacharia, June 1990, Zacharia, September 1990, Zacharia, 1992)

An expert system is a knowledge intensive computer program that emulates an expert when solving a problem. An expert system like any other computer program is a tool designed to aid the user. The sole intent of an expert system is to provide advice. The output generated by an expert system is not a substitute for engineering judgement. They can also be defined as an automated consulting system designed to give expert advice within a particular domain. Conventional programs reduce a problem into mathematical terms that can be manipulated by an algorithm. An expert system deals with the graphical and verbal aspects of knowledge which are manipulated by logical inferences. Simply put, expert systems are sophisticated computer programs which manipulate knowledge to solve well-defined problems in a manner similar to the way a human expert would.

The term "heuristics" is used frequently in the description of expert systems. Heuristics can be defined as rules of thumb. A rule of thumb does not always guarantee the correct answer; it only increases the chances of finding a possible answer. Heuristics represent probable knowledge and play a major part in an

expert's description of real world problems. An example of a rule of thumb would be, "If your engine stopped suddenly while driving it is probably out of fuel". Knowing the rule of thumb does not mean it is the correct answer but it is a probable answer. There could be problems with the engine or problems in the electrical system instead of it being out of fuel. Heuristics depend on the knowledge of the specific situation and they are usually acquired from experience.

There are three major roles that are important in expert system development, the user, the expert and the knowledge engineer. The user is defined as the end user of the expert system, the person that the expert system was developed for. The expert is the person who, through years of training and experience has become extremely proficient at problem solving in a particular domain. The knowledge engineer is the person who interviews the expert and actually builds the expert system.

There are three major parts to an expert system, a knowledge base, working memory and an inference engine. For the purpose of analysis it is convenient to consider these components as different areas in the memory of a computer.

The knowledge base contains static information on the problem and how to solve the problem. It is here that the expert's heuristic knowledge or rules of thumb reside. The information in the knowledge base is static only during the analysis while the expert system is actually being used. An advantage of expert systems over conventional computer programs is the ease in updating information in the knowledge base. Therefore, it is always possible to keep the knowledge base as current as necessary.

The working memory is used for dynamic information. It is here that intermediate conclusions are stored while the expert system is running. Any data that is entered by the user during an analysis is also stored in the working memory.

The inference engine takes the heuristic knowledge in the knowledge base and applies it to the information in the working memory. The inference engine uses either forward chaining or backward chaining or a combination of both methods. Forward chaining uses the rules to determine what can be concluded from the given data. Backward chaining starts with a given goal and tries to answer the question, "Can we conclude this goal from the available information?".

The following is a comparison of the advantages and disadvantages of human experts to expert systems.

Human experts are creative and adapt to changing conditions. Expert systems have not yet become sophisticated enough to be able to learn on their own. Research is being done in this area, but, presently expert systems are incapable of changing their strategies to reorganize and synthesize new knowledge.

Human experts can access sensory data directly. Since expert systems have to convert sensory data to symbolic input, information such as taste, or texture can get lost in the translation.

Human experts tend to have a broad focus. They can examine many different sides of the problem to enable them to consider the overall picture. Expert systems by their very nature have a narrow focus. They can only consider the main problem and the factors associated with it.

Human experts have intuitive knowledge which the expert system cannot totally contain. There would be too much information to code if all the intuitive knowledge known by the expert was to be coded.

Human expertise is perishable. If the expert does not use his/her expertise, the knowledge can potentially decay. The expert could retire or change jobs. Expert systems on computer disks though are a permanent form of knowledge storage.

Documenting and transferring human expertise is time and labour intensive. Training and teaching new personnel is a major cost in many organizations. Transferring an expert system though, can be achieved by simply copying the program. As end users use expert systems they gain an understanding which speeds up the process of training and transferring human expertise. Once the expert system has been developed it becomes a simple process to extract the code and document the knowledge.

Human experts might make different decisions in identical situations because of emotional factors or perhaps some very subtle rules might have been overlooked. Expert systems, are consistent over the long term. There are no emotional factors to cloud the judgement and all the rules, subtle or otherwise, which are pertinent will be included in the analysis.

Human experts tend to be expensive. If they are unique enough, experts are able to demand and receive good incentives and valuable benefits. Expert systems, though over the long term, are comparatively low cost. Once an expert system is developed, the maintenance cost will be a fraction of the development costs.

To summarize, expert systems should be considered if there is a need to:

- Retain expertise that could be lost through personnel change.
- Duplicate an expert's knowledge in different locations.
- Reduce the expert's work load by solving everything but the most complex problems.
- Provide senior expertise and act as a training device for junior staff.
- Provide consistent designs and evaluations throughout the organization.
- Provide an affordable form of knowledge documentation.

Expert systems should not be considered if:

- The environment of the problem is constantly changing.
- There is a strong need for sensory data.
- The problem is especially broad and cannot be limited to a narrow domain.
- An abundance of intuitive knowledge is required.

4.3.2 The Existing Organization

The subject organization is a provincial government department. It is primarily a technically based one which implies scientifically based decision making processes are used. The caveat to this is that social political considerations can and do override or veto many of these decisions.

This organization is the third largest department in the provincial government. It employs over 2,000 people on a full-time basis and is focused on providing an integrated efficient transportation system which supports the province's social and economic well-being. There are over 155,000 kilometres of highways, of which almost 24,000 are paved, approximately 111,000 are gravelled and over 21,000 are graded or oil-treated.

Over the past ten years the full-time staff component has steadily decreased. After ten years it has been reduced by 33% and the part-time component by 25%. This represents an overall staff reduction of approximately 30%. In parallel with staff reduction there have occurred major reductions in capital construction budgets with a focus shift toward maintaining existing roads rather than constructing new ones. At the same time overall organization expenditures have

been reducing by roughly 10% per annum. Much of the heuristic knowledge that is disappearing is maintenance related.

The province is currently in a period of fiscal restraint. The overall managing philosophy can be described by the statement "doing more with less". However, there is an constantly decreasing resource pool. The organization's staff are facing intense personal pressure as they are expected to perform their jobs with fewer resources while the prospect of job loss (or at least severe change, such as reallocation) looms in their minds. This is creating a condition in which few people have slack time in their jobs (to experiment) nor do they have the inclination to try new things (when mere survival is on their minds). The current trend within the organization is expected to continue for the foreseeable future.

Support functions such as planning, design, contracting and construction administration are primary activities performed at head office in the provincial capital. Much of the organization is decentralized with field offices located throughout the province. These field offices are responsible for the delivery of the department's programs, mainly construction and maintenance of the roadway infrastructure (which also includes bridges and airports). Communications within the organization tend to follow established protocols. Current efforts in improving information access and delivery are starting to slowly chip away at these protocols. However, authority based decision making strictly adheres to the typical pyramid shaped hierarchical flow. The field offices have some autonomy with respect to decision making, but anything of significant fiscal consequence again reverts to the hierarchial protocol.

The structure of the organization is in a state of flux geared toward downsizing. The current situation within the organization is an unstable one. Although this instability should be conducive to change which in turn should be conducive to the introduction of new technology, this is not necessarily the case. As mentioned earlier there is an air of perceived threat among the staff which seems to undermine that excitement that one would expect to be generated by new technology. There are pockets of individuals that are very receptive to new concepts and ideas, and there are many pockets of individuals that are resisting change.

The culture within the organization is complex. It is almost schizophrenic in nature. The complexity arises from the organization's staff profile which includes engineers, technologists, individuals with administrative backgrounds, mechanics, equipment operators, political bureaucrats, lawyers, labourers and systems analysts.

There exist turf wars, between branches and between the head office and the field (the most significant cultural difference). There exists an "us versus them"

mentality. The observations made, supported by feedback received from individuals within the organization, suggest that communications are good in head office, but, they seem to be not so good between head office and the field. Rumours tend to abound in the field because of the isolation from head office. These groups also tend to have very different, sometimes opposing perspectives of the same reality.

There exists a Research and Development (R&D) Branch in head office. The branch has a complement of twelve technical positions (engineers and technologists) and two support positions. The branch evaluates research products related to materials, operational procedures, equipment, safety and environmental impact. New or innovative technologies are a primary component of these products. The research activities are strategically planned on an annual cycle which integrates well into the organizational strategic planning process. In the planning cycle, resource issues and research costs are of primary consideration.

Within the complement of staff within the R&D branch, there are three individuals charged with facilitating the delivery of technologies to the point of adoption. This section of staff is responsible for ensuring the implementation of technology, be it new, innovative or existing (but never tried). On an ongoing basis, the R&D branch staff are actively involved in sixty research initiatives.

The branch is headed by a director who has been part of the organization for fifteen years. In general he is very supportive of new technology and can be considered as an activist when it comes to its' implementation. He is a type of individual who likes to be informed, but retains a high confidence in his staff and encourages his staff's discretion over projects as long as the fundamental objectives are met. He tends to follow policy officially, but where warranted will challenge directives which frustrate the delivery of his branch's mandate. He is well informed with what is happening within the industry and keenly supports the department's participation in industry related research activities outside of the organization. The department executive also support these activities (due mainly to the R&D director's championing efforts).

The technology transfer process employed within this organization can be defined as one in which research findings and development efforts are translated into useful processes, products and programs. The underlying program facilitates a communication link between sources of new technology and targets (recipient end users) that are in need of technological enhancements. "New" technology in this sense refers to any improvement over existing technologies or processes, not necessarily a chronologically recent event.

The staff responsible for technology transfer constitute one of the operational sections (or business subunits) within the R&D branch. This subunit has three

main functions:

- to monitor the external environment for valuable products and technologies;
- to facilitate sharing of innovations development internally within the department (usually used in isolation where as broader application is viable);
- conduct evaluation of advance technologies that may impact the department in the foreseeable future.

This unit defines its' mission as promoting new or improved technologies throughout the organization by means of an active dynamic interaction between the sources of technologies and the potential end users. This is accomplished through mechanisms and communication infrastructures designed to effectively deliver technologies and produce tangible results. This organization has in place a well developed technology transfer process.

It should be noted that research and innovation also occur within other areas of the organization independently of the R&D branch. The technology transfer unit plays a key role here in ensuring the awareness of this research and the results are maintained through out the organization.

4.3.3 Application of the Technology within the Organization

The organization that is contemplating this technology was (and still is) a victim of severe attrition. In other words, the organization is losing much of its knowledge and expertise upon the retirement of its senior engineers. Over the years this knowledge and expertise has been acquired through hands on experiences. Because the matter at hand in most cases was more urgent than the knowledge itself, much of this heuristic knowledge was not documented. What resulted was that the knowledge remained in heuristic form in the minds of the individuals (eventually these individuals became resident experts because they were the sole custodians of the knowledge). Much of the subsequent engineering practice evolved to become dependent on this heuristic knowledge of the resident expert. Now the experts are leaving and so is the knowledge. Hundreds of person years of pertinent knowledge has disappeared.

This new technology was looked upon as a possible solution to encapsulating the expertise of these individuals in a form that could readily be exploited by their successors. Further to that, the expertise could also be duplicated and decentralized (in a sense leveraging its' effectiveness).

It was resolved at the onset that expert system technology was a suitable solution for the identified need within the organization. However, it was not necessarily a solution in every case. There was a point of diminishing returns as well, where although possible, implementation would not serve to improve anything, least of

all the cost effectiveness of the subject operation.

The selection of prototype applications considered the past experience of others, or in other words the technology's history (which incidently was short as the practical application of this technology was in its' infancy). An "infusion strategy" (the term used within the organization) was developed which addressed the technology attributes, its' risk and potential benefit. A detailed plan was established for the development, evaluation and post implementation assessment of the prototype applications. Resource requirements were also highlighted. This plan also included details of custodial handoff of the technology from R&D to those responsible for systems implementation and maintenance after successful seeding of the technology within the organization. The whole process involved close interaction with all stake holders including the potential end-users (on specific application basis).

4.3.4 The Implementation Success Potential Assessment

In an actual situation, the assessment process would involve data collection through interviews of all the key players within the organization involved in the technology implementation. The key players would usually include the potential end user, the end user's supervisor, the technology champion, the final decision maker and the technology transfer agent (of course one individual could take on multiple key player roles). For the purpose of testing the TIPS System with respect to the expert system case scenario, only the technology transfer agent was interviewed.

Sixteen different prototype expert systems were developed. Because of similarities three were chosen for thorough examination, each one best typically representing a low, medium and high implementation success rating. Bits and pieces from all sixteen expert systems were incorporated to better represent the profile of each rating.

Data was extracted from a series of interviews with the technology transfer agent. This agent's role was to act as the project leader for implementing expert system technology within the subject department of transportation. The interviews spanned a period of two weeks. Six hours of video tape recordings were produced. The video taped documentation proved to be a very valuable supplemental resource to the available written documentation on the subject.

The documented data was reviewed several times within the parameters set in the detailed descriptions of each factor. This process involved asking a series of questions and issuing statements to seed discussion. The key in making a valid assessment was in extracting enough information about each factor. The easiest way to do this was through the following simple interview and documentation

review protocol:

- prepare simple basic questions or statements using the W5-H method as a guide for their structure (i.e., who, what, when, where, why and how);

- ask the questions or make the statements (both open-ended) for each attribute that defines the factor; (i.e., to seed the interview candidate with appropriate thoughts) and solicit feedback (comments, opinions, etc.);

- go through as many cycles as necessary (using different questions/statements) to obtain a good understanding of the effect of the attribute;

- make note of all the outstanding issues (especially those which have negative impact);

- rate the attributes and aggregate these ratings to establish a factor rating for degree of influence as well as for confidence;

- transpose these ratings into the TIPS model (template);

- repeat the process for all attributes and factors that apply to the particular case scenario being assessed.

Figure 6 is typical of the process involved. The results of factor/attribute assessments for the expert system case scenario are located in Appendix A.5. Figure 7 provides an example of the results interpretation.

FIGURE 6 EXAMPLE OF FACTOR ASSESSMENT

CATEGORY: Human Factors (C4)
FACTOR: End User (C4F1)

TYPICAL QUESTIONS / STATEMENTS:

CYCLE # 1	1)	WHO are the technology end users within the organization?
	2)	WHAT are their attitude towards new technology and associated changes?
	3)	Are they expecting the technology, and if so, WHEN?
	4)	WHERE can their existing skill sets be applied?
	5)	Do they perceive the technology as a threat or benefit, and WHY?
	6)	HOW do they perceive the technology, as a benefit or a threat?
CYCLE # 2	1)	WHO in the organization will be affected by the technology?
	2)	Do they have an understanding of WHAT the technology is about?
	3)	WHEN will the end users be advised of the new technology?
	4)	WHERE are the potential end users located within the organizational structure?
	5)	WHY do they think the technology will affect their job?
	6)	Are they concerned about HOW the technology may affect their job?
CYCLE # 3	1)	Etc.....
	2)	Etc.....
	3)	Etc.....
...ETC.	...ETC.	

ATTRIBUTE	APPLY? Yes = 1 No = 0	CONTRIB? Support = +1 Hinder = -1	DEGREE (Same rating scale through out TIPS system)	RATING	CONFIDENCE		ISSUE DESCRIPTION
Attitude	1	1	0.7	0.7	0.9		Target pockets of individuals that support new technology.
Change	1	1	0.6	0.6	0.9		Target pockets of individuals that would be good change agen
Understanding	1	-1	0.3	-0.3	0.7	!	No real understanding of the technology.
Skill Sets	1	1	0.3	0.3	0.6		Basic computing skills and technical skills exist.
Perceive Threat	1	-1	0.3	-0.3	0.7	!	Lack of understanding fosters some concern re: job threat.
Perceive Benefit	1	1	0.5	0.5	0.5		Some accept that benefits will accrue from technology adopte

FACTOR DEGREE RATING 0.250
FACTOR CONFIDENCE RATING = 0.717

FIGURE 7 EXAMPLE OF RESULTS INTERPRETATION

[redacted]

CATEGORY: Composite Factors (CS)
FACTOR: Current Situation (CSF2)

RESULTS: Refer to Figure 2 and Appendix A.5 for details.

ACTUAL RATING:

APPLIES	Yes	
CONTRIBUTION	-0.22	Low Hinder
ACT RATE	0.611	Mod-High
PERCENTILE	35%ile	
CONFIDENCE	0.48	Mod
SENSITIVITY	0.656	High
ACTION LEVEL	2	Remedial

ATTRIBUTE:	ISSUE DESCRIPTION:
Priorities	R&D and technological innovation paid little attention by senior management.
Fiscal Situation	Current fiscal situation foster survival mentality.
Do Nothing Impact	Only tried and true methods being considered. Experimentation not common.

RECOMMENDATION:

"WEAK LINK" FACTOR?	Yes
REMEDIAL ACTION?	Yes
RESOURCE INTENSIVE?	Depends on issues.
SDRAMMR ADJUSTMENT	From base of 10% to 11.35%.

COMMENTS:

The results of this analysis suggest that this factor applies and should be considered in the overall success potential analysis.
The contribution is negative and low.
Even though the actual rating for success potential is medium to high it only exceeds approximately 35 percent of the collective industry consensus of acceptable rating for this factor.
This suggests that the factor is a "weak link" and is critical to the successful implementation of the technology.
Remedial action is strongly recommended in the areas highlighted under issues.

[redacted]

4.3.5 The TIPS Prediction

The final results of the assessment suggest that the success potential for this case scenario technology is high to very high, with the caveat that some scrutiny of a number of factors is recommended. The External, Financial and Corporate factor categories rate comparatively lower to the other categories and should be reviewed. This result suggests that these categories may host "weak link" factors. On a factor by factor basis, six potential problem areas were identified. Remedial action for these six factors (if possible) is recommended in order to improve the technology implementation success potential (i.e., the technology's TIPS rating):

Technology LifeCycle (rated Action Level 2) - greater effort should be made to perform realistic economic evaluations of contemplated technologies. Currently, this is rarely, if ever, done to strict business standards. This is a factor that can be easily remediated.

Political (rated Action Level 1) - political influence is beyond the control of this organization. The organization may be able to manipulate and stretch policy to some degree to accommodate the technology. This factor is very difficult, if near impossible to remediate.

Economic (rated Action Level 2) - a recessional economy is beyond the control of the organization. The only thing that it could do is an internal reevaluation of business processes. It may require wholesale rethought as to how the organization's business is executed (i.e., possibly through business process reengineering) and may be too complicated of a remedial action to consider for the sake of one particular technology.

Corporate Culture, Current Situation, and Organization Environment (each rated Action Level 2) - are factors that can be remediated if the organization's inertia can be redirected. This would required effort from the top (i.e., executive, senior management) in terms of support through policy change, re-prioritization, etc.. Difficult, but possible to remediate over longer time span.

4.3.6 What Actually Happened

Out of the sixteen prototype experts systems developed during the technology implementation process:

- five have been rated as high levels of success (four implemented and currently in use and one to be implemented in the near future);
- seven have been rated as medium levels of success (five implemented and in use, but experiencing some difficulties and two not implemented yet because of

difficulties);

- four have been rated as low levels of success (none implemented with all having high likelihood of being abandoned).

The Expert System technology implementation process spanned three years. In that time the transfer agent developed an intimate understanding of the technology and its' potential role within the organization. The conclusions reached by him were:

- Expert Systems do not and cannot replace an expert.
- Expert Systems are very useful in developing a model or approach that represents the particular thought process used by an expert in solving problems.
- Expert Systems are very good for training.
- Expert Systems should only try to solve 80% of the problem.
- Full cooperation of the end user, the expert, the programmer and the associated management is necessary to ensure success.
- Some problems are too complex to be solved by Expert Systems.
- Expert Systems should be cost justified in terms of use (i.e., a system that reduces the decision time from four hours to one half hour is not useful if it only has to be done once a year).
- Overall, the implementation effort can be deemed successful as many branches have indicated some interest in continuing to develop new systems for other applications (i.e., the technology had been seeded within the organization).

Upon closer examination of the three typically representative prototypes (i.e., low, medium and high implementation success rating) in terms of deviations from the general assessment the degree of success was directly correlated to:

- the degree of client involvement;
- the degree of forefront investment of resources by the client;
- availability of human resources (critical);
- ability to absorb costs;
- end user's attitude towards the technology;
- the end user's perception of threat versus benefit;
- the supervisor's understanding of the technology;
- the technology champion's power of influence;
- consensus with regards to expert opinion (or the availability of an expert);
- subcultural (specific to a sub area of organization, i.e., field versus head office) attitude toward technology and change;
- degree of patience in realizing results;
- appropriateness of technology application;
- level of programming skill;

- availability of time (human resource issue);
- improvement over current methods;
- visibility of potential benefits.

All other factors were equal among the three typical prototypes and the general assessment.

4.3.7 Prognosis for the Future

The Expert System technology is very much depended on community effects. In other words, its' successful eventual adoption depends on the status of current and future networks of adopters, both internally within the organization, and externally throughout the industry. There currently exists some transient incompatibility because of delays in developing this network (i.e., due to economic, cultural and other factors). Because of this, there exists a real risk of stranding and subsequent failure due to a critical mass of adopters not being achieved.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The TIPS System (which incorporates the TIPS Model and the industry consensus baseline) was developed as methodology for objectively and rationally assessing the technology implementation success potential. Thirty-one factors were identified as important considerations that should be addressed in decisions involving investments in technology. Upon completing the research, that was required for developing this model, it can be concluded that technology implementation decisions are anything but trivial and should not be made intuitively. Upon testing the TIPS System with an actual case scenario involving expert system technology implementation into a large public organization the following additional conclusion were reached:

1) The TIPS System is comprehensive and provides confidence in the rational used in making technology implementation decisions.

2) There still exists some inherent subjectivity in the TIPS System. However, the process does break down the subjectivity (via attributes) into manageable parts. By doing this, the implementor can focus on particular issues that may affect the outcome of the implementation.

3) The TIPS System may not always be practical, especially when dealing with low cost technologies with localized or isolated application. However, the TIPS System becomes a valuable tool when there is a need for capital rationing and the selection of alternative technologies is necessary. The system also becomes a valuable tool when implementation of high cost technologies is contemplated.

4) In real life there are many other intangibles that also need to be considered (i.e., political agendas, the saving of lives, social issues). Value judgements will still have to be made, and it may not always be possible to quantify cash flows, nor will it always be realistic to quantify and classify all the benefits and all the costs (especially in monetary terms). Applying the TIPS System in the context of an overall economic analysis may not be a panacea, however, it does provide objectivity to the implementation rational.

5) Further research and future system improvements should be considered.

5.2 FURTHER RESEARCH & FUTURE SYSTEM IMPROVEMENT

Continuous improvement is always desirable. So is the case with the TIPS System. The following are thoughts for additional work in the field of assessing technology implementation:

- Further testing of the TIPS System involving original survey respondents to refine and validate the methodology.

- Application of the TIPS System to other industrial sectors. The baseline component is interchangeable. This could be a means to test whether the TIPS System is indeed generically applicable.

- Development of protocols for integrating the TIPS methodology with other Multi-Attribute Decision Analysis methodologies and its application to Utility Theory.

- Development of an expert system based advisor module for the TIPS System. This module would continue on with the recommended Action Level and provide detailed directions for the specific remedial actions that should be executed for each respective factor given the current situation of a particular case scenario.

- Neural Networks (NN) (Garrett Jr.) provide a nice method for modelling noisy, and somewhat uncertain or incomplete data or knowledge that will grow and change with time. As more factors and attributes are identified over time and as more case scenarios are examined, it may be prudent to investigate the application of NN theory to revising the TIPS Model.

- Development of a counterpart to the TIPS System for assessing the success potential for deploying new technology into the market (i.e., commercializing or licensing of technology).

- Development of a friendly user interface and shell for the TIPS System. This shell would facilitate easy input/output through assisted data collection, data analysis and results calculation, and report generation. The use of the Microsoft Visual Basic environment for this purpose would be a good candidate and should be investigated.

5.3 EPILOGUE

Implementation of a new technology is very difficult and should not be approached in a haphazard manner. Proper implementation requires planning and control. An integrated approach to technology transfer (Noori and Radford, 1990, p505) suggests a five-step action plan. In each step the objective, required actions, and goals (or anticipated results) are clearly defined. These steps are:

- Initiation and Strategic Planning Phase - which involves identifying those areas of the business where new technology will have the greatest impact;
- Feasibility Study and Justification Phase - which involves examining the characteristics of the available and potential technologies and the target environment;
- System (Technology) Selection/Development Phase - which involves developing an implementation plan which is detailed and unambiguous;
- Implementation Phase - which involves facilitating an environment for smooth implementation of the technology;
- Post Implementation Phase - which involves monitoring, evaluating and the ensuring continuity for subsequent cycles of change.

The TIPS System provides a solid foundation on which to piggyback the above approach. This combined process will improve the analysis of new technology viability and the quality of the decision for its' adoption.

.....

In terms of economic analysis in the public sector, government funds should be invested to promote economic and social objectives in an effective manner, utilizing an efficient allocation of resources among competing programs. This objective requires a systematic approach (Jones and Lockhart, 1990) (i.e., benefit-cost analysis) to the problem of evaluating and selecting individual research projects or technology implementation initiatives.

For proper Benefit/Cost evaluation of any government investment (research based or otherwise) the Discounted Cash Flow method is one method that can be used. The rate of interest used in evaluating alternative public projects, referred to as the social discount rate (SDR), is critical to the accept/reject the decision. It is

essential that public investments use a SDR that is based on sound economic judgement.

In the private sector companies usually use a discount rate based on the investments (research, technology or other) opportunity cost of capital (i.e., the return available in the capital markets for investments of the same risk). In other words, this discount rate is referred to as the minimum attractive rate of return (MARR). The Discounted Cash Flow method is commonly applied in economic analysis.

In either case, most investment justifications also tend to be subject to value judgements and it is often not possible or realistic to quantify all cash flows associated with the investment. An additional problem in using benefit-cost analysis is in identifying what should be classified and quantified as benefits and what as costs. To quantify all factors in terms of a dollar value is also often extremely difficult.

The TIPS System again provides a means for handling some of these intangible issues. As well, the TIPS System provides a means for quantifying the SDR or MARR value and can be considered as one possible method for evaluating investment in new technology in the private and public sectors.

BIBLIOGRAPHY

Anandalingam, G. and C.E. Ollson. *A Multi-Stage Multi-Attribute Decision Model for Project Selection*. European Journal of Operational Research. December 1988. p. 271-283.

Ang, A.H.S. and W.H. Tang. *Probability Concepts in Engineering Planning and Design - Vol 1 - Basic Principles*. John Wiley & Sons, Inc. Copyright 1975.

Betsold, R.J. and M.J. Resnbaum. *The Marketing of New Highway Research Products*. Public Roads. December 1988.

Bunting, P.M. *Conceptualizing Technology Transfer*. Cole, Sherman & Associates. (no other information available)

Burgelman, R.A. and M.A. Maidique. *Strategic Management of Technology and Innovation*. Richard D. Irwin, Inc. Copyright 1988.

Coates, D.E. adapted for *The Targeted - Innovation Process*. Targeted Innovation Facilitator's Guide. Greensboro, NC, Centre for Creative Leadership. 1984.

Datta, V.D. et al. *Multi-Attribute Decision Model Using the Analytic Hierarchy Process for Justification of Manufacturing Systems*. International Journal of Production Economics. 1992. p.227-234.

De La Garza, J.M. and P. Mitropoulos. *Flavours and Mixins of Expert Systems - Technology Transfer Model for AEC Industry*. Journal of Construction Engineering and Management, Vol. 118, No. 3. Copyright September 1993. p. 435-453.

Falkner, C.H. and S. Benhajla. *Multi-Attribute Decision Models in the Justification of CIM SYstems*. The Engineering Economist, Vol. 35 No. 2. Winter 1990. p.91-114.

Federal Highway Administration. *Marketing Highway Technology and Programs*. U.S. Department of Transportation. Publication No.: FHWA-RD-91-010. October 1990.

Federal Highway Administration. *FHWA / OECD - Transportation Technology Transfer* (Video). Produced by Audio Video Film for FHWA & OECD, Orlando, Florida. ~1992.

Fichman and C.F. Kemerer. *Adoption of Software Engineering Process Innovations: The Case of Object Orientation*. Sloan Management Review. Winter 1993.

Filipiak, R.M. *Technology Transfer - The process of Transforming Technology Into a Useful Tool*. Published by R&D Branch - Alberta Transportation and Utilities. May 1990.

Filipiak, R.M. *Proposal for Alberta Transportation and Utilities Awards and Recognition Program*. 1992.

Garrett Jr., J.H. *Neural Networks and Their Application Within Civil Engineering*. Computing in Civil Engineering (publishing date and issue number not available). p. 1155.

Gibson, J.E. *Managing Research and Development*. John Wiley & Sons, Inc. Copyright 1981.

Hertz, D.B. *Risk Analysis in Capital Investment*. Harvard Business Review. January-February 1964.

Hillier, F.S. *The Derivation of Probabilistic Information for the Evaluation of Risky Investments*. Management Science. Vol 9, No 3. April, 1963. p. 443-57.

Jones, G.J.F. and R.A.C Lockhart. *Technology Transfer in a Government Office*. Publication No.: PUB-90-03. Published by the R&D Branch - Ontario Ministry of Ontario.

Katz, R., ed. *Managing Professionals in Innovative Organizations*. Harper Collins Publishers. Copyright 1988.

Kepner, C.H. and B.B Tergoe. *Problem Analysis / Potential Problem Analysis / Decision Analysis* (extracted from The New Rational Manager). Princeton Research Press. Copyright 1981.

Large, D.W. and D.W. Baclay. *"A Marketing Planning Framework for Successful Technology Transfers"*. OPTIMUM - The Journal of Public Sector Management. V23-2. Autumn 1992.

Licensing Executive Society. *Technology Transfer - Licensing Executives Society* (Video). McLeod-Mills & Associates, LTD. for LES. Copyright 1988.

Noori, H. and R.W. Radford. *Readings and cases in the Management of New Technology - An Operations Perspective*. Prentice-Hall, Inc., Copyright 1990.

Noori, H. *Newtech Expert Choice: The Decision Support System for New Technology Adoption* (Software Reference Manual). Published by Expert Choice Inc. (Copyright date not available)

Rubough Jr., M.E. *"Technology Transfer: A Random Function"*. Automotive Engineering. July 1993.

Schmitt, R.P. and M.J. Mulroy. and Beimborn, E.A. *The Technology Transfer Primer*. University of Wisconsin. August 1984.

Shrieves, G.M. *"Technology Transfer - American Style"*. Public Roads. Vol. 56, No. 3. December 1992. p.112-119.

Sprague, J.C. and J.D. Whittaker. *Economic Analysis for Engineers and Managers - The Canadian Context*. Prentice-Hall Canada, Inc. Copyright 1986.

Tushman, M.L. and W.L. Moore. *Readings in the Management of Innovation*. 2nd Edition. Harper Business Publishers. Copyright 1988.

Wolf, C. *Risk Management in Cost Engineeering - Application of Utility Theory*. AACE Transactions. 1983. p. D.3.1-D.3.6.

Zacharia, Z. and R. Powers and B. Lasby. *Bridge Paint Expert System User Documentation*. Report No.: ABTR/RD/RR-90/09, published by R&D Branch - Alberta Transportation and Utilities. June 1990.

Zacharia, Z. *Expert System Prototype Development, Applicability and Evaluation*. Report No.: ABTR/RD/RR-90/08, published by R&D Branch - Alberta Transportation and Utilities. September 1990.

Zacharia, Z. *Inexpensive Strategies to Implement Expert Systems in Your Organization*. Report No.: ABTR/RD/RR-92/03, published by R&D Branch - Alberta Transportation and Utilities. September 1992.

Zacharia, Z. and K. Cameron. *Technology Transfer In Alberta Transportation*. ORG.A. 622 paper. Copyright April 8, 1993.

APPENDIX

A.1 SURVEY FORM

A.2 RAW SURVEY RESULTS

A.3 TEMPLATE USER DOCUMENTATION

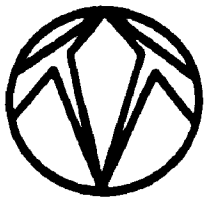
A.4 TEMPLATE FORMULAS

A.5 CASE SCENARIO RESULTS

A.6 TEMPLATE PERSPECTIVES

A.1 SURVEY FORM

SURVEY NO: _____



TECHNOLOGY TRANSFER SURVEY FORM

Thank you for participating in this survey. The objective of this survey is to gain a better understanding of the factors which influence the technology transfer process (specifically the decision making process related to technology implementation). The survey is simple in that all that you are asked to do is provide numeric responses. It should not take you more than five to ten minutes to complete.

There are a total of 31 factors listed in this survey. They are divided into 6 thematic categories. Under each factor you will find a number of supporting attributes with short descriptions. They have been provided to better define each factor. If you have any comments regarding the factors presented or any ideas for additional factors please provide them either directly on the survey form in the "comments" box or on a separate sheet.

If you have any questions regarding the survey or would like to discuss any technology transfer issues I would be more than happy to do so over the telephone or in person (where practically possible). Please feel free to contact me anytime at 403-422-2750.

Upon completion please return this survey in the pre-addressed and postage paid envelope to the attention of Ray M. Filipiak. Thank you.

PLEASE PRINT NAME:

_____

PLEASE PROVIDE YOUR PHONE NUMBER:

(____)_____

PLEASE PROVIDE YOUR MAILING ADDRESS:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

DEFINITION OF NEW TECHNOLOGY:

Any process, methodology, material, instrument or tool (new to an organization) that can improve current ways of performing a task or job (in this case related to any highway / road infrastructure planning, design, construction or maintenance operation). The technology does not necessarily need to be "high tech". It can be a recent innovation or a "not yet tried" existing technology.

COMMUNICATION FACTORS INFLUENCING THE TECHNOLOGY TRANSFER PROCESS
[illegible]
[illegible]

NUMERIC RATING	1	3	5	7	9	10
SUBJECTIVE RATING	NIL	LOW	MEDIUM	HIGH	V HIGH	EXTREME

IMPORTANCE LEVEL
[illegible]

[illegible]	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]	
[illegible]	Existence [illegible]
Transfer [illegible] Agent	Existence [illegible] staff [illegible]
Transfer [illegible]	Existence [illegible]
[illegible]	Existence [illegible]

[illegible]	
[illegible]	Degree of [illegible]
Industry [illegible]	Existence of [illegible] industry and external [illegible]
Internal Network	Existence of [illegible] network [illegible] technology transfer [illegible]
External Network	Existence of [illegible] technology transfer [illegible]

INFORMATION A[illegible]	
Electronic [illegible]	Existence of [illegible] electronic [illegible] facilities
Library Resources	Existence of facilities for easy access to information by an organization staff
Library Services	Existence of library services [illegible] searches, research, database access, etc.

TECHNOLOGY TRANSFER [illegible]	
Needs Establishment	Existence of mechanism for determining technology needs
Current Process	Degree of understanding of existing processes re: integration new technology
Search & Capture	Existence of mechanism for interrogating industry / market for technology [illegible]
Adaptation & Translation	Existence of mechanism for adapting & translating [illegible] technical information
Test & Evaluation	Existence of mechanism for testing and evaluating new technology
Packaging	Existence of mechanism for preparing information for distribution
Dissemination	Existence of mechanism for targeting and delivery of packaged information
Media Production	Existence of facilities for packaging information in different formats, target specific

TECHNOLOGY TRANSFER APPROACH	
Personal Contact	Degree of face to face interaction employed in the process
Information Packaging	[illegible] and [illegible] of information
Client Involvement	Degree of involvement of client in the development and evaluation process
Target Identification	Methodology for identifying audience for implementation
Pull vs Push Approach	Type of approach used in process, ie demand / needs driven / pull

FINANCIAL FACTORS INFLUENCING THE TECHNOLOGY TRANSFER PROCESS
The following financially related factors have been identified as influential to the technology transfer process.
Review each factor and its supporting attributes, and provide the most appropriate numeric rating in response to the question.

NUMERIC RATING	1	3	5	7	9	10
SUBJECTIVE RATING	NIL	LOW	MEDIUM	HIGH	V HIGH	EXTREME

IMPORTANCE LEVEL
How important do you think this factor is in assessing the success potential for implementing new technology?

PRODUCT / TECHNOLOGY LIFECYCLE	
Payback	Degree of significant payback and time to payback
Justification	Degree of return on investment

RESEARCH PLAN	
Organization Strategy	Research as part of overall organization fiscal planning
Research Strategy	Level of research funding planned for
Resource Commitment	Level of fiscal, human and other resources commitments

RESOURCES	
Human Resources	Availability of human resources when required
Financial Resources	Availability of fiscal resources when required
Capital Funding	Availability of required front end funds
User Assistance	Availability of resources for providing assistance to user
External Resources	Availability of resources through other sources ie cooperative ventures

COSTS	
Proof of Concept	Ability to determine costs for developing a proof of concept
Cost to Prototype	Ability to determine costs for prototyping
Cost Absorption	Ability to absorb costs associated with preliminary development

EXTERNAL FACTORS INFLUENCING THE TECHNOLOGY TRANSFER PROCESS
The following external factors have been identified as influential to the technology transfer process.
Review each factor and its supporting attributes, and provide the most appropriate numeric rating in response to the question.

NUMERIC RATING	1	3	5	7	9	10
SUBJECTIVE RATING	NIL	LOW	MEDIUM	HIGH	V HIGH	EXTREME

IMPORTANCE LEVEL
How important do you think this factor is in assessing the success potential for implementing new technology?

INDUSTRY TRENDS & DEVELOPMENTS	
Effort Duplication	Avoidance of duplication of effort
Cooperative Alliances	Cooperative alliance with other organizations, leveraging resources
Competition	Market driven competition within the industry
Technology Development	State of the art

POLITICAL	
Government Regulation	Degree of imposed government regulations, ie environmental impact
Government Stability	Effects due to political situation of the current government
Gov't vs Private	Type of organization
Gov't Fiscal Situation	Current government fiscal situation
Taxes and Legislation	Current government philosophy towards new technology

ECONOMIC	
Shrinking Economy	Effects due to a recessionary economic situation
Growing Economy	Effects due to an inflationary economic situation
Cost of Money	Current cost of financing

HUMAN FACTORS INFLUENCING THE TECHNOLOGY TRANSFER PROCESS

[illegible]

Review each factor and its supporting attributes and provide the most appropriate numeric rating in response to the question.

IMPORTANCE LEVEL

[illegible]

NUMERIC RATING	1	3	5	7	9	10
SUBJECTIVE RATING	NIL	LOW	MEDIUM	HIGH	V HIGH	EXTREME

END USER

Attitude	[illegible]
Knowledge	[illegible]
Understanding	[illegible]
Involvement	[illegible]
Perception of Threat	[illegible]
Perception of Benefit	[illegible]

MANAGER (SUPERVISOR) OF THE END USER

Attitude	[illegible]
Understanding	[illegible]
Support	[illegible]

TECHNOLOGY CHAMPION

Attitude	[illegible]
Influence	Potential for influencing outcome

DECISION MAKER

Understanding	General understanding of the new technology
Support	Support for investing resources towards implementation of new technology
Benefits	Belief that benefits will accrue from implementation of new technology
Influence	Potential for influencing outcome

TRANSFER TEAM AGENT ATTRIBUTES

Intelligence	Ability to exhibit intelligent behaviour
General Competence	Level of general competence
Technical Competence	Level of technical competence
Independence	Ability to plan and execute actions independently
Team Play	Ability to work in a learning environment with individuals with diverse backgrounds
Leadership	Ability to lead a team of individuals with diverse backgrounds
Persistence	Ability to persevere through implementation barriers and reestablish the change
Creativity	Ability to develop new strategies for implementation of new technology
Credibility	Degree of credibility in the eyes of end user
Commitment	Level of commitment to a technology transfer initiative
Articulate	Ability to articulate between information source groups and user groups
Business Sense	Level of business sense and empathy
People Skills	Ability to work with people of diverse backgrounds

CORPORATE FACTORS INFLUENCING THE TECHNOLOGY TRANSFER PROCESS

The following corporate related factors have been identified as influencing to the technology transfer process.

Review each factor and its supporting attributes and provide the most appropriate numeric rating in response to the question.

IMPORTANCE LEVEL

[illegible]

NUMERIC RATING	1	3	5	7	9	10
SUBJECTIVE RATING	NIL	LOW	MEDIUM	HIGH	V HIGH	EXTREME

CORPORATE CULTURE

Reward Systems	Existence of rewards programs to incite innovation
Corporate Philosophy	Corporate philosophy towards technology innovation and change
Executive Support	Backing from highest authorities and decision makers
Challenge Old Paradigms	Organizational approach to change (proactive or reactive)
Challenge Problems	Organizational approach to solving problems
Management Philosophy	Overall management attitude towards new technology
Corporate Image	Organization self image and reputation within the industry
Barriers	Organization approach towards removing barriers (e.g. outdated policy, etc.)
Allowed Dreaming	Corporate philosophy towards creativity

CURRENT CORPORATE SITUATION

Priorities & Urgency	Existing needs, level of importance and available resources
Fiscal Situation	Current financial state of the organization
Do Nothing Impact	Impact to organization when a problem is ignored
External Solutions	Better solutions available outside of the organization
Organizational Expertise	Availability of internal expertise vs. outsourcing for solutions

CORPORATE POLICY

Tech Transfer Mandate	Existence of a corporate technology transfer mandate
Organization Mandate	Technology transfer mandate supports organizational mandate
Technology Policy	Technology transfer policy is communicated in corporate policy
Support Mechanisms	Existence of support mechanisms to assist in technology transfer

ORGANIZATIONAL ENVIRONMENT

Idea Receptiveness	Degree of receptiveness towards ideas generated outside of the organization
Crowded R&D Agenda	R&D agenda requiring refinement of resources
Environment Generation	Degree of environment generated from new technologies
Experiment Opportunity	Degree of freedom to experiment and fail
Conditions for Change	Appropriate conditions to facilitate change
User Involvement	Support for user involvement in the development of the new technology
Rights Ownership	Philosophy towards patent, copyright, industrial design rights ownership, etc.

REPRESENTATIVE STAFF PROFILE

R&D Director Influence	Willingness to take up new technology
User - Inventor Coop	Degree of consensus and cooperation between technology user and inventor
Behavior Patterns	Degree to which staff behaviors patterns can be modified if necessary
Trust	Degree of trust between individuals involved in the transfer process
Team Cooperation	Degree of consensus and cooperation among organizational teams or business units
Impatience	Degree of patience for receiving returns
Complexity Aversion	Degree of aversion to complex technology

TECHNOLOGY FACTORS INFLUENCING THE TECHNOLOGY TRANSFER PROCESS

[illegible]

NUMERIC RATING	1	[illegible]	5	7	[illegible]	10
SUBJECTIVE RATING	NIL	LOW	MEDIUM	HIGH	V HIGH	EXTREME

IMPORTANCE LEVEL

[illegible]

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	Existence of better value alternatives

TECHNICAL RISK

Technology Capability	Capability of technology to solve the problem
Technology Drawbacks	Possible problems or side effects from using the technology
Understanding Problem	The technology brokers understand the problem being addressed
Failure Prediction Capability	Existence of mechanism for calculating failure potential
Previous Performance	Existence of a previous performance history of the technology
Costing Information	Ability to determine costs associated with implementing the new technology
Cost/Benefit Information	Existence of mechanism for estimating costs & benefits

TECHNOLOGY ATTRIBUTES

Applicable	Degree to which the technology is applicable
Reproducable	Degree to which the technology is reproducable
Transferable	Degree to which the technology is transferable
Practical	Degree to which the technology is practical
Compatibility	Degree of compatibility with existing procedures
Adaptable	Degree to which the technology is adaptable
Workable	Degree to which the technology is workable
Documentable	Degree to which the technology is documentable
Implementable	Degree to which the technology is implementable

TECHNOLOGY EFFECTIVENESS

Ease of Evaluation	Degree to which the technology is easy to evaluate
Results	Degree to which the results are tangible & quantifiable
Problem Addressed	Degree to which the technology directly addresses the problem
Adequate	Degree to which the technology is capable to adequately solve the problem
Reliable	Degree to which the technology is reliable
Produces Improvement	Whether the technology produces improvements over the current situation
Spinoff Applications	Possibility of applying technology for other problems or support other reseach efforts
Benefits Exceed Costs	Degree to which the benefits exceed implementation cost
Benefits Immediate	How immediate the benefits are realized
Benefit Duration	How long the benefits last
Contribute to S.O.A.	Degree to which the technology contributes to the state of the art

TRANSFER PROPOSAL ATTRIBUTES

Sustainable Profit	Technology provides a sustainable and substantial profit
Strategic Fit	Technology fits strategically at all the levels of the organization it affects
Marketing Fit	Marketing plans accommodate the technology being transferred
Financial Fit	Fiscal requirements can be accommodated in the organization's finacial planning
User Value	Real value to the end user established
Transfer Cost	Ability to determine cost of transfering the technology
Prototype Efficacy	Prototype is representative of the final solution

TARGET ENVIRONMENT

End User Needs	End user needs fully addressed by the new technology
End User Anticipation	Anticipation for the technology as solution to problem
End User Evaluation	End user involvement in the evaluation process
Management Goals	Management goals achieved
Organization Goals	Organization goals achieved
Method of Operation	Operational methods in the target environment may require modification
Addequate Supply	Enough units availble to supply all who exhibit need
Acceptance Barriers	Barriers to acceptance identified and planned for

MARKETING

Adequate Resources	Existence of adequate resources for proper marketing
Business Plan	A business plan is used as a marketing tool
Marketing Strategy	Existence of a marketing strategy
Technology Visibility	Existence of a technology awarness and promotion program
Target Identified	End user identified and relationship established
Decision Maker Identified	The highest authority required to make decision has been identified and approached

DISTRIBUTION / DISSEMINATION

Training Availability	Provisions arranged for training
Technical Assistance	Provisions arranged for technical assistance
Readiness	Every aspect of the technology is "ready to go" at time of distribution
Implementation Support	Required resources are prepared for support during implementation
Introduction Rate	Best rate for technology introduction established
Timing	Appropriateness of timing and sufficient warning
Distribution System	Adequate systems in place at time of distribution
Documentation	Complexity of documentation explaining the technology (ie. users manuals, etc.)

COMMENTS

(If you require additional space please use a separate sheet and attach to survey form.)

A.2 RAW SURVEY RESULTS

ADDITIONAL COMMENTS BY SURVEY RESPONDENTS:

A17
- all factors important since failure in one could result in overall *implementation failure*
- survey itself could be used as a checklist to screen candidate technologies

A29
- print size too small

A32
- felt that many factor attributes started becoming repetitive

A44-
- "attitude" is the most important factor and the most difficult to establish

A52
- survey difficult to respond to, factors difficult to assess because of the numerous attributes that were used to describe each factor

B09
- print size too small

B27
- print size too small
- somewhat repetitive & hard to understand (possibly rewording would help)

B30
- would like a copy of final report
- responses to survey depend on which of two perspectives are used *(from public sector or from private sector)*

B35
- very well defined survey

B38
- person to person technology transfer is most effective
- availability of training and resources to implement for the user is most important

B40
- the technology being marketed can be controlled, but, not the target market itself
- it is important to adapt the technology to fit the market than the converse

B49
- too complicated for a 5 minute survey
- technology should be appealing and not too complicated

C23A - other factors to consider: environment, safety, government mandate and/or legislation

C32 - credibility in the eyes of the potential end user must be established first
- technologies must be practical and applicable
- end user assistance is very important
- communication networks are critical
- effective processes or mechanisms are necessary for timely delivery of technology
- political, fiscal and environmental factors are the least important

C41 - would like a copy of final report
- this survey is overly detailed and difficult to respond to

C49 - very thorough survey
- some supporting attributes induce varied response, hence, the importance level is sometimes inconclusive
- effort is well appreciated and the survey serves as a catalyst for ideas

D02 - took longer than 10 minutes to complete

E06 - would like a copy of final report
- every factor presented is important

E10 - would like a copy of final report

E11 - many broad concepts to be covered in quantitative form, not easy to consolidate ratings based on several short statements

F01 - effective communication is critical, surmounting barriers in this area is most important

F08 - took liberty to distribute copy of survey to 15 other individuals

F08A - would like a copy of final results
- technology transfer is primary duty of a technical specialist

G02 - support from senior management is necessary for implementing new technology

G06 - net present value should be used rather than payback time in economic analysis

H01 - a network of gatekeepers is necessary to support communications
- executive backing is critical

A.3 TEMPLATE USER DOCUMENTATION

REQUIRED SOFTWARE:

Load LOTUS 1.2.3 for WINDOWS (version 1 or higher). A working knowledge of this software is highly recommended.

REQUIRED FILES:

From the diskette supplied, open a file named MODELRAW.WK3. This is the system template in which the TIPS model resides.

Immediately save as the file to another name with a .WK3 extension.

Only work on the newly saved version of the template. The information on the original file is the data used in the case scenario in the thesis. This information will be lost once new input is keyed in.

Also, open a file named SURVEYRAW.WK3 and minimize it. Keep this file open in the background when working on the template. The MODELRAW.WK3 (or newly named duplicate) is dynamically linked to SURVEYRAW.WK3 file.

PROTECTED INFORMATION:

The first seven columns are protected as they are dynamically linked to the survey database file named SURVEYRAW.WK3.

- the first column, ***FACT NO***, is the factor identifier;
- the second column, ***FACTOR DESCRIPTION***, gives the factor description;
- the third column, ***BASE RATE***, is the sample mean derived from the survey (establishes the baseline for the model);
- the forth & fifth columns, ***STD-*** and ***STD+***, are the standard deviation values;
- the sixth column, ***SENS RNG***, represents the standard deviation range which also provides an indication of factor sensitivity as well as the confidence in survey values;
- the seventh column, ***FACT SENS***, is the actual factor sensitivity value.

DATA TO BE KEYED IN (INPUT):

There are 31 factors identified in the template. Review each factor within the context of the scenario (i.e., technology) being evaluated. Refer to the thesis text for detailed explanation of each factor.

Key into the appropriate cell location, under the column identified by ***FACT APPL***, a value of +1.0 if the factor applies in this case scenario and a value of 0.0 if it does not.

In the next column to the right, identified by ***SUP/HIND***, key in a value of +1.0 if the factor contributes positively (i.e., supports a successful final outcome), or key in a value of -1.0 if the contribution is negative (i.e., hinders a successful final outcome). If the factor does not apply, leave the cell entry blank.

Under the column identified by ***DEG***, key into the appropriate cell locations the degree of the contribution of each factor (whether negative or positive). Use the ***Numeric*** and respective ***Subjective Rating*** scales at the top of the template. Only input positive values. If the factor does not apply leave the cell entry blank.

In the column identified by CONF input a confidence rating using the same scales as identified immediately above. Again, if the factor does not apply leave the cell entry blank.

Finally, in the ***ADJUSTED (iA) SDR/MARR*** column input the current organizational social discount rate or minimum attractive rate of return value in the cell immediately below ***BASE (iB) SDR/MARR =***. This value will be used in calculating (iA) for each factor, factor category and overall.

AUTOMATICALLY CALCULATED RESULTS (OUTPUT):

As you enter the values the template automatically recalculates the actual rating for each factor for the particular case scenario and displays them in the appropriate cell locations in the column identified by ***ACT RATE***. At the same time aggregate values are calculated for each factor category and for the overall analysis. These values are displayed in the appropriate columns just below the 31 factors.

As the template recalculates the actual ratings, it also automatically compares the values against the baseline established from the survey and represents the results graphically on two graphs.

Success Potential

In the first graph, titled ***GRAPH #1***, the horizontal lines represent the standard deviation range of the survey values. These, in actuality, are the values from the cells located under ***SENS RNG*** bounded by the values from the cells under the ***STD-*** and ***STD+*** column.

The vertical line emanating perpendicularly and downwards from the horizontal lines represents the sample mean, or the values in the cell under the ***BASE RATE*** column.

The vertical line emanating perpendicularly and upwards from the horizontal lines represent the actual rating, or **ACT RATE**, for the respective factor.

Factor Sensitivity / Confidence

In the second graph, titled ***GRAPH #2***, the horizontal line represents factor sensitivity, which is inversely proportional to the sensitivity range. This line also graphically represents the level of confidence in the survey results for the respective factor. The numeric values are found under the ***FACT SENS*** column.

The vertical line emanating perpendicularly and downwards from the horizontal lines represent the level of confidence rated for the respective factor in a particular case scenario. The numeric values are found under the ***CONF*** column.

Both graphs provide a quick visual overview of the results for a particular case scenario in comparison to the baselines established through a survey of industry experts.

Recommended Actions

The cells under the column titled ***RECOMMENDED ACTIONS*** provides information on the type of action that should be considered to ensure a overall positive outcome. This information is also automatically provided once the case scenario data has been input.

Economic Evaluation

Finally, the column furthest right, entitled ***ADJUSTED (IA) SDR/MARR***, provides recommended internal rate of return values for use in an economic analysis of the technology.

OPTIONS:

Four perspectives of the same information are possible for any particular case scenario. They are:
- baseline factor importance;
- degree of baseline factor sensitivity (and confidence);
- case scenario success potential factor rating;
- case scenario confidence rating.

To accomplish all this, the data in columns 3 through 7 (from the left) must be converted from formulas (in actuality they are dynamic links to the database file) to actual values. This can be accomplished using the **RANGE-VALUE** menu features in LOTUS 1.2.3. This must be done for all "factors", the "factor categories" and the "overall". Once this is done, save the file.

To get the different perspectives use the **DATA-SORT** features in LOTUS 1.2.3. Using the mouse pointer establish a range which encompasses all the columns for all 31 factors. Once this is done, use the **DATA-SORT** command as follows for each perspective, respectively:

Baseline Factor Importance -> sort on *BASE RATE* column using the descending option.

Baseline Factor Sensitivity (Confidence) -> sort on *FACT SENS* column using the descending option.

Case Scenario Success Potential -> sort on *ACT RATE* column using the descending option.

Case Scenario Confidence -> sort on *CONF* column using the descending option.

The same procedures can be used on the category aggregates to obtain the various perspectives.

SUMMARY:
In summary, input is required for four cells for each factor. Everything else is calculated automatically. Additional pertinent information explaining the process involved (i.e., the algorithms used, etc.) are presented on the template itself.

A.4 TEMPLATE FORMULAS

	A	B	C	D	E	F
8		FACTOR DETAILS:				
9						
10		FACT	FACTOR	BASE		STD
11		NO	DESCRIPTION	RATE		
12						
13						
14		BASE SCENARIO:		EXPERT SYSTEMS		
15						
16						
17		C1F1	Org Structure	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:C140..A:C140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:C151..A:C151	
18		C1F2	IT Infrastructure	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:E140..A:E140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:E151..A:E151	
19		C1F3	Info Flow	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:G140..A:G140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:G151..A:G151	
20		C1F4	Info Access	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:I140..A:I140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:I151..A:I151	
21		C1F5	IT Mechanisms	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:K140..A:K140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:K151..A:K151	
22		C1F6	IT Approach	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:M140..A:M140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:M151..A:M151	
23		C2F1	Tech Lifecycle	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:O140..A:O140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:O151..A:O151	
24		C2F2	Research Plan	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:Q140..A:Q140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:Q151..A:Q151	
25		C2F3	Resources	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:S140..A:S140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:S151..A:S151	
26		C2F4	Costs	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:U140..A:U140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:U151..A:U151	
27		C3F1	Industry Trends	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:W140..A:W140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:W151..A:W151	
28		C3F2	Political	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:Y140..A:Y140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:Y151..A:Y151	
29		C3F3	Economic	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AA140..A:AA14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AA151..A:AA15	
30		C4F1	End User	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AC140..A:AC14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AC151..A:AC15	
31		C4F2	Mgr. / Supervisor	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AE140..A:AE140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AE151..A:AE151	
32		C4F3	Tech Champion	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AG140..A:AG14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AG151..A:AG15	
33		C4F4	Decision Maker	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AI140..A:AI140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AI151..A:AI151	
34		C4F5	Transfer Agent	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AK140..A:AK140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AK151..A:AK151	
35		C5F1	Corp Culture	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AM140..A:AM14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AM151..A:AM15	
36		C5F2	Current Situation	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AO140..A:AO14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AO151..A:AO15	
37		C5F3	Corp Policy	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AQ140..A:AQ14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AQ151..A:AQ15	
38		C5F4	Org Environment	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AS140..A:AS140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AS151..A:AS151	
39		C5F5	Staff Profile	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AU140..A:AU14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AU151..A:AU15	
40		C5F1	Solution Possibility	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AW140..A:AW14	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AW151..A:AW15	
41		C6F2	Technical Risk	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AY140..A:AY140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:AY151	
42		C6F3	Tech Attributes	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BA140..A:BA140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BA	
43		C6F4	Tech Effectiveness	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BC140..A:BC140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BC	
44		C6F5	Transfer Proposal	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BE140..A:BE140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BE	
45		C6F6	Target Environment	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BG140..A:BG140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BG	
46		C6F7	Marketing	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BI140..A:BI140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BI	
47		C6F8	Sketch / Sitcom	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BK140..A:BK140	+<<A:\PFMBC\123FILES\THESIS\SURV_RAW.WK3>>A:BK	
48						
49		AVG	CATEGORIES			
50		C1	Communications	@AVG(E17..E22)	@AVG(F17..F22)	
51		C2	Personal	@AVG(E23..E26)	@AVG(F23..F26)	
52		C3	External	@AVG(E27..E29)	@AVG(F27..F29)	
53		C4	Human	@AVG(E30..E34)	@AVG(F30..F34)	
54		C5	Corporate	@AVG(E35..E39)	@AVG(F35..F39)	
55		C6	Technology	@AVG(E40..E47)	@AVG(F40..F47)	
56						
57						
58						
59		TOT	OVERALL	@AVG(E17..E47)	@AVG(F17..F47)	
60						
61						
62						
63						

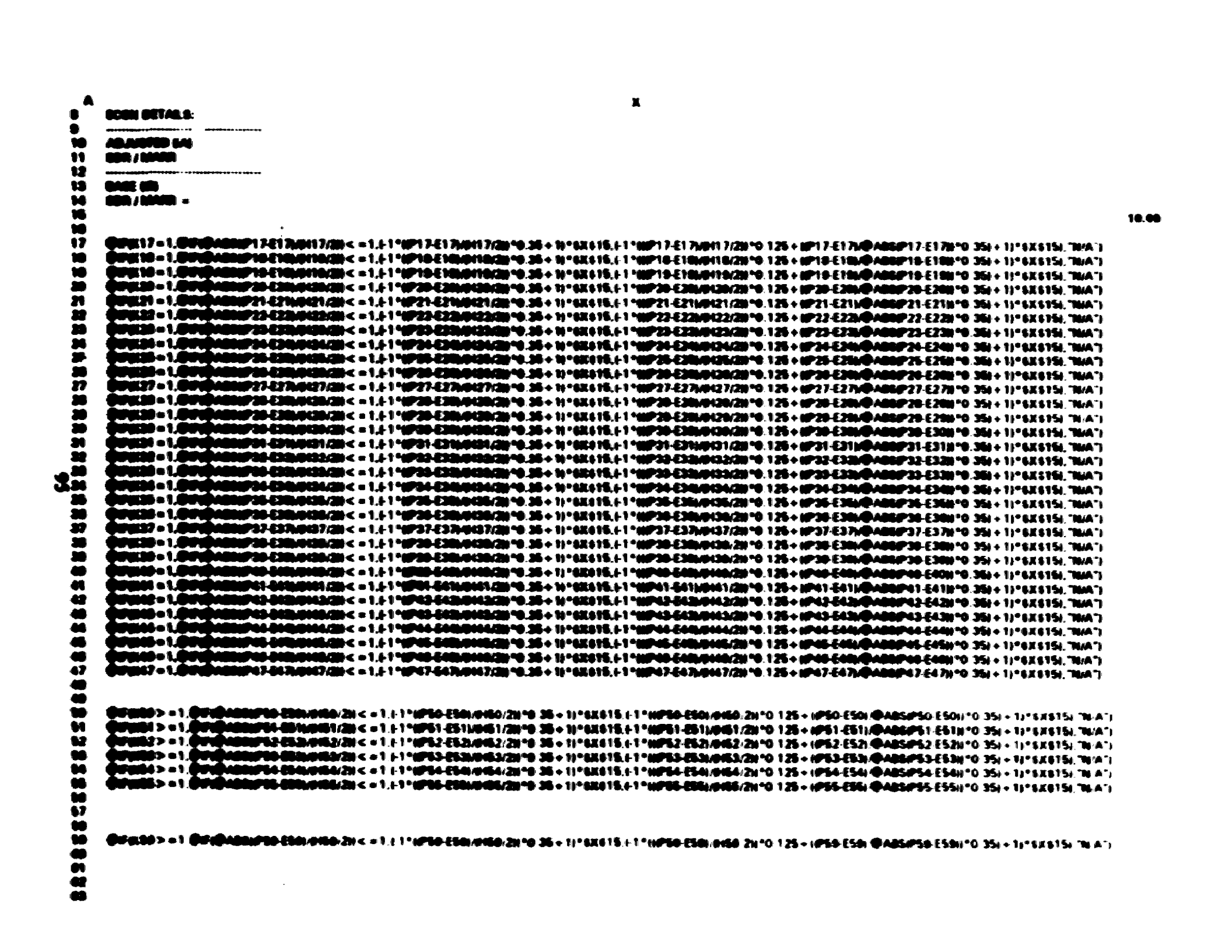
	A	G	H	I	J
10		STD ♦	SENS RNG	FACT SENS	
17		♦ < < A:[redacted]_RAW.WK3 > > A:C152..A:C152	♦ G17-F17	1-H17	
18		♦ < < A:[redacted]_RAW.WK3 > > A:E152..A:E152	♦ G18-F18	1-H18	
19		♦ < < A:[redacted]_RAW.WK3 > > A:G152..A:G152	♦ G19-F19	1-H19	
20		♦ < < A:[redacted]_RAW.WK3 > > A:I152..A:I152	♦ G20-F20	1-H20	
21		♦ < < A:[redacted]_RAW.WK3 > > A:K152..A:K152	♦ G21-F21	1-H21	
22		♦ < < A:[redacted]_RAW.WK3 > > A:M152..A:M152	♦ G22-F22	1-H22	
23		♦ < < A:[redacted]_RAW.WK3 > > A:O152..A:O152	♦ G23-F23	1-H23	
24		♦ < < A:[redacted]_RAW.WK3 > > A:Q152..A:Q152	♦ G24-F24	1-H24	
25		♦ < < A:[redacted]_RAW.WK3 > > A:S152..A:S152	♦ G25-F25	1-H25	
26		♦ < < A:[redacted]_RAW.WK3 > > A:U152..A:U152	♦ G26-F26	1-H26	
27		♦ < < A:[redacted]_RAW.WK3 > > A:W152..A:W152	♦ G27-F27	1-H27	
28		♦ < < A:[redacted]_RAW.WK3 > > A:Y152..A:Y152	♦ G28-F28	1-H28	
29		♦ < < A:[redacted]_RAW.WK3 > > A:AA152..A:AA15	♦ G29-F29	1-H29	
30		♦ < < A:[redacted]_RAW.WK3 > > A:AC152..A:AC15	♦ G30-F30	1-H30	
31		♦ < < A:[redacted]_RAW.WK3 > > A:AE152..A:AE152	♦ G31-F31	1-H31	
32		♦ < < A:[redacted]_RAW.WK3 > > A:AG152..A:AG15	♦ G32-F32	1-H32	
33		♦ < < A:[redacted]_RAW.WK3 > > A:AI152..A:AI152	♦ G33-F33	1-H33	
34		♦ < < A:[redacted]_RAW.WK3 > > A:AK152..A:AK152	♦ G34-F34	1-H34	
35		♦ < < A:[redacted]_RAW.WK3 > > A:AM152..A:AM15	♦ G35-F35	1-H35	
36		♦ < < A:[redacted]_RAW.WK3 > > A:AO152..A:AO15	♦ G36-F36	1-H36	
37		♦ < < A:[redacted]_RAW.WK3 > > A:AQ152..A:AQ15	♦ G37-F37	1-H37	
38		♦ < < A:[redacted]_RAW.WK3 > > A:AS152..A:AS152	♦ G38-F38	1-H38	
39		♦ < < A:[redacted]_RAW.WK3 > > A:AU152..A:AU15	♦ G39-F39	1-H39	
40		♦ < < A:[redacted]_RAW.WK3 > > A:AW152..A:AW15	♦ G40-F40	1-H40	
41		♦ < < A:[redacted]_RAW.WK3 > > A:AY152..A:AY152	♦ G41-F41	1-H41	
42		♦ < < A:[redacted]_RAW.WK3 > > A:BA152..A:BA152	♦ G42-F42	1-H42	
43		♦ < < A:[redacted]_RAW.WK3 > > A:BC152..A:BC152	♦ G43-F43	1-H43	
44		♦ < < A:[redacted]_RAW.WK3 > > A:BE152..A:BE152	♦ G44-F44	1-H44	
45		♦ < < A:[redacted]_RAW.WK3 > > A:BG152..A:BG152	♦ G45-F45	1-H45	
46		♦ < < A:[redacted]_RAW.WK3 > > A:BI152..A:BI152	♦ G46-F46	1-H46	
47		♦ < < A:[redacted]_RAW.WK3 > > A:BK152..A:BK152	♦ G47-F47	1-H47	
50		@AVG617..G22)	@AVG617..H22)	@AVG617..I22)	
51		@AVG623..G29)	@AVG623..H29)	@AVG623..I29)	
52		@AVG627..G29)	@AVG627..H29)	@AVG627..I29)	
53		@AVG630..G34)	@AVG630..H34)	@AVG630..I34)	
54		@AVG635..G39)	@AVG635..H39)	@AVG635..I39)	
55		@AVG640..G47)	@AVG640..H47)	@AVG640..I47)	
59		@AVG617..G47)	@AVG617..H47)	@AVG617..I47)	

	K	L	M	N	O	P
8	SCENARIO DETAILS:					
9						
10	FACT	SUP /	DEG	CONF	ACT	
11	APPL	NMD			RATE	
12						
13						
14						
15						
16						
17					+K17*(E17+(H17/2)*L17*M17))+(N17-I17)*(H17/2))	
18					+K18*(E18+(H18/2)*L18*M18))+(N18-I18)*(H18/2))	
19					+K19*(E19+(H19/2)*L19*M19))+(N19-I19)*(H19/2))	
20					+K20*(E20+(H20/2)*L20*M20))+(N20-I20)*(H20/2))	
21					+K21*(E21+(H21/2)*L21*M21))+(N21-I21)*(H21/2))	
22					+K22*(E22+(H22/2)*L22*M22))+(N22-I22)*(H22/2))	
23					+K23*(E23+(H23/2)*L23*M23))+(N23-I23)*(H23/2))	
24					+K24*(E24+(H24/2)*L24*M24))+(N24-I24)*(H24/2))	
25					+K25*(E25+(H25/2)*L25*M25))+(N25-I25)*(H25/2))	
26					+K26*(E26+(H26/2)*L26*M26))+(N26-I26)*(H26/2))	
27					+K27*(E27+(H27/2)*L27*M27))+(N27-I27)*(H27/2))	
28					+K28*(E28+(H28/2)*L28*M28))+(N28-I28)*(H28/2))	
29					+K29*(E29+(H29/2)*L29*M29))+(N29-I29)*(H29/2))	
30					+K30*(E30+(H30/2)*L30*M30))+(N30-I30)*(H30/2))	
31					+K31*(E31+(H31/2)*L31*M31))+(N31-I31)*(H31/2))	
32					+K32*(E32+(H32/2)*L32*M32))+(N32-I32)*(H32/2))	
33					+K33*(E33+(H33/2)*L33*M33))+(N33-I33)*(H33/2))	
34					+K34*(E34+(H34/2)*L34*M34))+(N34-I34)*(H34/2))	
35					+K35*(E35+(H35/2)*L35*M35))+(N35-I35)*(H35/2))	
36					+K36*(E36+(H36/2)*L36*M36))+(N36-I36)*(H36/2))	
37					+K37*(E37+(H37/2)*L37*M37))+(N37-I37)*(H37/2))	
38					+K38*(E38+(H38/2)*L38*M38))+(N38-I38)*(H38/2))	
39					+K39*(E39+(H39/2)*L39*M39))+(N39-I39)*(H39/2))	
40					+K40*(E40+(H40/2)*L40*M40))+(N40-I40)*(H40/2))	
41					+K41*(E41+(H41/2)*L41*M41))+(N41-I41)*(H41/2))	
42					+K42*(E42+(H42/2)*L42*M42))+(N42-I42)*(H42/2))	
43					+K43*(E43+(H43/2)*L43*M43))+(N43-I43)*(H43/2))	
44					+K44*(E44+(H44/2)*L44*M44))+(N44-I44)*(H44/2))	
45					+K45*(E45+(H45/2)*L45*M45))+(N45-I45)*(H45/2))	
46					+K46*(E46+(H46/2)*L46*M46))+(N46-I46)*(H46/2))	
47					+K47*(E47+(H47/2)*L47*M47))+(N47-I47)*(H47/2))	
48						
49						
50	@SUMIF(K17:K21)			@SUMIFS(N17:N21,K17:K50)	@SUMIFS(P17:P21,K17:K50)	
51	@SUMIF(K23:K26)			@SUMIFS(N23:N26,K23:K51)	@SUMIFS(P23:P26,K23:K51)	
52	@SUMIF(K27:K28)			@SUMIFS(N27:N28,K27:K52)	@SUMIFS(P27:P28,K27:K52)	
53	@SUMIF(K30:K33)			@SUMIFS(N30:N33,K30:K53)	@SUMIFS(P30:P33,K30:K53)	
54	@SUMIF(K35:K38)			@SUMIFS(N35:N38,K35:K54)	@SUMIFS(P35:P38,K35:K54)	
55	@SUMIF(K40:K47)			@SUMIFS(N40:N47,K40:K55)	@SUMIFS(P40:P47,K40:K55)	
56						
57						
58						
59	@SUMIF(K17:K47)			@SUMIFS(N17:N47,K17:K59)	@SUMIFS(P17:P47,K17:K59)	
60						
61						
62						
63						

ACTION DETAILS:

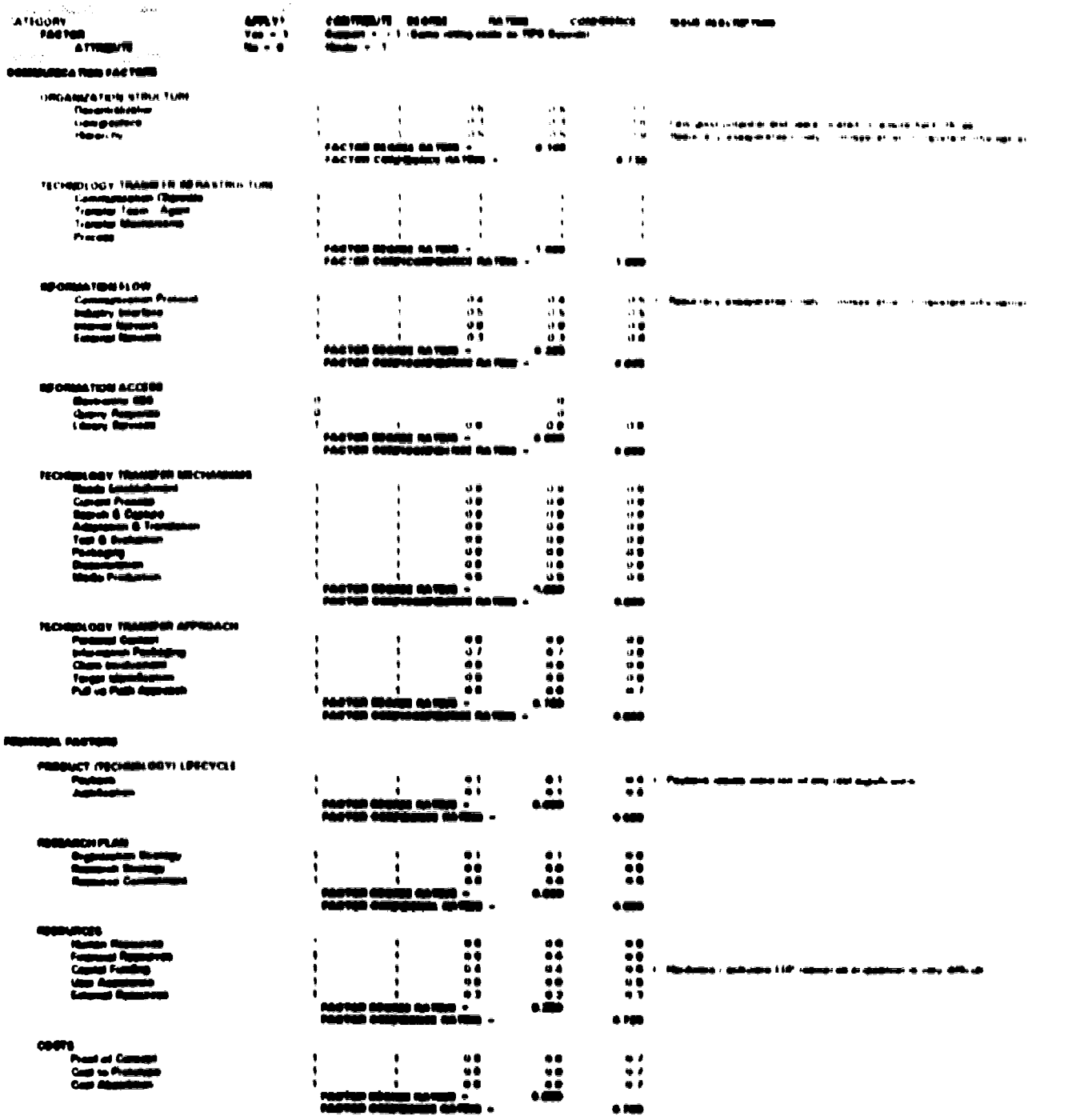
RECOMMENDED
ACTIONS

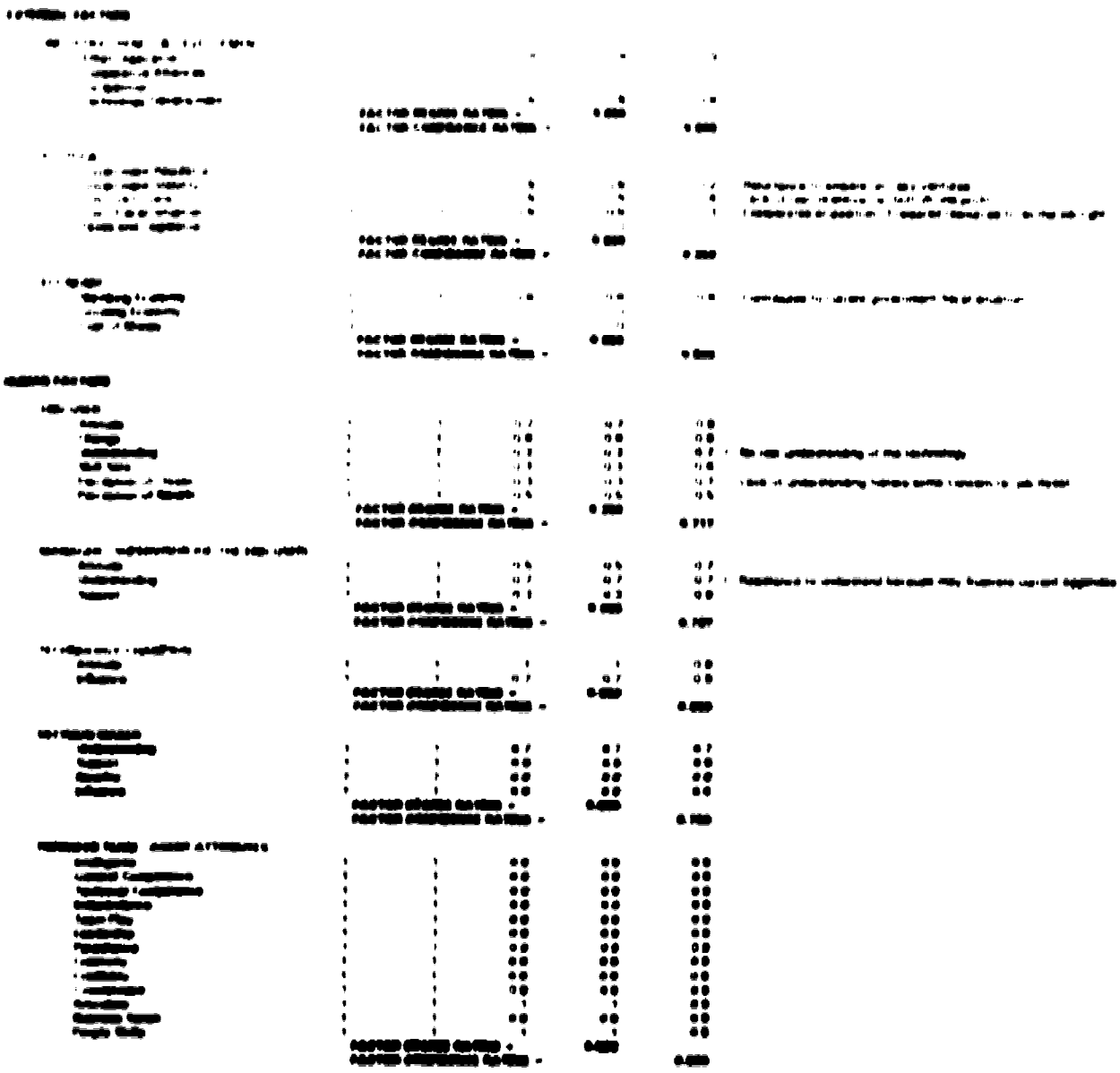
```
[illegible]17=1,[illegible]P17< =F17,"ACTION LEVEL 1",@IF(P17< =E17,"ACTION LEVEL 2",@IF(P17< =G17,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]18=1,[illegible]P18< =F18,"ACTION LEVEL 1",@IF(P18< =E18,"ACTION LEVEL 2",@IF(P18< =G18,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]19=1,[illegible]P19< =F19,"ACTION LEVEL 1",@IF(P19< =E19,"ACTION LEVEL 2",@IF(P19< =G19,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]20=1,[illegible]P20< =F20,"ACTION LEVEL 1",@IF(P20< =E20,"ACTION LEVEL 2",@IF(P20< =G20,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]21=1,[illegible]P21< =F21,"ACTION LEVEL 1",@IF(P21< =E21,"ACTION LEVEL 2",@IF(P21< =G21,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]22=1,[illegible]P22< =F22,"ACTION LEVEL 1",@IF(P22< =E22,"ACTION LEVEL 2",@IF(P22< =G22,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]23=1,[illegible]P23< =F23,"ACTION LEVEL 1",@IF(P23< =E23,"ACTION LEVEL 2",@IF(P23< =G23,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]24=1,[illegible]P24< =F24,"ACTION LEVEL 1",@IF(P24< =E24,"ACTION LEVEL 2",@IF(P24< =G24,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]25=1,[illegible]P25< =F25,"ACTION LEVEL 1",@IF(P25< =E25,"ACTION LEVEL 2",@IF(P25< =G25,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]26=1,[illegible]P26< =F26,"ACTION LEVEL 1",@IF(P26< =E26,"ACTION LEVEL 2",@IF(P26< =G26,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]27=1,[illegible]P27< =F27,"ACTION LEVEL 1",@IF(P27< =E27,"ACTION LEVEL 2",@IF(P27< =G27,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]28=1,[illegible]P28< =F28,"ACTION LEVEL 1",@IF(P28< =E28,"ACTION LEVEL 2",@IF(P28< =G28,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]29=1,[illegible]P29< =F29,"ACTION LEVEL 1",@IF(P29< =E29,"ACTION LEVEL 2",@IF(P29< =G29,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]30=1,[illegible]P30< =F30,"ACTION LEVEL 1",@IF(P30< =E30,"ACTION LEVEL 2",@IF(P30< =G30,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]31=1,[illegible]P31< =F31,"ACTION LEVEL 1",@IF(P31< =E31,"ACTION LEVEL 2",@IF(P31< =G31,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]32=1,[illegible]P32< =F32,"ACTION LEVEL 1",@IF(P32< =E32,"ACTION LEVEL 2",@IF(P32< =G32,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]33=1,[illegible]P33< =F33,"ACTION LEVEL 1",@IF(P33< =E33,"ACTION LEVEL 2",@IF(P33< =G33,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]34=1,[illegible]P34< =F34,"ACTION LEVEL 1",@IF(P34< =E34,"ACTION LEVEL 2",@IF(P34< =G34,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]35=1,[illegible]P35< =F35,"ACTION LEVEL 1",@IF(P35< =E35,"ACTION LEVEL 2",@IF(P35< =G35,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]36=1,[illegible]P36< =F36,"ACTION LEVEL 1",@IF(P36< =E36,"ACTION LEVEL 2",@IF(P36< =G36,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]37=1,[illegible]P37< =F37,"ACTION LEVEL 1",@IF(P37< =E37,"ACTION LEVEL 2",@IF(P37< =G37,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]38=1,[illegible]P38< =F38,"ACTION LEVEL 1",@IF(P38< =E38,"ACTION LEVEL 2",@IF(P38< =G38,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]39=1,[illegible]P39< =F39,"ACTION LEVEL 1",@IF(P39< =E39,"ACTION LEVEL 2",@IF(P39< =G39,"ACTION LEVEL 3","ACTIO  LEVEL 4"))),"N/A")
[illegible]40=1,[illegible]P40< =F40,"ACTION LEVEL 1",@IF(P40< =E40,"ACTION LEVEL 2",@IF(P40< =G40,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]41=1,[illegible]P41< =F41,"ACTION LEVEL 1",@IF(P41< =E41,"ACTION LEVEL 2",@IF(P41< =G41,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]42=1,[illegible]P42< =F42,"ACTION LEVEL 1",@IF(P42< =E42,"ACTION LEVEL 2",@IF(P42< =G42,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]43=1,[illegible]P43< =F43,"ACTION LEVEL 1",@IF(P43< =E43,"ACTION LEVEL 2",@IF(P43< =G43,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]44=1,[illegible]P44< =F44,"ACTION LEVEL 1",@IF(P44< =E44,"ACTION LEVEL 2",@IF(P44< =G44,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]45=1,[illegible]P45< =F45,"ACTION LEVEL 1",@IF(P45< =E45,"ACTION LEVEL 2",@IF(P45< =G45,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]46=1,[illegible]P46< =F46,"ACTION LEVEL 1",@IF(P46< =E46,"ACTION LEVEL 2",@IF(P46< =G46,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]47=1,[illegible]P47< =F47,"ACTION LEVEL 1",@IF(P47< =E47,"ACTION LEVEL 2",@IF(P47< =G47,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")

[illegible]50> =1,[illegible]P50< =F50,"ACTION LEVEL 1",@IF(P50< =E50,"ACTION LEVEL 2",@IF(P50< =G50,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]51> =1,[illegible]P51< =F51,"ACTION LEVEL 1",@IF(P51< =E51,"ACTION LEVEL 2",@IF(P51< =G51,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]52> =1,[illegible]P52< =F52,"ACTION LEVEL 1",@IF(P52< =E52,"ACTION LEVEL 2",@IF(P52< =G52,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]53> =1,[illegible]P53< =F53,"ACTION LEVEL 1",@IF(P53< =E53,"ACTION LEVEL 2",@IF(P53< =G53,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]54> =1,[illegible]P54< =F54,"ACTION LEVEL 1",@IF(P54< =E54,"ACTION LEVEL 2",@IF(P54< =G54,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
[illegible]55> =1,[illegible]P55< =F55,"ACTION LEVEL 1",@IF(P55< =E55,"ACTION LEVEL 2",@IF(P55< =G55,"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")

[illegible]> =1,[illegible]P[illegible]< =F[illegible],"ACTION LEVEL 1",@IF(P[illegible]< =E[illegible],"ACTION LEVEL 2",@IF(P[illegible]< =G[illegible],"ACTION LEVEL 3","ACTION LEVEL 4"))),"N/A")
```



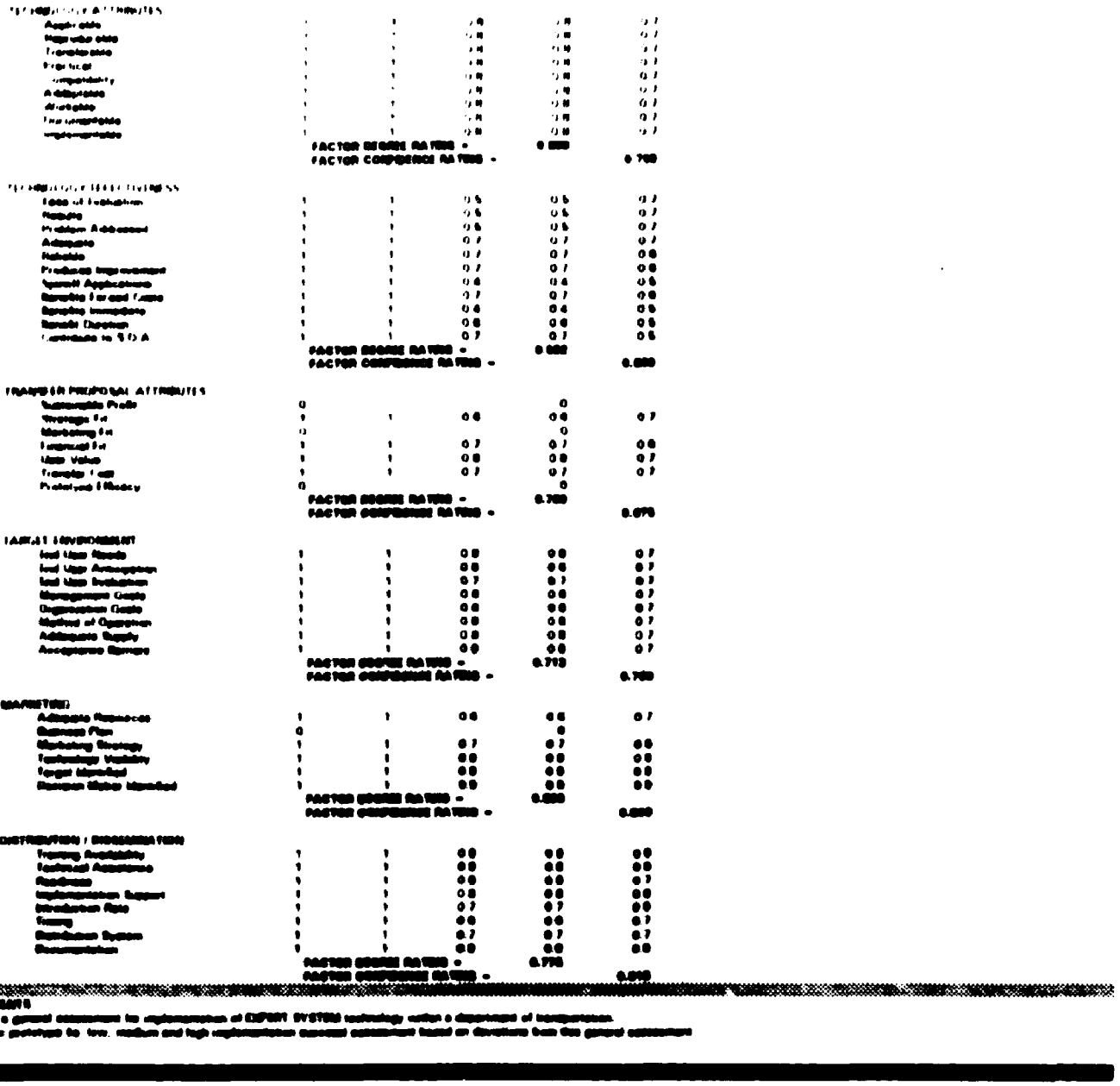
A.5 CASE SCENARIO RESULTS

ASSESSMENT OF EXPERT SYSTEM TECHNOLOGY IMPLEMENTATION





[redacted]



COMMENTS

This is a general assessment for implementation of EXPERT SYSTEMS technology within a department of headquarters.

Specific prototypes for low, medium and high implementation success assessment based on directions from this general assessment

A.6 TEMPLATE PERSPECTIVES

FIGURE 8 BASE RATE PERSPECTIVE

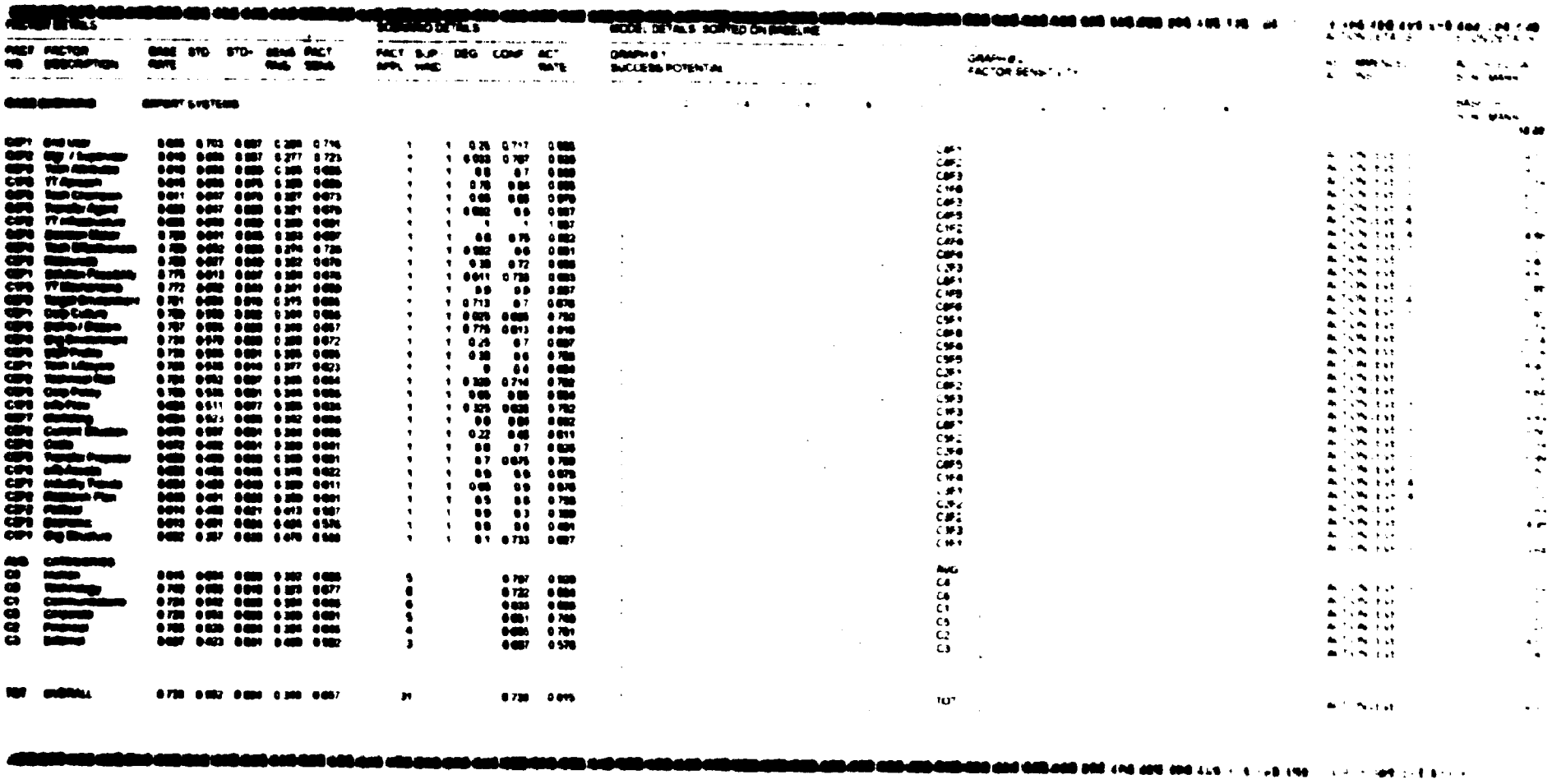


FIGURE 9 FACTOR SENSITIVITY RATE PERSPECTIVE

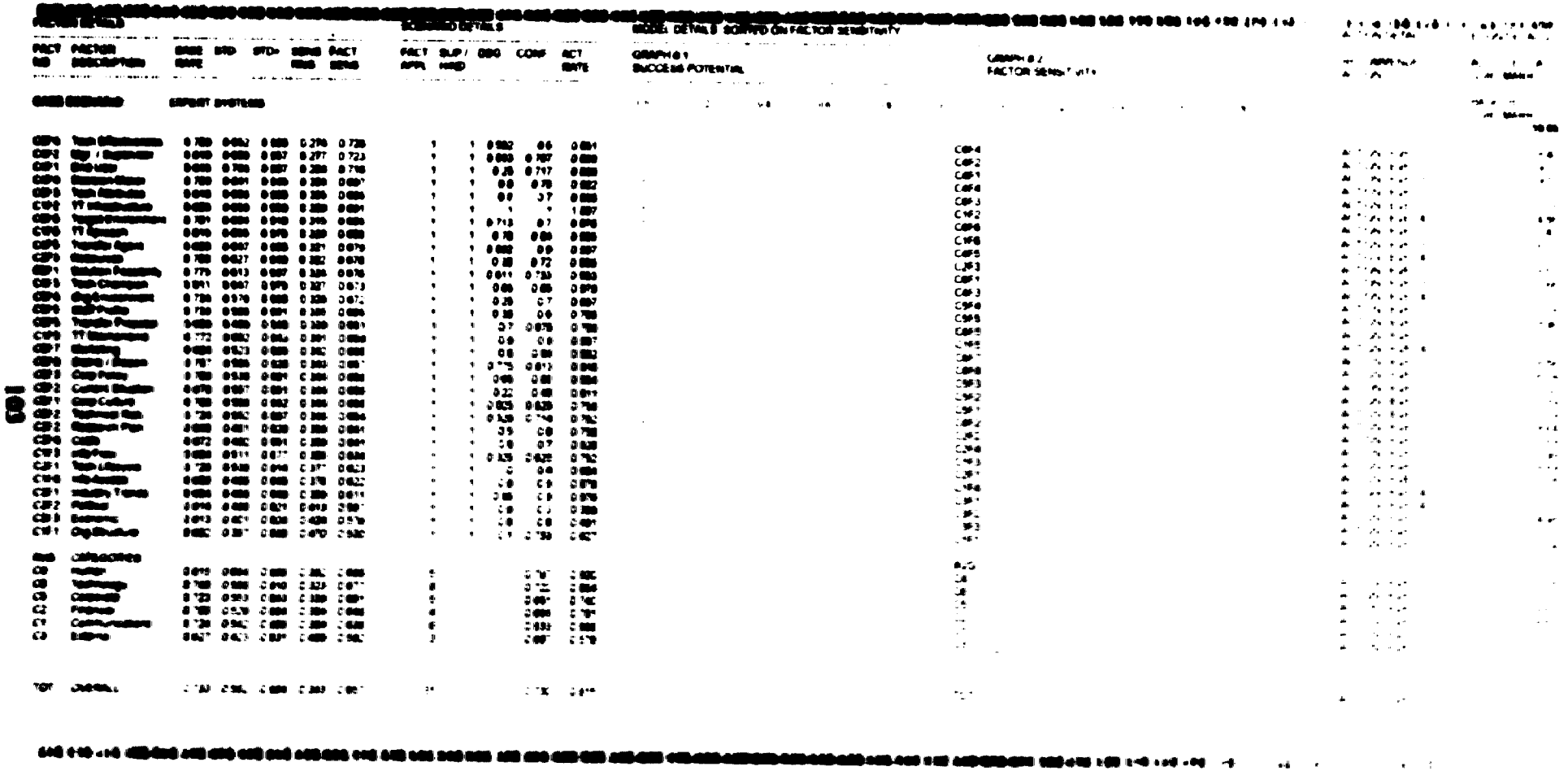


FIGURE 10 ACTUAL RATE PERSPECTIVE

FIGURE 11 CONFIDENCE RATE PERSPECTIVE

Table 4.9 Chinese Schooling of the Respondents

	The Chinatown Group		The Suburban Group		Total Sample	
Years	Number	Percentage	Number	Percentage	Number	Percentage
None	2	5.9	5	2.8	7	3.3
1-5	7	20.6	13	7.4	20	9.5
6-10	13	38.2	63	35.8	76	36.2
11 and over	12	35.3	95	54.0	107	51.0
Total	34	100	176	100	210	100

χ^2=5.14 (recategorized) d.f.=2 Insignificant at .01 level

Table 4.10 English Schooling of the Respondents

	The Chinatown Group		The Suburban Group		Total Sample	
Years	Number	Percentage	Number	Percentage	Number	Percentage
None	21	61.8	27	15.4	48	22.9
1-5	10	29.4	81	46.0	91	43.3
6-10	1	2.9	46	26.1	47	22.4
11 and over	2	5.9	22	12.5	24	11.4
Total	34	100	176	100	210	100

χ^2=11.77 (recategorized) d.f.=2 Significant at .01 level

In order to further assess each respondent's ability in Chinese and English, each was asked to self evaluate their proficiency in speaking, reading and writing both Chinese and English. The results are summarized in Table 4.11 and Table 4.12. Table 4.11 shows that the suburban group has a more dispersed response pattern than the Chinatown group. The suburban group have larger proportions in the category "fluently" in all three items - speaking Chinese (79.1 per cent), reading Chinese (71.2 per cent) and writing Chinese (55.9 per cent). At the same time they also have larger proportions in the category "not at all"

for the three items (3.4 per cent for speaking Chinese, 9.0 per cent for reading Chinese and 9.0 per cent for writing Chinese). These results appear consistent with the findings that a larger proportion of the suburban group received Chinese schooling for six years and more and with the larger proportion arriving in Canada before they were ten years of age. Table 4.11 shows that in general, both groups are proficient in Chinese. The majority in both groups speak, read and write Chinese either "fluently" or "pretty well".

Compared with the proficiency in Chinese, both groups have a "weaker" ability in English. Again this is consistent with the fact that both groups have received less English schooling than Chinese (see Table 4.10). The sample as a whole has smaller proportions in the category "fluently" in all three items - speaking English (33.6 per cent), reading English (33.2 per cent) and writing English (26.6 per cent).

Table 4.12 also shows the two groups have even a larger difference in their proficiency in English than in Chinese. The majority of the suburban group can speak, read and write English either "fluently" or "pretty well" (75.7 per cent for speaking, 75.8 per cent for reading and 68.3 per cent for writing). However, the majority of the Chinatown group falls into the category "enough to be understood" or "not at all" (76.4 per cent for speaking, 76.4 per cent for reading and 79.4 per cent for writing). This means the majority of people living in Chinatown face serious problems in the use of English. In fact, more than half of the respondents there claim that they cannot speak, read and write English at all.

Table 4.11 Self-Evaluation of Proficiency in Chinese of the Respondents

		The Chinatown Group		The Suburban Group		Total Sample	
		Number	Per centage	Number	Per centage	Number	percentage
Speaking Chinese	Fluently	21	61.8	140	79.1	161	76.3
	Pretty well	11	32.4	23	13.0	34	16.1
	Enough to be understood	1	2.9	8	4.5	9	4.3
	not at all	1	2.9	6	3.4	7	3.3
	χ^2 test not applicable (25% of cells with expected value less than 5)						
Reading Chinese	Fluently	12	35.3	126	71.2	138	65.4
	Pretty well	12	35.3	27	15.3	39	18.4
	Enough to get by	9	26.5	8	4.5	17	8.1
	Not at all	1	2.9	16	9.0	17	8.1
	χ^2=4.19 (recategorized)		d.f.=1	Significant at .01 level			
Writing Chinese	Fluently	9	26.5	99	55.9	108	51.2
	Pretty well	9	26.5	44	24.9	53	25.1
	Enough to be understood	14	41.2	18	10.2	32	15.2
	Not at all	2	5.9	16	9.0	18	8.5
	χ^2=10.74 (recategorized)		d.f.=1	Significant at .01 level			
	Total	34	100	177	100	211	100

Table 4.12 Self-Evaluation of Proficiency in English of the Respondents

		The Chinatown Group		The Suburban Group		Total Sample	
		Number	Per centage	Number	Per centage	Number	Percen -tage
Speaking English	Fluently	3	8.8	68	38.4	71	33.6
	Pretty well	5	14.7	66	37.3	71	33.6
	Enough to be understood	8	23.5	37	20.9	45	21.4
	Not at all	18	52.9	6	3.4	24	11.4
	χ^2=32.95 (recategorized)		d.f.=1	Significant at .01 level			
Reading English	Fluently	3	8.8	67	37.9	70	33.2
	Pretty well	5	14.7	67	37.9	72	34.1
	Enough to get by	6	17.6	32	18.1	38	18.0
	Not at all	20	58.8	11	6.2	31	14.7
	χ^2=32.95 (recategorized)		d.f.=1	Significant at .01 level			
Writing English	Fluently	3	8.8	53	29.9	56	26.6
	Pretty well	4	11.8	68	38.4	72	34.1
	Enough to be understood	6	17.6	43	24.3	49	23.2
	Not at all	21	61.8	13	7.4	34	16.1
	χ^2=25.78 (recategorized)		d.f.=1	Significant at .01 level			
	Total	34	100	177	100	211	100

To summarize the language abilities of the two groups, it is clear that both are proficient in Chinese and more proficient in Chinese than in English. The suburban group, in general, do not have problems in the use of English while the Chinatown group face serious problems in using it. This together with their old age, makes the Chinatown group's tendency to seek ethnic propinquity not too difficult to understand. Because they are old and unable to speak English, they live together in Chinatown to take advantage of the highly clustered Chinese institutions and businesses and to avoid a life of loneliness and inconvenience. On the other hand, the suburban group's relatively greater ability in English

demonstrates their potential for further assimilation, although this potential does not necessarily mean giving up their Chinese life-styles.

4.2.7 Employment Status and Income

There is a big difference in the employment status between the Chinatown group and the suburban group. As Table 4.13 shows, 67.6 percent of the Chinatown group are retired people. In contrast, 91.0 percent of the suburban group are employed. Only 6.2 percent are retired. These results indicate that the people who live in Chinatown are largely beyond the employable years.

When the annual incomes of the two groups are examined, the differences are also very obvious. As Table 4.14 shows, the majority (55.9 per cent) living in Chinatown has an annual family income below $10,000 and 26 per cent between the category $10,000-$24,999. Only 2.9 per cent receive $50,000 and more. On the other hand, over one third (39.0 per cent) of the suburban group has an annual family income of $50,000 and over, and a very small proportion (2.8 per cent) receive less than $10,000. These results suggest the Chinatown group is poorer in comparison to the suburban group. In fact, several respondents who live inside Chinatown mentioned in their questionnaires that they receive money from their children.

Table 4.13 Employment Status of the Respondents

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Employed	11	32.4	161	91.0	172	81.5
Unemployed	0	0	5	2.8	5	2.4
Retired	23	67.6	11	6.2	34	16.1
Total	34	100	177	100	211	100

χ^2 not applicable (Recategorization does not make sense and 25% of cells with expected value less than 5).

Table 4.14 Family Income of the Respondents

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Under 10,000$	19	55.9	5	2.8	24	11.3
10,000$-24,999$	9	26.5	30	16.9	39	18.5
25,000$-49,999$	5	14.7	73	41.2	78	37.0
50,000$ and over	1	2.9	69	39.0	70	33.2
Total	34	100	177	100	211	100

χ^2=54.00 (recategorized) d.f.=2 Significant at .01 level

4.3 Summary

This chapter began by discussing how the two groups perceive the relative importance of seven residential locational factors. The results showed that the life-cycle stage factor and socioeconomic status played very important roles in people's residential locational choices. Both groups try to adjust their housing needs within their financial

abilities. The results also indicated that the Chinatown group has a tendency to seek ethnic propinquity while the suburban group does not. In addition, the findings suggested that the two groups are in the different stages of the life-cycle. Because the life-cycle stage factor played such an important role in people's residential locational choices, previous studies using spatial dispersal of an ethnic group as a measure of assimilation is not adequate. The life-cycles of an ethnic group should also be examined.

Further examination of the two groups' socio-demographic characteristics in terms of the life-cycle, socioeconomic status and assimilation status (specifically abilities in English and Chinese) demonstrated that the Chinatown group are old, retired and have passed the child-rearing stage of the life-cycle. The suburban group are younger and in the child-bearing and child-rearing stage of the life-cycle. In addition, the suburban group were younger on arrival in Canada and with a substantial knowledge in English. In contrast, the Chinatown group were, in general, quite old on arrival in Canada and with hardly any knowledge of English. Considering all these factors together as well as their old age, the tendency to seek ethnic propinquity by the Chinatown group is not surprising. Other socio-demographic findings include: the majority of the respondents' spouses are Chinese; the average years resident in Canada for both groups is slightly less than twenty years; the suburban group are better educated and better off economically than the Chinatown group. The question to be addressed next is on the basis of their demographic profiles, to what extent has each group maintained its ethnic identity? Will the suburban group be less ethnically oriented and thus more assimilated than the Chinatown group? This is the major objective of the study and will be discussed in the next chapter.

Chapter 5 Maintenance of Ethnic Identity

The findings summarized in Chapter 4 suggested that where people of an ethnic group live may be caused by factors not related to assimilation. Stages in the life-cycle were proposed as an alternative. In other words, it is difficult to decide an ethnic group's degree of assimilation and ethnicity maintenance from only its spatial distribution. The group's behavior in relation to assimilation and ethnic maintenance after they are dispersed residentially has to be examined in order to know to what extent residential dispersal is associated with a diminution ethnic identity. This chapter will focus on this issue. By comparing the differences in life-style and social circle of the two groups, an attempt is made to determine if the suburban group are less ethnically oriented than the Chinatown group.

5.1 Ethnicity Maintenance in Cultural Aspects

5.1.1 Language Used At Home

A preference for speaking one's mother tongue has always been one of the major measures of assimilation (Hurh *et al*, 1978). One way to measure ethnic language maintenance is the language used between members of the household (Driedger, 1975; O'Bryan *et al*, 1976). As Table 5.1 shows most of the respondents communicate with their spouses mainly in Chinese[1]. Among the married respondents over 65 percent of them reported that Chinese was the "major" or the "only" language they use to communicate with

[1]The married people in this question and the next question "what language(s) do you use to your children" include both the "married" and"widowed" respondents in Table 4.4. This accounts for the variation in the married totals in Table 5.1 and 5.2.

their spouses. There is no statistically significant difference (χ^2=9.80, d.f.=2) between the Chinatown group and the Suburban group. However, some notable differences can still be found in the language used when speaking to their spouses. Since the Chinatown group has a considerable proportion who cannot speak English, it is not surprising that 76.6% of this group speak only Chinese to their spouses. This compares with only 34.9% for the suburban group. On the other hand, none of the respondents in the Chinatown group use English as the "major" or the "only" language to communicate with their spouses. These two categories contain 16.6 percent of the suburban group. In addition, the suburban group has a higher proportion using both English and Chinese to communicate with their spouses.

Table 5.1 Language Used to the Spouse at Home

	The Chinatown group		The suburban group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
English Only	0	0	14	8.8	14	7.4
English Mainly	0	0	4	2.5	4	2.1
English and Chinese (each about equal)	3	10.0	44	27.7	47	24.9
Chinese Mainly	4	13.3	61	38.4	65	34.4
Chinese Only	23	76.7	36	22.6	59	31.2
Total	30	100	159	100	189	100

χ^2=9.80 (recategorized) d.f.=2 Insignificant at .01 level

The situation is different in the language used to communicate with the children. There is statistically significant difference (χ^2=25.21, d.f.=2) between the two groups. For the Chinatown group, "Chinese only" is the absolute major category which contains 69 percent of the respondents. There are no respondents who reported that they speak

"English only" or "English mainly" to their children. For the suburban group, "English and Chinese" is the major category. It contains 44.1 percent of the respondents. "Chinese only" is the third major category. It contains only 14.5 percent. In addition, "English only" and "English mainly" is spoken by 19.7 per cent of suburban households. This is not a large proportion but nevertheless quite significant.

The significant difference in the language used to the children between the two groups is not surprising. The majority of the Chinatown group (See Table 4.12) do not speak English at all. Therefore, when talking at home to either the spouses or the children, the Chinese language will be the only communication tool. In contrast, most people in the suburban group (75.7%) can speak English fluently or pretty well. At the same time, considering 65% of the suburban group is between the age of 35-49 years, their children must be receiving an education in Canada. These children may feel more comfortable speaking English. Thus, English is more frequently used when speaking to the children than when speaking to one's spouse. It is expected that the speaking English with the children will have a positive impact on the parents' assimilation process.

Table 5.2 Language Used to the Children at Home

	The Chinatown group		The suburban group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
English Only	0	0	12	7.9	12	6.6
English Mainly	0	0	18	11.8	18	9.9
English and Chinese (each about equal)	4	13.8	67	44.1	71	39.2
Chinese Mainly	5	17.2	33	21.7	38	21.1
Chinese Only	20	69.0	22	14.5	42	23.2
Total	29	100	152	100	181	100

χ^2=25.21 (recategorized) d.f.=2 Significant at .01 level

5.1.2 Dietary Preferences

The respondents were asked to report the frequency of eating western food. As Table 5.3 shows, the majority (48.8%) eat western food only "occasionally". There are 26.5 per cent who eat western food frequently. The percentage (8.1%) drops drastically in the categories of "every meal" and "once a day". In the current research, respondents were not asked how frequently they eat western food for breakfast, lunch and dinner separately. However Hurh *et al*'s (1978) research on Korean immigrants in the Chicago area, showed that western food is eaten most frequently for breakfast and lunch but not for dinner. This implies that western food has become a necessity rather than a preference, since western food is easier to prepare. His conclusion is that the traditional Korean food is predominantly preferred over western food, while western food is utilized for convenience. From the author's personal experience, the Chinese also eat western food as a convenience.

Although neither of the two groups eat western food very often, there is still a statistically significant difference ($\chi^2 = 20.91$, d.f. = 2) between them. The suburban group has a higher proportion (21.1%) that eats western food "frequently" and a lower proportion (29.3%) of "rarely" than does the Chinatown group. The proportion eating western food occasionally is quite similar for the two groups. On the whole, the results show the suburban group are more assimilated than the Chinatown group with respect to their dietary habits. However, this is only relative to the Chinatown group. In fact, the majority of the suburban group report they eat western food only "occasionally". In this sense they are not considered to be highly assimilated.

Table 5.3 Respondents' Frequency of Eating Western Food

	The Chinatown group		The suburban group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Every Meal	1	2.9	4	2.3	5	2.4
Once a Day	0	0	12	6.8	12	5.7
Frequently	3	8.8	53	29.9	56	26.5
Occasionally	16	47.1	87	49.2	103	48.8
Rarely	14	41.2	21	11.9	35	16.6
Total	34	100	177	100	211	100

χ^2=20.91 (recategorized) d.f.=2 Significant at .01 level

5.1.3 Festivals Celebrated

There are a lot of Chinese traditional holidays and festivals. These include the Chinese New Year, the Mid-Autumn Festival, the Dragon Boat Festival and the Lantern Festival. Each festival has its own special food. For example, in the Chinese New Year people usually make very big feasts containing various dishes which may symbolize happiness

and money. Although many of these festivals have lost their traditional meanings, for example, the Dragon Boat Festival was originally in memory of a great poet who lived two thousand years ago, they have become a part of the symbols of Chinese culture. It is argued that celebrating these holidays functions as a form of ethnic maintenance.

In the present study, people were asked if they celebrate any Chinese holidays in any form, such as going out for dinner or Karaoke, inviting friends home, having big feasts and/or taking part in the activities organized by various Chinese organizations. As Table 5.4 shows, 80.1 percent of the total respondents reported they celebrate Chinese holidays and festivals. This result shows that the Chinese people in Edmonton still maintain quite a strong ethnic identity. The two groups are not statistically significantly different ($\chi^2 = 5.90$, d.f. = 2) although proportionately more Chinese people in Chinatown (97.1%) celebrate Chinese holidays than do those in the suburban group (76.8%).

Table 5.4 Chinese Festivals Celebrated

	The Chinatown group		The suburban group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Yes	33	97.1	136	77.3	169	80.5
No	1	2.9	40	22.7	41	19.5
Total	34	100	176	100	210	100

$\chi^2 = 5.90$ d.f. = 2 Insignificant at .01 level

5.1.4 Chinese Games Played

Different cultures and countries have different kinds of recreational styles. For example, Chinese people enjoy Mahjong. It is a kind of card game. People usually gamble

when they play Mahjong. When people of an ethnic group participate in their own games their ethnic life style is being maintained. In the present study people were asked if they play any popular Chinese games, such as Mahjong.

Table 5.5 shows that for the whole sample, 7.6 percent of the respondents claimed that they play Chinese games "frequently", 27.5 percent claimed "never", and 30.3 percent and 34.5 percent claimed that they play Chinese games "occasionally" and "rarely" respectively. These results suggest that Chinese games are not an important part of the life-styles of both the Chinatown group and the suburban group. The two groups do not differ significantly difference ($\chi^2 = 4.69$, d.f. = 1) in the frequency with which Chinese games are played. But when comparing the frequency distribution of the two groups, proportionately more people in the Chinatown group play Chinese games "frequently" (8.8%) and "occasionally" (47.1%), while proportionately more people in the suburban group play Chinese games "rarely" or "never".

Table 5.5 Respondents' Frequency of Playing Chinese Games

	The Chinatown group		The suburban group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	3	8.8	13	7.3	16	7.6
Occasionally	16	47.1	48	27.1	64	30.3
Rarely	9	26.5	64	36.2	73	34.6
Never	6	17.6	52	29.4	58	27.5
Total	34	100	177	100	211	100

χ^2=4.69 (recategorized) d.f.=1 Insignificant at .01 level

5.1.5 Frequency of Reading Chinese Newspapers

One area by which to measure the immigrants' maintenance of ethnic identity is their use of the ethnic media. In order to avoid bias, for example, some people prefer reading rather than watching television, the questions about exposure to the Chinese media included several kinds of public media, including newspapers, books/magazines, radio, television and videos. This section will discuss readership of Chinese newspapers.

As mentioned in Chapter 2, there are three free Chinese community newspapers in Edmonton. In addition, people can subscribe the National Canadian-Chinese newspaper and other Chinese newspapers from Hong Kong, Taiwan and mainland China. They also can get access to the above newspapers in public libraries and Chinese bookstores. Table 5.5 shows that for the whole sample, about half of the respondents read Chinese newspapers "frequently", 34.6 per cent read Chinese newspapers "occasionally", only 10.4 per cent and 9.0 per cent reported they "rarely" or "never" respectively read Chinese newspapers . The results show that Chinese newspapers play an important part in the lives of the Chinese in Edmonton.

Table 5.6 Respondents' Frequency of Reading Chinese Newspapers

	The Chinatown group		The Suburban group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	24	70.6	73	41.2	97	46.0
Occasionally	8	23.5	65	36.7	73	34.6
Rarely	1	2.9	21	11.9	22	10.4
Never	1	2.9	18	10.2	19	9.0
Total	34	100	177	100	211	100

χ^2=3.78 (recategorized) d.f.=1 Insignificant at .01 level

The two groups are not statistically different ($\chi^2 = 3.78$, d.f. = 1) in their frequencies of reading Chinese newspapers. However, when comparing the frequency distributions some notable differences between the two groups emerged. The Chinatown group read Chinese newspapers more frequently than the suburban group. More than ninety per cent (94.1%) of the Chinatown group reads Chinese newspapers "frequently" and "occasionally" whereas in the suburban group, although these two categories still consist of the majority (77.9%) of the respondents, quite a proportion (22.1%) "rarely" or "never" reads a Chinese newspaper. This difference is probably due to the fact that many people who live in Chinatown are unable to read English and they have to rely on the Chinese newspaper to get up to date information.

5.1.6 Frequency of Reading Chinese Books / Magazines

Table 5.7 shows that for the whole sample, the most frequently reported response in reading Chinese books/magazines is the category "occasionally". The category "frequently" (23.7%) and "rarely" (23.7%) ranked second equally. Compared with the frequency reading Chinese newspapers, the frequency reading Chinese books/magazines is generally lower. This may indicate that books/magazines are not as informative and important as newspapers in the lives of the Chinese in Edmonton. It may also indicate that the Chinese books/magazines are not as easily obtained as Chinese newspapers. There is no significant difference ($\chi^2 = 1.65$, d.f. = 1) between the two groups. However, the Chinatown group has a larger proportion (76.5%) in the combined categories "frequently" and "occasionally" than the suburban group (65.4%). The suburban group has a higher proportion in the "frequently" (25.4%) category. This may be due to the fact that the

suburban group has attained a higher educational level and enjoys reading more than the people who live in Chinatown.

Table 5.7 Respondents' Frequency of Reading Chinese Books / Magazines

	The Chinatown group		The suburban group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	5	14.7	45	25.4	50	23.7
Occasionally	21	61.8	67	37.9	88	41.7
Rarely	5	14.7	45	25.4	50	23.7
Never	3	8.8	20	11.3	23	10.9
Total	34	100	177	100	211	100

χ^2=1.65 (recategorized) d.f.=1 Insignificant at .01 level

5.1.7 Frequency of Listening to Chinese Radio

The role of Chinese radio is neither as important as Chinese newspapers in the Chinese community life nor as important as Chinese books/magazines. Table 5.8 shows that most of the respondents "rarely" listen to the Chinese radio broadcasts (34.1%), and only 18 percent listen "frequently". There is a statistically significant difference (χ^2 = 1.65 (recategorized), d.f. = 1) in the frequency of listening to Chinese radio between the two groups. The Chinatown group has quite a large proportion (73.6%) who listen to the Chinese radio "frequently" and "occasionally", while these two categories comprise less than half (36.8%) of the suburban group. The above different response rates again illustrates that due to their lack of English ability, the people who live in Chinatown rely more on the Chinese media for information than those who live outside Chinatown. On the other hand, the difference also illustrate that people who live in Chinatown have deeper Chinese roots

and are more interested in Chinese music and stories. In this sense, the Chinatown group has retained its cultural identity more so than the suburban group.

Table 5.8 Respondents' Frequency of Listening to Chinese Radio

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	11	32.4	27	15.4	38	18.2
Occasionally	14	41.2	38	21.7	52	24.9
Rarely	5	14.7	67	38.3	72	34.4
Never	4	11.8	43	24.6	47	22.5
Total	34	100	175	100	209	100

χ^2=13.92 (recategorized), d.f.=1 Significant at .01 level

5.1.8 Frequency of Watching Chinese TV

There is a national Chinese TV station in Canada broadcasting in Chinese everyday. Most programs are in Cantonese. The programs include news and entertainment programs. Table 5.9 shows the response pattern for the whole sample is distributed across all categories unlike the frequencies of reading Chinese newspapers and frequency of reading Chinese books/magazines. A majority (28.6 per cent) rarely watch Chinese TV. However, a slightly lower proportion (21.4 per cent) reported that they watch Chinese TV everyday. Combined with the category "frequently", the proportion of respondents in these two categories reaches 37.6 per cent, which is much larger than the proportion (23.7 per cent) which reads Chinese books/magazines or which listens frequently to the Chinese radio (18.2 per cent). This result shows that Chinese TV is more important in the lives of the Chinese than Chinese books/magazines and Chinese radio but is less important than Chinese newspapers.

The two groups are not significant different ($\chi^2 = 1.40$, d.f. = 1) in the frequency of watching Chinese TV. However, some differences can be noted between the two groups. The respondents in the Chinatown group have a much higher proportion (64.7 per cent) which watches Chinese TV "everyday" and "frequently" than does the suburban group (32.4 per cent). To the contrary, the suburban group has a higher proportion (42.1 per cent) in the combined category "rarely" and "never". These results reaffirm that people who live in Chinatown rely more on the Chinese media and consequently are less likely to relinquish their cultural heritage.

Table 5.9 Respondents' Frequency of Watching Chinese TV

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Everyday	12	35.3	33	18.8	45	21.4
Frequently	10	29.4	24	13.6	34	16.2
Occasionally	2	5.9	45	25.6	47	22.4
Rarely	5	14.7	55	31.3	60	28.6
Never	5	14.7	19	10.8	24	11.4
Total	34	100	176	100	210	100

χ^2=1.40 (recategorized) d.f.=1 Insignificant at .01 level

5.1.9 Frequency of Borrowing/Renting/Purchasing Chinese Videos

The frequency with which Chinese videos are borrowed/rented/purchased is presented in Table 5.10. "Rarely" (34.1 per cent) ranked as the major category for the whole sample. "Occasionally" (30.2 per cent) ranked second. The two groups are not significantly different ($\chi^2 = 4.13$, d.f. = 1). However, this is the first time the Chinatown group has a lower proportion in the combined categories "frequently" and "occasionally" than the suburban

group. No respondents, in the Chinatown group, fall into the "frequently" category. This result is most likely due to the fact that most videos available in the market are new movies and performances which are popular among young people. The old people whose tastes are generally in favor of traditional Chinese operas, are not interested in these videos even though they can afford VCRs. Rather than more "assimilated" than the suburban group, the people living in Chinatown simply lack an interest in Chinese videos. Instead they use other kinds of Chinese media more often than do the suburban group.

Table 5.10 Respondents' Frequency of Borrowing/Renting/Purchasing Chinese Videos

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	0	0	22	12.6	22	10.5
Occasionally	8	23.5	55	31.4	63	30.2
Rarely	11	32.4	61	34.9	72	34.4
Never	15	44.1	37	21.1	52	24.9
Total	34	100	175	100	209	100

χ^2=4.13 (recategorized) d.f.=1 Insignificant at .01 level

5.2 Connection with Homeland

One way to measure the immigrants' degree of assimilation is to examine their connection with their homeland. If the immigrants have close association through contacts with their homeland, it means that psychologically they still belong to the place where they came from and thus they have not been totally assimilated (Jiobu, 1988).

To examine their connection with the homeland, the respondents were asked if they still have relatives in their homeland, how often they contact them and how often they visit their homeland. The answers are provided in Table 5.11, 5.12 and 5.13.

Table 5.11 The Number of People Who Still Have Relatives in the Homeland

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Yes	34	100	148	85.1	182	87.5
No	0	0	26	14.9	26	12.5
Total	34	100	174	100	208	100

χ^2 test not applicable (25 per cent of cells with expected frequency less than 5 after recategorization).

Table 5.11 shows that 87.5 per cent of the total respondents still have relatives in their homeland. χ^2 test is not applicable for this variable. However, it is clear all of the Chinatown group have relatives in their homeland, whereas fewer, 85.1 per cent, of the suburban group do. Table 5.12 illustrates that the majority of the respondents (44.9 per cent) contacted their relatives "occasionally". The next major category is "frequently" (25.1 per cent). The frequency distributions for the two groups are quite similar and there is no statistically significant difference ($\chi^2 = 0.02$, d.f. = 1) between them.

Table 5.12 Respondents' Frequency of Contacts With Relatives

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	8	23.5	37	25.0	45	24.7
Occasionally	15	44.1	67	45.3	82	45.1
Rarely	6	17.6	33	22.3	39	21.4
Never	5	14.7	11	7.4	16	8.8
Total	34	100	148	100	182	100

χ^2=0.02 (recategorized) d.f.=1 Insignificant at .01 level

The majority of the respondents (48.8 per cent) reported they "rarely" visit their homeland (See Table 5.13). The next major category is "occasionally" (24.6 per cent), followed by "never" (22.3 per cent). Only a very small proportion (4.2 per cent) claim they visit their homeland "frequently". Again there is no statistically significant difference between the two groups ($\chi^2 = 0.00$, d.f. = 1). Those differences in their responses are greatest in the categories "rarely" and "never". The suburban group has a higher proportion (59.8 per cent) than the Chinatown group (38.2 per cent) in the category "rarely". However, the Chinatown group has a higher proportion (32.4 per cent) in the category "never" than the suburban group (20.3 per cent). Perhaps this is a reflection of the inability of the people living in Chinatown to afford the trip. Also it may be because most of the family members of the Chinatown group already live in Canada.

Table 5.13 Respondents' Frequency of Visiting Homeland

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	1	2.9	8	4.5	9	4.3
Occasionally	9	26.5	43	24.3	52	24.6
Rarely	13	38.2	90	50.9	103	48.8
Never	11	32.4	36	20.3	47	22.3
Total	34	100	177	100	211	100

χ^2=0.00 (recategorized) d.f.=1 Insignificant at .01 level

5.3 Maintenance of Ethnic Identity on the Secondary Level

Structural assimilation of the immigrants can be divided into two parts: assimilation on the secondary level and assimilation on the primary level (Gordon, 1964). Assimilation on the secondary level generally indicates assimilation in work related areas so that the ethnic group has the same occupational distribution and occupational independence as the host,i.e. not dependent on ethnic employers. Assimilation on the primary level indicates assimilation in informal social contacts. In this section, ethnic maintenance on the secondary level will be discussed. The occupational distribution of the Chinese along with that of Edmontonians was discussed in Chapter 2 using census data. The data shows that relative to the city population, the Chinese are over-represented in specialized areas such as technological and related fields and under-represented in managerial areas. The focus of this section is on the occupational independence of the Chinese. In other words, for whom do Chinese work, with whom do they work and if they work for themselves are their customers or clients mainly Chinese? The assumption here is that if a person of an ethnic group does not feel comfortable working for and with people of other ethnic groups, as a

result of discrimination or language barriers, the person will try to confine his/her work in his/her own group (Gills and Whitehead, 1972). As a consequence, ethnic identity will be strengthened.

The first question asked about the occupational independence of the respondents was whether they are self-employed or not. The answers to this question are provided in Table 5.14.

Table 5.14 Self-Employment Rate of the Respondents

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Self-employed	1	9.1	28	17.4	29	16.9
Not self-employed	10	90.9	133	82.6	143	83.1
Total	11	100.0	161	100.0	172	100.0

χ^2 test not applicable (25 per cent of cells with expected frequency less than 5 after recategorization).

For the whole sample, among those who are currently employed, 16.9 per cent of them are self-employed. This percentage is higher than the self-employment rate of 10 per cent for the Canadian labour force in 1991 (Statistics Canada, 1993). The result shows that the Chinese in Edmonton demonstrate to a certain degree occupational independence. The Chinatown group has a smaller proportion (9.1 per cent) of self-employed people than the suburban group. However, this does not suggest that the Chinatown group is more assimilated than the suburban group. First the sample size is too small. Second, this question alone cannot provide a single conclusion. Considering their relatively low educational level and income, the lower self-employment rate of the Chinatown group is

because of their inability to set up their own businesses. A conclusion can only be made in relation to other variables.

Among the 29 self-employed respondents, four of them owned restaurants, three operated real estate companies and three owned grocery stores. Other specified types of business or service include a medical clinic, building design, publishing, import/export, advertisement, herb store, automechanics, carpenter, clothing, drafting, cab driver and daycare.

The ethnic origin of the customers/clients of these self-employed respondents are presented in Table 5.15. Nearly 65 percent of the respondents' customers or clients are mainly non-Chinese. Slightly over ten percent of the respondents' customers or clients are mainly Chinese. The significance of these results will be discussed next when the ethnic origins of the customers/clients of the companies in which the respondents work are compared.

Table 5.15 Ethnic Origin of the Customers/Clients of the Self-employed Respondents

	Number	Percentage
Mainly Chinese	3	10.7
Chinese and Non-Chinese (each about equal)	7	25.0
Mainly Non-Chinese	18	64.3
Total	28	100.0

The ethnic origin of the employers, co-workers and customers/clients of the 143 respondents who are not self-employed are provided in Table 5.16, Table 5.17 and Table

5.18 respectively. Because of the small sample size, the χ^2 test was not used for these variables.

Table 5.16 Ethnic Origin of the Employers

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Chinese	3	30.0	10	7.7	13	9.1
Non-Chinese	7	70.0	123	92.3	130	90.9
Total	10	100.0	133	100.0	143	100.0

Table 5.17 Ethnic Origin of Coworkers

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Chinese	1	30.0	6	4.5	7	4.9
Non-Chinese	2	20.0	52	39.1	54	37.8
both	7	70.0	75	56.4	82	57.3
Total	10	100.0	133	100.0	143	100.0

Table 5.18 Ethnic Origin of the Customers

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Mainly Chinese	1	10.0	3	2.5	4	3.1
Chinese and Non-Chinese (about equal number)	1	10.0	10	8.2	11	8.4
Mainly Non-Chinese	8	80.0	108	89.3	116	88.5
Totalu	10	100.0	121	100.0	131	100.0

Table 5.16 shows that among the 143 respondents who are not self-employed, 9.1 per cent have Chinese employers while 90.9 per cent have non-Chinese employers. Thirty percent of the Chinatown group have Chinese employers in contrast to only 7.7 per cent for the suburban group. This result shows that the Chinatown employees are dependent on other Chinese for their employment.

Of the 143 respondents, seven people (4.9 per cent) reported that all of their coworkers are Chinese (Table 5.17). In fact, six out of the seven respondents also have Chinese employers. Thirty-eight per cent of the 143 respondents reported that the other employees of the company are non-Chinese and 57.3 per cent reported that the other employees include both Chinese and non-Chinese. Comparing the two groups, the Chinatown group has a higher percentage (10.0 per cent) in the "All Chinese" category than the suburban group (4.5 per cent), while the suburban group has a higher percentage of "non-Chinese" (39.1 per cent) than the Chinatown group (20.0 per cent). These results also indicate that the Chinatown group is more restricted to a Chinese work circle while the suburban group has been able to take advantage of wider opportunities.

Among the 131 respondents who answered the question about ethnic origin of the customers/clients, 8.4 per cent reported that Chinese and non-Chinese were about equal in number and 88.5 per cent reported the customers were mainly non-Chinese. The Chinatown group has a higher percentage in the categories "mainly Chinese" (10.0 per cent) and "Chinese and non-Chinese, about equally" (10.0 per cent) than the suburban group. The suburban group has a higher proportion in the category "mainly non-Chinese" (89.3 per cent) than the Chinatown group. These results are consistent with the facts that the Chinatown

group has a higher proportion of Chinese employers and co-workers. They also imply that the Chinatown group has a higher proportion working in Chinese-oriented types of businesses.

Using Table 5.15 and 5.18 the customers/clients' ethnic origin of the self-employed respondents and the companies in which the non-self-employed respondents work can be compared. Self-employed respondents have a higher proportion of customers/clients in the "mainly Chinese" (10.7 per cent) and "Chinese and non-Chinese" (25.0 per cent) categories. This is probably due to self-employed people attracting Chinese customers/clients because they are Chinese, even though their services are not necessarily Chinese oriented.

In summary, the total sample of Chinese in Edmonton are assimilated on the secondary level despite the fact that the Chinese have a higher self-employment rate than Canadians. Most employed people have found jobs with people of other groups. However, the Chinatown group are more confined to Chinese circle in work than the suburban group. This result indicate that the suburban group is more assimilated on the secondary level interaction than the Chinatown group.

5.4 Maintenance of Ethnic Identity in Primary Interactions

5.4.1 Organizational Participation

One widely recognized measure of social assimilation is organizational membership. If one group of immigrants has a higher proportion of its members attending organizations and associations of the host society than another, then it is argued that group has a higher

degree of social assimilation. Conversely, if a group has a higher proportion attending associations within the same ethnic circle than another, the former demonstrates a stronger ethnic identity.

To ascertain the degree to which respondents have retained their ethnic identity, they were asked if they belong to any voluntary Chinese organizations such as a clan (a kind of association of people with the same surnames), locality (a kind of association of people from same region), religious, political or entertainment associations. The results are provided in Table 5.19. Forty per cent of the total respondents belong to Chinese organizations. This result is slightly higher than the 35 per cent that are members in Chinese organizations in Toronto (Lai, 1972). However, it is lower than Korean immigrants in Chicago. Hurl *et al* 's (1978) research showed that 63.8 per cent of their respondents belong to Korean organizations.

There is a statistically significant difference ($\chi^2 = 33.91$, d.f. = 1) between the two groups' membership in Chinese organizations. The majority (87.9 per cent) of the Chinatown group belong to a Chinese organization. Only 31.6 per cent of the suburban group are members of a Chinese organization.

The high proportion of organizational membership of the Chinatown group may be due to three reasons. First the majority of the Chinatown group are old. Over 70 per cent of them are above 60 years. Hoyt and Babchuk's (1981) research showed the aged have a higher level of participation in ethnic voluntary associations because retired people have the opportunity to spend their leisure time in various associations. Second, the Chinatown

group's ability in English is poor. Over 50 per cent of them do not speak English at all. Therefore, they feel more comfortable with, and some of them can only socialize with, other Chinese. Third, the Chinatown group are fairly old on arrival in Canada. They have deep "roots" in their original culture. Besides, many of them may never really get involved in the Canadian society. Therefore, they are more interested in maintaining their previous way of life and prefer to communicate with people of their own group. The suburban group's lower proportion of organizational membership is an indicator of their assimilation. Wickberg (1982) stated that the post-1967 Chinese immigrants rarely joined the old type of Chinese organizations because such organizations did not fit their needs and interests. In addition, they may be busy with their jobs and their children so that they have little energy left for such activities. In either case, it shows that the suburban group may be more involved in Canadian society and its affairs rather than the Chinese way of life.

Table 5.19 Respondents' Membership of Chinese Organizations

	The Chinatown Group		The Suburban Group		Total Sample	
Membership	Number	Percentage	Number	Percentage	Number	Percentage
Yes	29	87.9	56	31.8	85	41.7
No	1	12.1	120	68.2	124	58.3
Total	30	100	176	100	209	100

χ^2=33.91 d.f.=1 Significant at .01 level

Mere membership in an organization does not provide sufficient information on the degree of involvement in organizational activities. The respondents who belong to Chinese associations were further asked about their frequency of participation in the associations' activities. It is expected that the suburban group may not be as active in Chinese

associations as those of the Chinatown group, since the former are busy doing other things such as spendir g most of the time with their children. However, Table 5.20 shows that the two groups have a similar distribution pattern in the frequency of participation. There is no statistically significant difference ($\chi^2 = 0.06$, d.f. = 1) between the two groups. Both groups have a majority who participate in their associations' activities "frequently". The categories "frequently" and "occasionally" together contain more than seventy percent of the respondents in each group. In fact, the suburban group has an even higher proportion in the categories "frequently" and "occasionally" than the Chinatown group. This is contrary to our assumption and illustrates that those association members who live outside Chinatown have the same degree of ethnic identity as their counterparts. It also illustrates that residential dispersal does not prevent people from attending the activities of the Chinese associations, most of which are located in Chinatown.

Table 5.20 Respondents' Frequency of Participation in the Chinese Organizations

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
Frequently	13	45.0	27	48.2	40	47.1
Occasionally	9	31.2	19	33.9	28	32.9
Rarely	6	20.2	8	14.3	14	16.5
Never	1	3.6	2	3.6	3	3.5
Total	29	100	56	100	85	100

χ^2=0.06 (recategorized) d.f.=1 Insignificant at .01 level

5.4.2 Presence of Close Friends

Closely related to organizational participation as a measure of social assimilation is the occurrence of close friends outside the ethnic group. An immigrant may be integrated

with the host society on a secondary level, such as in the work force, while at the same time solely interacting with friends of his/her own ethnic group---the primary level.

In the present study, the respondents were asked if their closest friends are all Chinese, mainly Chinese, each about equal, mainly non-Chinese or all non-Chinese. Table 5.21 shows that there is no statistically significant difference ($\chi^2 = 9.64$, d.f. = 2) between the two groups in their response to the question. However, if the frequency distributions are compared, the differences between the two groups are obvious. The frequency distribution of the Chinatown group is concentrated in the Chinese part of the scale. Nearly 70 percent of the respondents identify all of their friends as Chinese. Another 23.5 percent identify their friends as "mainly Chinese". Only 8.8 percent report they have Chinese friends and non-Chinese friends in about equal numbers. Furthermore, no respondents in this group identify their friends as "mainly non-Chinese" or "all non-Chinese". Compared with the Chinatown group, the responses of the suburban group are more evenly distributed. The categories "all non-Chinese" and "mainly non-Chinese" contain 4.5 per cent and 6.8 per cent respectively of the respondents in the suburban group. The category "each about equal" contains 27.3 per cent of the respondents compared to only 8.8 per cent for the Chinatown group. On the other hand, the category of "all Chinese" contains only 20.9 per cent of the suburban group compared to 67.6 per cent for the Chinatown group. However, on the whole, the frequency distribution of the suburban group is still weighted towards the Chinese part of the scale. The categories "mainly Chinese " and "all Chinese" together contain 65 per cent of the respondents.

Table 5.21 Respondents' Presence of Close Friends

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
All Non-Chinese	0	0	8	4.5	8	3.8
Mainly Non-Chinese	0	0	12	6.8	12	5.7
Each about equal	3	8.8	42	23.7	45	21.3
Mainly Chinese	8	23.5	78	44.1	86	40.8
All Chinese	23	67.6	37	20.9	60	28.4
Total	34	100	177	100	211	100

χ^2=9.64 (recategorized) d.f.=2 Insignificant at .01 level

The above differences between the two groups are not difficult to understand. The Chinatown group are mainly old, retired people who came to Canada in their old-age. They lack a knowledge of English. They do not work and consequently their social circle is mainly confined to the ethnic community. On the other hand, the majority of the suburban group use English "fluently" or "pretty well" (see Table 4.10). They work outside the ethnic community so that they have more opportunities to interact with people from other groups. Thus, they have more opportunities to make friends with people in other groups. In summary, the data above have shown that the suburban group is more assimilated in terms of informal social networks than the Chinatown group. However, the extent of the involvements is limited since the majority of the suburban group's closest friends are still Chinese.

5.4.3 Attitude Toward Canadians

As mentioned in Chapter 1, the social environment has an important impact on the immigrants' degree of assimilation. If the host society is hostile towards the immigrants,

then the immigrants are more likely to confine themselves to the ethnic community in order to avoid conflict and consequently ethnic identity is strengthened. Conversely, if the host society is friendly towards immigrants, the assimilation process is likely to accelerate. In this respect the respondents were asked how they feel about the statement "Canadians are generally friendly".

The respondents' attitudes are divided into five categories, ranked from "strongly agree" (1) to "strongly disagree" (5). The results are presented in Table 5.22. The mean score for the total sample is 2.1, showing that these immigrants feel Canadians are generally friendly. The means are 2.02 for the Chinatown group and 2.11 for the suburban group. This indicates the Chinatown group feels Canadians are more friendly than the suburban group does. At first sight, this result seems unreasonable. Since the Chinatown group has less interaction with members of other groups, they should have more prejudice towards Canadians. One plausible explanation seems to be that the people who live in Chinatown may not have experienced the same psychological deprivation as the suburban group. It is generally accepted that during the initial adjustment period after migration, immigrants' occupations may not be as prestigious as what they have been used to. Thus they may feel frustrated and this generates "hatred" towards the host society (Hurh *et al*, 1978). Most of the people who live in Chinatown do not work. They still live in the Chinese community and thus they do not feel threatened by discrimination. On the surface Canadians may be more polite towards the aged in everyday matters than people were in their home country. Therefore, the Chinatown group tends to feel the Canadians more friendly than does the suburban group.

Table 5.22 Respondents' Attitude Towards Canadians

	The Chinatown Group		The Suburban Group		Total Sample	
	Number	Percentage	Number	Percentage	Number	Percentage
1	9	26.5	44	24.9	53	24.9
2	16	47.1	76	42.9	92	42.9
3	8	23.5	52	29.4	60	29.4
4	1	2.9	3	1.7	4	1.7
5	0	0	2	1.1	2	1.1
Total	34	100	177	100	211	100

5.5 Discussion and Summary

The major objective of this chapter was to determine whether the suburban group maintained a lesser degree of ethnic identity than the Chinatown group. Four areas of ethnic maintenance were examined. They were: ethnic maintenance in cultural aspects, connection with the homeland, ethnic maintenance on the secondary level and ethnic maintenance in primary interactions. The results were too complicated to make a simple conclusion. Except for "ethnic maintenance on the secondary level" and the two variables "relatives in the homeland" and "contacts with them", χ^2 test were applied. There are no statistically significant differences in most of the variables. This result seems to suggest that the two groups have the same degree of ethnic identity, at least as far as these variables are concerned.

On the other hand, the two groups do have statistically significant differences in "language used to children", "frequency of eating western food", "membership of Chinese organizations" and "frequency of listening to Chinese radios". Further examination of the

frequency distributions of the t o groups on the above four variables showed that the suburban group are more assimilated than the Chinatown group. In addition, those variables in which there are no statistically significant differences between the two groups and in the variables where χ^2 tests were not applied, it was found that the responses of the Chinatown group are always more weighted toward the Chinese part of the scales than the suburban groups. The exception is their "attitudes towards Canadians". These results again suggest, although tentatively, that the suburban group has been prepared to adopt a variety of features of the Canadian culture.

The findings in this chapter also suggest that a strong ethnic identity persists among the Chinese immigrants no matter whether they live in an ethnic cluster or not. Both groups maintained Chinese life-styles although the degree of maintenance is stronger for the Chinatown group than the suburban group.

To summarize all the above findings of this chapter, both the Chinatown group and the suburban group maintained a high degree of ethnic identity. The suburban group were slightly less ethnically oriented and thus more assimilated than the Chinatown group. How does this conclusion say about the hypothesis that ethnic residential dispersal is associated with a diminution of ethnic identity? The result that both groups maintain a high degree of ethnic identity suggests, at least, that ethnic residential dispersal does not prevent people from maintaining their ethnic life-styles. This conclusion support Agócs' (1980) hypothesis that a viable ethnic community without neighborhood. People who live dispersed all over the city can still use ethnic languages, celebrate ethnic holidays, use ethnic media and interact with friends of their own group. In this respect, Driedger and Church's (1974)

argument that residential segregation is a necessary condition of institutional completeness and as a result a necessary condition to maintain a high degree of ethnic identity is not correct.

Second, the result that the suburban group is slightly less ethnically oriented than the Chinatown group suggests that there is some relationship between ethnic residential dispersal and assimilation although this relationship may not be as simple and direct as previous studies suggested. The results of Chapter 4 indicated that residential dispersal may be mainly caused by life-cycle stage factor which has nothing to do with assimilation. It is also because of their stages in the life-cycle that the suburban group are more "exposed" to the Canadian society. For example, they have to talk with the teachers about their children's school performance; they have to read Canadian newspapers in order to learn about the economic situation. All these will make the suburban group adopt the Canadian way of lives and in this process they become more assimilated without necessarily lose their own culture. In other words, residential dispersal will have some impact on the immigrants' assimilation. However, this impact is not a short-term and an obvious one, and it does not necessarily cause a diminution of ethnic identity.

In conclusion, both groups maintained a strong ethnic identity. The suburban group was slightly less ethnically oriented than the Chinatown group. These results indicate first, that ethnic residential dispersal does not prevent people from maintaining their ethnic identity and second, that the suburban group is more involved in Canadian society and thus has a greater potential to assimilate. Although only in four out of the 15 variables χ^2 tests showed the suburban group was significantly different from the Chinatown group, the people

living in the suburbs seem more prepared to move towards assimilation. How far, or to what extent, they will progress is not known from the analysis. However, one thing is certain, people living in the suburbs are more ready to adapt to the Canadian way of life. Their demographic profiles suggest they people have been "forced" to expose themselves to Canadian society. Opposed to this, the Chinatown group will stay much as they are now, as people living in Chinatown are old, without much involvement with the host society and with little knowledge of English.

Chapter 6. Conclusions

The major objective of the study was to examine the relationship between ethnic residential segregation/dispersal and the maintenance of ethnic identity. Specifically, the goal was to test whether ethnic residential dispersal is associated with a diminished ethnic identity. In order to achieve this purpose, a case study was conducted of the Chinese in Edmonton. The Chinese were divided into two groups - the Chinatown group which live clustered in the Chinatown area, and the suburban group which live in other parts of the city. If the assumption that ethnic residential dispersal is associated with a diminished ethnic identity is correct, the suburban group was expected to be less ethnically oriented than the Chinatown group. For a better understanding of this issue, how the two groups perceive the relative importance of some residential locational factors was examined first. This provided some insight into the reasons for residential differentiation within the ethnic group. Secondly, the socio-demographic profiles of the two groups were examined. These gave the extent to which they might maintain their ethnic identity and important insights into why they chose their present residential locations. The goal of the third section of the study was to establish the degree of ethnic identity maintained by each group. This was accomplished by examining ethnic maintenance in language, eating, entertainment, work related areas and the social network. The research findings are summarized below.

6.1 Summary of Findings

1. In general, both the life-cycle stage factor (indicated directly by dwelling space and indirectly by general accessibility to other parts of the city, pleasant neighborhood,

closeness to workplace and closeness to children's school) and socioeconomic status (indicated indirectly by ability to rent or pay off a mortgage) played very important roles in people's residential locational choices. The most important thing for both groups when they chose their present dwelling was to try to adjust their housing needs within their limited financial resources. The fact that first priority of the Chinatown group was the locational factor "general accessibility to the other parts of the city" and that the suburban group's second priority was "pleasant neighborhood" indicated that the two groups were in the different stages of the life-cycle. Because stage in the life-cycle played such important role in people's residential locational choices, spatial dispersal of an ethnic group as a measure of assimilation, is not sufficient. On the other hand, the Chinatown group had a tendency to seek ethnic propinquity while the suburban group did not. This result indicates that ethnic factor, closeness to friends and/or relatives, is an important reason for residential segregation.

2. Further examination of the two groups' socio-demographic characteristics in terms of life-cycle, socioeconomic status and assimilation status (specifically their abilities in English and Chinese) demonstrated that the Chinatown group are old, retired and have passed the child-rearing stage of the life-cycle. The suburban group are younger and in the child-bearing and child-rearing stages of the life-cycle. In addition, the suburban group was younger on arrival in Canada and had a substantial knowledge of English. In general, the Chinatown group was quite old on arrival in Canada and with hardly any knowledge of English. Their old age and difficulty with English are the major reasons why the Chinatown group sought ethnic propinquity.

Other socio-demographic findings showed the majority of respondents' spouses were Chinese. This will have a negative impact on the assimilation process. The average years resident in Canada for both groups was slightly under twenty years and the impact of length of residence on assimilation depends on whether the respondents are involved in the Canadian society or not. The suburban group was better educated and better off economically than the Chinatown group which suggests that the suburban group has a greater potential to be assimilated than the Chinatown group.

The socio-demographic profiles obtained for the Chinese in Edmonton, especially Chinese living in Chinatown, are similar to what Nann (1970) obtained for the Chinese in Vancouver in several ways. However, there are some differences between the two. Nann's study was conducted more than twenty years ago when post-1967 immigration had not been long in effect. Our data for the Chinatown group are biased towards the people who live in the Elders' Mansion. One of the prominent differences between the people living in Chinatown in Vancouver and those in the Edmonton's Chinatown is that in the former there are a lot more respondents under the age of 18 when they arrived in Canada despite the fact that both groups consist of high percentages of old people. This fact indicates that the old people in the Vancouver Chinatown are mainly remnants of the pre-1923 generation of the Chinese immigrants. The old people in the Edmonton Chinatown today arrived under the family classification after the Second World War. Another prominent difference is that the educational level of the people in Edmonton's Chinatown is a lot higher than those in the Vancouver Chinatown. This result shows that the educational level of the Chinese immigrants is increasing over time.

3. The Chinatown group and the suburban group did not have significant differences in most of the areas examined to establish the extent to which they had maintained their ethnic identity. These areas included: "language used to spouse", "whether celebrating Chinese holidays", "frequency of playing Chinese games", "frequency of reading Chinese newspaper", "frequency of reading Chinese books/magazines", "frequency of watching Chinese TV", "frequency of visiting homeland", "frequency of participating the activities of Chinese organizations" and "ethnic origin of close friends". On the other hand, the two groups do have statistically significant differences in "language used to children", "frequency of eating western food", "frequency of listening to Chinese radio" and "membership of Chinese organizations". Further examination of the frequency distributions of the two groups on these above four variables showed that the suburban group have adapted more Canadian ways than the Chinatown group. In addition, for those variables in which there were no statistically significant differences between the two groups and where χ^2 testing was not applied, it was found that the responses of the Chinatown group were always weighted more towards the Chinese part of the scale than the suburban group.

4. A strong ethnic identity persists among the Chinese immigrants in Edmonton no matter whether or not they live in an ethnic cluster. Ethnic identity is expressed as the tendency to cling to the Chinese ways of lives in language used at home, eating, entertainment and the social network. Both groups maintained the Chinese life-style although the Chinatown group has maintained its ethnic identity more than the suburban group. The high degree of institutional completeness of the Chinese in

Edmonton (especially their dispersed restaurants which serve a residentially dispersed people) and their racial and cultural distinctiveness, all promote the persistence of a strong Chinese ethnic identity.

5. The result that both the Chinatown group and the suburban group retained a high degree of ethnic identity indicated that ethnic residential dispersal does not prevent people from maintaining their ethnic life-styles. The result that the suburban group was slightly less ethnically oriented, and thus more assimilated, than the Chinatown group indicated that residentially dispersed people appear to be on the path towards assimilation. They are more "exposed" and involved in the Canadian society through force of circumstances. For instance, they have to pay bills and talk with teachers about their children's school performance. To what extent this assimilation will reach need longitudinal study and beyond the scope of the thesis. However it is certain that the suburban group has strong demographic potential to move on towards assimilation while the Chinatown group will stay much as they are now.

To summarize the whole thesis, the general goal of the present study was to examine the relationship between ethnic residential segregation and assimilation. The conception adopted in this thesis is not a causal relationship. Little attempt was made to determine whether assimilation is a cause or effect of ethnic residential segregation. Rather, the thesis focused on whether, and to what extent, ethnic residential segregation is associated with assimilation. The research findings summarized above showed that there is some relationship between the two in the sense that the suburban group is slightly less ethnically oriented than the Chinatown group. However, at the present stage we cannot determine

whether residential location is the cause of the suburban group's higher degree of assimilation. Perhaps residential location's effect on assimilation is superficial. As we also summarized above, the suburban group is very different from the Chinatown group in terms of their socio-demographic profiles. The suburban group, which consisted mainly of young and educated people from Hong Kong, has already been more westernized than the Chinatown group before they set foot in Canada and therefore its potential to assimilate was greater. The different socio-demographic characteristics of the two groups might be a more accurate way of explaining the different degree of assimilation than the impact of residential location. In addition our findings suggest that the socio-demographic characteristics of the two groups are responsible for the different residential locational choices. Because of the importance of the socio-demographic variables in this area of study, more detailed studies should be conducted on how the age, age upon arrival in the host society, education and knowledge of English affect people's residential locational choices and assimilation.

6.2 Limitations of the Study

The study was designed to compare ethnic maintenance of the two Chinese groups in Edmonton - the Chinatown group and the suburban group. Due to language barrier and financial restrictions, a snowball sampling method, a non-probability procedure, was used to sample the Chinatown group. Thus, data quality is reduced compared with probability sampling. The results have to be examined with a degree of caution and are suggestive only.

There are also some weaknesses in the questionnaire. A part of the study was to examine whether life-cycle stage has an impact on ethnic residential locational choices. Due to a serious concern about the length of the questionnaire, the variables indicating life-cycle stage directly or indirectly in the questionnaire included only "age and marriage status" of the respondents, "general accessibility to other parts of the city", "pleasant neighborhood", "closeness to workplace" and "closeness to children's school". Questions on "age of the children" which may have helped more fully understand the impact of the life-cycle stage on residential locational choices, were neglected.

The questions about maintenance of ethnic identity mainly included questions about ethnic life-styles and social interaction. Questions about attitudes towards ethnic norms, such as "a son should live with his parents even after he is married", were not asked. In future research, such questions about attitudes towards ethnic norms should be added. Assimilation not only includes changes in behavior but also includes changes in attitudes and ideology and this aspect, although difficult to isolate and measure, should be examined in some detail in future work on assimilation.

6.3 Suggestions for Future Research

In addition to the above shortcomings requiring further examination, the following issues are also worthy of future research.

1. The present study examined ethnic maintenance of the first generation Chinese immigrants and found a strong ethnic identity persists among these people. Whether

or not this will continue in subsequent generations and how ethnic identity is perpetuated to in second and third generation Chinese needs further study in the future. This will require longitudinal approaches which may be difficult to implement given the reluctance on the part of the Chinese to respond to this survey.

2. In the present study, the relationship between ethnic residential segregation/dispersal and maintenance of ethnic identity was examined. We drew the conclusion that ethnic residential dispersal does not necessarily prevent people from maintaining their ethnic identity. However, we do not know whether people living dispersed are more "assimilated" than the people living clustered in terms of "using English media", "attitudes towards western value system" and "social interaction with non-Chinese". "Assimilation" and "maintenance of ethnic identity" are like two sides of the same coin. Both are important for understanding theories of ethnic relations. Future research conducted on the Chinese "assimilation" pattern should endeavor to establish how the Chinese adopt to the majority culture while keeping their own culture and identity. This kind of research will provide a full knowledge of the general process of how immigrants adapt to the host society. The same type of study should also be conducted with other ethnic groups.

3. The findings of the present study raised the question that if ethnic residential dispersal does not necessarily cause people to loose their ethnic identity, why some groups, such as the Jews, choose to live highly clustered together in the suburbs in order to maintain their ethnic identity? Ethnic religion has been suggested tentatively as a factor for this voluntary type of suburban segregation (Driedger,

1989; Agócs, 1981). Further study should be undertaken to establish the factors that shape suburban ethnic residential patterns.

4. In Figure 2.3 we showed the presence of localized concentrations of Chinese households in several Edmonton peripheral suburbs, namely Millwoods and Castle Downs. The tendency towards spatial propinquity with friends/relatives was not found within this outer-suburban group. The same results were also found for South Asians in Edmonton (Khatun, 1984). The reasons for this peripheral concentration are not clear. From our findings it might tentatively be suggested that the "aspiration for a new house" is the reason for the peripheral concentration of Chinese immigrants. Research should be conducted in this area in the future.

Bibliography

Agócs, C. 1981. Ethnic Settlement in a Metropolitan Area: A Typology of Communities. *Ethnicity*, 8:127-48.

Alberta Municipal Affairs 1977. *The Hamlet of Sherwood Park: A Review of Alternative Forms of Government*. Edmonton, Alberta: Alberta Municipal Affairs, Special Projects and Policy Research.

Anderson, A. B. and Frideres, J. S. 1981. *Ethnicity in Canada: Theoretical Perspectives*. Toronto: Butterworths & Co Ltd.

Balakrishnan, T.R. 1982. Changing Patterns of Ethnic Residential Segregation in the Metropolitan Areas of Canada. *Canadian Review of Sociology and Anthropology*, 19:92-110.

-----1976. Ethnic Residential Segregation in the Metropolitan Areas of Canada. *Canadian Journal of Sociology*, 1:481-98.

Baureiss, G. 1987. Chinese Immigration, Chinese Stereotypes and Chinese Labour. *Canadian Ethnic Studies*, 19:15-34.

Becker, T. 1968. Patterns of Attitudinal Changes among Foreign Students. *American Journal of Sociology*, 73:431-42.

Berry, B. 1958. *Race and Ethnic Relations*. Boston: Houghton-Mifflin.

Berry, J.W., Kalin, R. and Taylor, D.M. 1977. *Multiculturalism and Ethnic Attitudes in Canada*. Ottawa: Minister of Supply and Services.

Bleda, S. E. 1979. Socioeconomic, Demographic and Cultural Bases of Ethnic Residential Segregation. *Ethnicity*, 6:147-67.

-----1978. Intergenerational Differences in Patterns and Bases of Ethnic Residential Dissimilarity. *Ethnicity*, 5:91-107.

Breton, R. 1964. Institutional Completeness of Ethnic Communities and the Personal Relations of Immigrants. *American Journal of Sociology*, 70:193-205.

Chan, A. B. 1983. *Gold Mountain*. Vancouver: New Star Books.

City of Edmonton 1978(a). *The Future of Chinatown, Downtown Plan Working Paper No.1*. Edmonton: Area Planning Section, Planning Department, City of Edmonton.

-----1978 (b). *Boyle Street and McCauley Plan: Planning Issues and Objectives Working Paper No.2*, Edmonton: Area Planning Section, Planning Department, City of Edmonton.

Cressey, P.F. 1938. Population Succession in Chicago 1898-1930. In Peach, C., editor, *Urban Social Segregation*, pages 87-95. New York: Longman Group Ltd.

Cuber, J.F. 1955. *Sociology: A Synopsis of Principles*. New York: Appleton-Century Crofts.

Darroch, A. G. and Marston, W. G. 1972. The Social Class Basis of Ethnic Residential Segregation: The Canadian Case. *American Journal of Sociology*, 77:491-50.

-----1969. Ethnic Differentiation: Ecological Aspects of a Multidimensional Concept. *International Migration Review*, 4:71-95.

Dashefsky, A., editor 1976. *Ethnic Identity in Society*. Chicago: Rand McNally.

Dixon, C and Leach, B. 1976. *Sampling Methods for Geographical Research*. London, U.K.: Concepts and Techniques in Modern Geography No.17. Institute of British Geographers.

Driedger, L. 1989. *The Ethnic Factor: Identity in Diversity*. Toronto: McGraw-Hill Ryerson Ltd.

-----1977. Toward a Perspective on Canadian Pluralism: Ethnic Identity in Winnipeg. *The Canadian Journal of Sociology*, 2:77-95.

-----1975. In Search of Cultural Identity Factors: A Comparison of Ethnic Minority Students in Manitoba. *Canadian Review of Sociology and Anthropology*, 12:150-62.

Driedger, L. and Church, G. 1974. Residential Segregation and Institutional Completeness: A Comparison of Ethnic Minorities. *Canadian Review of Sociology and Anthropology*, 11:30-52.

Driedger, L. and Peters, J. 1977. Identity and Social Distance: Towards Understanding Simmel's The Stranger'. *Canadian Review of Sociology and Anthropology*, 14:158-73.

Duncan O. and Duncan, B. 1955. A Methodological Analysis of Segregation Indices. *American Sociological Review*, 2:210-17.

Duncan, O.D. and Lieberson, S. 1959. Ethnic Segregation and Assimilation. In Peach, C., editor, *Urban Social Segregation*, pages 96-121. New York: Longman Group Ltd.

Economic Council of Canada 1991. *New Faces in the Crowd: Economic and Social Impacts of Immigration*. Ottawa: Minister of Supply and Services Canada.

Employment and Immigration Canada 1985-1991. *Immigration Statistics*. Ottawa: Immigration Canada.

-----1989. *Immigration to Canada, a Statistical Overview*. Ottawa: Employment and

Immigration Canada.

Etzioni, A. 1959. The Ghetto---A Re-Evaluation. *Social Forces*, 37:225-62.

Fairbairn, K. J. and Khatun H. 1989. Residential Segregation and the Intra-Urban Migration of South Asians in Edmonton. *Canadian Ethnic Studies*, 21:45-64.

Farley, R. 1970. The Changing Distribution of Negroes Within Metropolitan Areas: The Emergence of Black Suburbs. *The American Journal of Sociology*, 75:512-29.

Firey, W. 1945. Sentiment and Symbolism As Ecological Variables. *The American Sociological Review*, 10:140-48.

Fleras, A. and Elliott, J. L. 1992. *Multiculturalism in Canada.* Ontario: Nelson Canada.

Frideres, J.S.. 1978. British Canadian Attitudes Toward Minority Ethnic Groups in Canada. *Ethnicity*, 5:20-32.

Gahr, G.A. 1979. *Sherwood Park: Residents's Attitudes Toward a Dormitory Satellite of Edmonton*. Unpublished M.A. Thesis, Department of Geography, University of Alberta.

Gist, N. P. and Fava, S. F. 1974. *Urban Society*. New York: Thomasy,Crowell Company, Inc.

Glazer, N. and Moynihan D. P. 1963. *Beyond the Melting Pot*. Cambridge, Massachusettes: MIT press.

Glebe, G. 1986. Segregation and Intra-Urban Mobility of a High-Status Ethnic Group: The Case of the Japanese in Dusseldorf. *Ethnic and Racial Studies*, 9:461-83.

Golant, S. M. and Jacobsen, C. W. 1978. Factors Underlying the Decentralized Residential Locations of Chicago's Ethnic Population. *Ethnicity*, 5:379-97.

Gordon, M. M. 1964. *Assimilation in American Life*. New York: Oxford University Press.

Grimble, L.G. and Associates 1976. *St. Albert Area Transportation Study*. Edmonton, Alberta: L.G. Grimble and Associates Ltd.

Guest, A.M. and Weed, J.A.. 1976. Ethnic Residential Segregation: Patterns of Change. *American Journal of Sociology*, 81:1088-111.

Guy, R. F., Edgley, C.E., Arafat, I., and Allen, D.E. 1987. *Social Research Methods: Puzzles and Solutions*. Boston: Allyn and Bacon, Inc..

Hanowski, A., Hayward, E.E., Reed C, and Teather, E.C. 1962. *Housing for the Aged: An Exploratory Study of Needs and Preferences*. Unpublished Master's thesis, School of Social Work, University of British Columbia.

Henry, G. T. 1990. *Practical Sampling*. Newbury Park, California: Sage Publications, Inc..

Herberg, E. N.. 1989. *Ethnic Groups in Canada: Adaptions and Transitions*. Ontario: Nelson Canada.

Himmelfarb, H. S. 1980. Patterns of Assimilation-Identification Among American Jews. *Ethnicity*, 6:249-67.

Hoyt, D. R. and Babchuk, N. 1981. Ethnicity and the Voluntary Associations of the Aged. *Ethnicity*, 8:67-81.

Hurh, W. M., Kim, H. C. and Kim, K. C. 1978. *Assimilation Patterns of Immigrants in the United States: A Case Study of Korean Immigrants in the Chicago Area*. Chicago: University Press of America.

Isajiw, W. W. 1978. Olga in Wonderland: Ethnicity in a Technological Society. In Driedger,L., editor, *The Canadian Ethnic Mosaic*, pages 29-39. Toronto: McClelland & Stewart.

-----1970. Definitions of Ethnicity. In Goldstein, J.E. and Bienvenue,R. M.,editors, *Ethnicity and Ethnic Relations in Canada: A Book of Readings*, pages9-25. Toronto: Butterworth & Co. Ltd.

Jaret, C. 1979. Recent Patterns of Chicago Jewish Residential Mobility. *Ethnicity*, 5:235-48.

Jiobu, R. M. 1988. *Ethnicity and Assimilation: Blacks, Chinese, Filipinos, Japanese, Koreans, Mexicans, Vietnamese and Whites*. Alberny: State University of New York Press.

Johnson, G. E. 1992. Ethnic and Racial Communities in Canada and Problems of Adaption: Chinese Canadians in the Contemporary Period. *Ethnic Groups*, 9:151-74.

Kantrowitz, N. 1981. Ethnic Segregation: Social Reality and Academic Myth in Peach, C. and Smith, S., editors, *Ethnic Segregation in Cities*, pages 43-61. London: Croom Helm Ltd.

-----1973. *Ethnic and Racial Segregation in New York Metropolis*. New York: Praeger.

Khatun, H. 1984. *Intra-Urban Residential Migration of East Indian People in Edmonton*. Unpublished M.A. thesis. Department of Geography, University of Alberta.

Lai, D. C. 1988. *Chinatowns: Towns Within Cities in Canada*. Vancouver: University of British columbia Press.

Lai, V. 1972. The New Chinese Immigrants in Toronto. In Elliott, J. L., editor, *Immigrant Groups*, pages 120-40. Scarborough, Ontario: Prentice-Hall of Canada Ltd.

Ley, D. 1983. *A Social Geography of the City*. New York: Harper & Row, Publishers, Inc.

Li, Peter S. 1990. *Race and Ethnic Relations in Canada*. Toronto: Oxford University Press.

-----1988. *The Chinese in Canada*. Toronto: Oxford University Press.

-----1987. The Economic Cost of Racism to Chinese-Canadians. *Canadian Ethnic studies*, 19:102-13.

-----1980. Immigration Laws and Family Patterns: Some Demographic Changes Among Chinese Families in Canada, 1885-1971. *Canadian Ethnic studies*, 12:58-73.

Lieberson, S. 1963. *Ethnic Patterns in American Cities*. New York: The Free Press of Glencoe.

-----1961. The Impact of Residential Segregation on Ethnic Assimilation. *Social Forces*, 40:52-7.

McCracken, K.W.J. 1973. *Patterns of Intra-Urban Migration in edmonton and the Residential Relocation Process*. Unpublished Ph.D thesis, Department of Geography, University of Alberta.

Matwijiw, P. 1979. Ethnicity and Urban Residence: Winnipeg:1941-1971. *Canadian Geographer*, 23:45-61.

Michelson, W. 1976. *Man and His Urban Environment: A Sociological Approach with Revisions*. Reading, Massachusetts: Addison-Wesley Publishing Company.

Murguia, E. 1975. *Assimilation, Colonialism and the Mexican American People*. Austin: The University of Texas at Austin Press.

Nann, R. C. 1970. *Urban Renewal and Relocation of Chinese Community Families*. Ottawa: the Citizenship Branch, Department of the Secretary of State.

Newman, W. M. 1978. Theoretical Perspectives for the Analysis of Social Pluralism. In Driedger, L.,editor, *The Canadian Ethnic Mosaic*, pages 40-54. Toronto: McClelland & Stewart.

-----1973. *American Pluralism: A Study of Minority Groups and Social Theory*. New York: Harper and Row Inc.

Norusis, M.J. 1991. *The SPSS Guide to Data Analysis for SPSS/PC+* 2nd edition. Chicago: SPSS Inc.

O'Bryan, K.G., Reitz Jeffrey G. and Kuplowska O. 1976. *Non-Official Languages: A Study in Canadian Multiculturalism*. Ottawa: Department of the Secretary of State.

Park, R. E. and Burgess, E.W. 1921. *Introduction to the Science of Sociology*. New York: Greenwoodd Press, Publishers.

Porter, J. 1965. *The Vertical Mosaic*. Toronto: University of Toronto Press.

Powers, M. G. 1978. Ethnic Concentration and Socioeconomic Status in Metropolitan Areas. In *Ethnicity*, 5:266-73.

Richmond, A. H. 1967. *Post-War Immigrants in Canada*. Toronto: University of Toronto Press.

Rodriguez, C. 1975. A Cost-Benefit Analysis of Subjective Factors Affecting Assimilation: Puerto Ricans. *Ethnicity*, 2:66-80.

Rose A. 1956. *Sociology: The Study of Human Relations*. New York: Knopf.

Rose, H. M. 1981. The Black Professional and Residential Segregation in the American City. In Peach, C., editor, *Ethnic Segregation in Cities*, pages 127-47. London: Croom Helm Ltd.

Rossi, P. H. 1980. *Why Families Move*. Beverly Hills, California: Sage Publication Inc.

Rogers, J. 1980. Different Faces From the Same Boat. *Maclean's*, 93(43):52-3.

Spence J.T., Cotton, J.W., Underwood, B.J. and Duncan C.P. 1990. *Elementary Statistics*, 5th edition. Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Sorenson, A, Taeuber, K.E. and Jollingsworth, L.J. Jr. 1975. Indexes of Rural residential Segregation for 109 Cities in the United States, 1940-1970. *Sociological Focus*, 8:125-42.

Sprinthall, R.C. 1987. *Basic Statistical Analysis*, 2nd edition. Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Statistics Canada 1993. *The Daily*. Statistics Canada, Catalogue 11-001E. Tuesday, March 2, 1993.

------1991. *Census of Canada*. Catalogue 93-315. Ottawa: Minister of Supply and Services.

------1986. *Census of Canada*. Catalogue 95-107, 95-108, 93-154, CD-ROM. Ottawa: Minister of Supply and Services.

Taeuber, K. E. and Taeuber A. 1964. The Negro as an Immigrant Group in Peach, C., editor, *Urban Social Segregation*, pages 122-34. New York: Longman Group Ltd.

Tan, J. 1987. Chinese labour and the Reconstituted Social Order of British Columbia. *Canadian Ethnic Studies*, 19:68-88.

Thompson, R. H. 1979. Ethnicity Versus Class: An Analysis of Conflict in a North American Chinese Community. *Ethnicity*, 6:306-26.

Timms D. 1965. Quantitative Techniques in Urban Social Geography in Chorley, R. and Haggett, P., editors, *Frontiers in Geographical Teaching*, pages 239-65. London: Methuen.

Uyeki, E. 1980. Ethnic and Race Segregation, Cleveland, 1910-1970. *Ethnicity*, 7:390-403.

Ward, D. 1982. The Ethnic Ghetto in the United States: Past and Present. *Transaction, Institute of British Geographers*, 7:257-75.

Warner, W. L. and Srole, L. 1945. *The Social Systems of American Ethnic Groups*. New Haven: Yale University Press.

Waterman, S. and Kosmin, B.A. 1988. Residential Patterns and Processes: A Study of Jews in Three London Boroughs. *Transactions of the Institute of British Geographers*, 13:79-95.

Webber, M. 1963. Order in Diversity: Community without Proqinquity. In Wingo, L. editor, *Cities andd Space: The Future Uses of Urban Land*, pages 23-54. Baltimore, MD: Johns Hopkins Press.

Wickberg, E. editor 1982. *From China to Canada: A History of the Chinese Communities in Canada*. Toronto: McClelland & Stewart.

Yinger, J. M. 1981. Toward a theory of assimilation and dissimilation. *Ethnic and Racial Studies*, 4:249-64.

Appendix A Codebook of Variables Used for χ^2 Test in Data Analysis

Variable Name	Description of the Variable	Original Coding Scheme	Recoding Scheme
Agecome	How old were you when you arrived in Canada?	1=0-4 years 2=5-9 years 3=10-14 years 4=15-19 years 5=40-49 years 6=50-59 years 7=60-69 years 8=70 years and over	1=0-14 years 2=15-29 years 3=30-49 years 4=50 years and over
Agenow	How old are you now?	1=20-24 years 2=25-29 years 3=30-34 years 4=35-39 years 5=40-49 years 6=50-59 years 7=60-69 years 8=70 years and over	1=20-34 years 2=35-59 years 3=60 years and over
Attitucn	Please indicate your attitudes towards the statement "Canadians are generally friendly".	1=strongly agree 2=agree 3=somewhere in between 4=disagree 5=strongly disagree	1=strongly agree or agree 2=somewhere in in between 3=disagree or strongly disagree
Chholidn	Does your family celebrate any Chinese holidays?	1=yes 2=no	No Recoding
Chlisay	In which language(s) do the parents speak to the children in your family?	1=English only 2=English mainly 3=English and Chinese 4=Chinese mainly 5=Chinese only	1=English only or mainly 2=English and Chinese 3=Chinese mainly or only
Chmember	Are you a member of any voluntary Chinese organizations?	1=yes 2=no	No Recoding

Variable Name	Description of the Variable	Original Coding Scheme	Recoding Scheme
Chngame	Do you play any popular Chinese games?	1 = frequently 2 = occasionally 3 = rarely 4 = never	1 = frequently or occasionally 2 = rarely or never
Chnread	How well do you read Chinese?	1 = fluently 2 = pretty well 3 = enough to get by 4 = not at all	1 = fluently or pretty well 2 = enough to get by or not at all
Chnsay	How well do you speak Chinese?	1 = fluently 2 = pretty well 3 = enough to be understood by others 4 = not at all	1 = fluently or pretty well 2 = enough to be understood by others or not at all
Chnschol	How many years of Chinese schooling did you finish?	1 = none 2 = 1-5 years 3 = 6-10 years 4 = 11 years and over	1 = 0-5 years 2 = 6-10 years 3 = 11 years and over
Chnwrite	How well do you write Chinese?	1 = fluently 2 = pretty well 3 = enough to be understood by others 4 = not at all all	1 = fluently or pretty well 2 = enough to be understood by others or not at
Educnatn	Indicate your education status (no matter English or Chinese)	1 = completed university or college 2 = some university or college 3 = completed high school 4 = some high school 5 = elementary	1 = completed or some university or college 2 = completed or some high school 3 = elementary
Employ	Indicate your employment status	1 = employed 2 = unemployed 3 = retired	No Recoding

Variable Name	Description of the Variable	Original Coding Scheme	Recoding Scheme
Engread	How well do you read English?	1 = fluently 2 = pretty well 3 = enough to get by 4 = not at all	1 = fluently or pretty well 2 = enough to get by or not at all
Engsay	How well do you speak English?	1 = fluently 2 = pretty well 3 = enough to be understood by others 4 = not at all	1 = fluently or pretty well 2 = enough to be understood by others or not at all
Engschol	How many years of English schooling did you finish?	1 = none 2 = 1-5 years 3 = 6-10 years 4 = 11 years and over	1 = none 2 = 6-10 years 3 = 11 years and over
Engwrite	How well do write English?	1 = fluently 2 = pretty well 3 = enough to be understood by others 4 = not at all	1 = fluently or pretty well 2 = enough to be understood by others or not at all
Frebooks	How often do you read Chinese books/magazines?	1 = frequently 2 = occasionally 3 = rarely 4 = never	1 = frequently or occasionally 2 = rarely or never
Frepaper	How often do you read Chinese newspapers?	1 = frequently 2 = occasionally 3 = rarely 4 = never	1 = frequently or occasionally 2 = rarely or never
Freparti	How often do you participate in activities of your organizations?	1 = frequently 2 = occasionally 3 = rarely 4 = never	1 = frequently or occasionally 2 = rarely or never

Variable Name	Description of the Variable	Original Coding Scheme	Recoding Scheme
Freradio	How often do you listen to Chinese radio programs?	1 = frequently 2 = occasionally 3 = rarely 4 = never	1 = frequently or occasionally 2 = rarely or never
FreTV	How often do you watch Chinese TV programs?	1 = every day 2 = frequently 3 = occasionally 4 = rarely 5 = never	1 = everyday or frequently or occasionally 2 = rarely or never
Frevideo	How often do you borrow/ rent/purchase Chinese videos?	1 = frequently 2 = occasionally 3 = rarely 4 = never	1 = frequently or occasionally 2 = rarely or never
Frevisit	How often do you visit your homeland?	1 = frequently 2 = occasionally 3 = rarely 4 = never	1 = frequently or occasionally 2 = rarely or never
Friend	Are your closet friends (to whom you would like to tell your personal problems) Chinese or Nno-Chinese?	1 = all Non-Chinese 2 = mainly non-Chinese 3 = each about equal 4 = mainly Chinese 5 = all Chinese	1 = all or mainly Non-Chinese 2 = each about equal 3 = mainly or all Chinese
Income	Indicate the approximate income of your household (include all sources).	1 = under $10,000 2 = $10,000-24,999 3 = $25,000-49,999 4 = $50,000 and over	1 = under $10,000 2 = $10,000-$49,999 3 = $50,000 and over
Lenstay	How long have you been staying in Canada?	1 = 1-4 years 2 = 5-9 years 3 = 10-14 years 4 = 15-19 years 5 = 20-29 years 6 = 30 years and over	1 = 1-9 years 2 = 10-19 years 3 = 20 years and over

Variable Name	Description of the Variable	Original Coding Scheme	Recoding Scheme
Marriage	Indicate your marriage status.	1 = single 2 = married (including separared) 3 = divorced 4 = widowed	No Recoding
Relnhas	Do you still have relatives in either China or Hong Kong or both?	1 = yes 2 = no	No Recoding
Spousri	Is your spouse of Chinese origin?	1 = yes 2 = no 3 = mixture	No Recoding
Spousay	In which language(s) do you speak to your spouse?	1 = English only 2 = Englsih mainly 3 = English and Chinese 4 = Chinese mainly 5 = Chinese only	1 = English only or mainly 2 = English and Chinese 3 = Chinese mainly or only
Westfood	How often does your family eat western food at home?	1 = every meal 2 = once a day 3 = frequently 4 = occasionally 5 = rarely	1 = every meal or once a day or frequently 2 = occasionally or rarely

Appendix B. The Survey Questionnaire (English Version)

(ALL QUESTIONS TO BE ANSWERED BY THE MAJOR WAGE EARNER)

I. Questions About Your Daily Behavior And Social Life

The first group of questions in this section are about the language or languages you use daily. Please tick (✓) only ONE answer to each question.

1. How well do you speak Chinese?
   [ ] Fluently
   [ ] Pretty well
   [ ] Enough to be understood by others
   [ ] Not at all

2. How well do you read Chinese?
   [ ] Fluently
   [ ] Pretty well
   [ ] Enough to get by
   [ ] Not at all

3. How well do you write Chinese?
   [ ] Fluently
   [ ] Pretty well
   [ ] Enough to be understood by others
   [ ] Not at all

4. How well do you speak English?
   [ ] Fluently
   [ ] Pretty well
   [ ] Enough to be understood by others
   [ ] Not at all

5. How well do you read English?
   [ ] Fluently
   [ ] Pretty well
   [ ] Enough to get by
   [ ] Not at all

6. How well do you write English?
   [ ] Fluently
   [ ] Pretty well
   [ ] Enough to be understood by others
   [ ] Not at all

7. In which language(s) do you speak to your spouse? (If you do not have a spouse, please go to Question 9)

[ ] English only
[ ] English mainly
[ ] English and Chinese
[ ] Chinese mainly
[ ] Chinese only

8. In which language(s) do the parents speak to the children in your family? (If you do not have children, please go to Question 9)

[ ] English only
[ ] English mainly
[ ] English and Chinese
[ ] Chinese mainly
[ ] Chinese only

9. How many years of Chinese schooling did you finish? Please specify number of years.

_____year(s)

10. How many years of English schooling did you finish? Please specify number of years. (Note: Please do not include those years in which English was taught as a foreign language.)

_____year(s)

Now I would like you to answer a couple of questions about the food you eat and the stores you use.

11. How often does your family eat Western food at home?

[ ] Every meal
[ ] Once a day
[ ] Frequently
[ ] Occasionally
[ ] Rarely

12. Where does your family buy Chinese food and groceries? (Note: for this questionnaire, Chinatown is defined as the block area bounded by 97 Street on the west, 95 Street on the east, Jasper Avenue to the south, and 107 Avenue to the north).

[ ] In Chinatown only
[ ] In Chinatown mainly
[ ] Equally in Chinatown or outside Chinatown
[ ] Outside Chinatown mainly
[ ] Outside Chinatown only
[ ] Never

Questions 13---17 deal with your participation in the Chinese community and your connections with your homeland.

13. Does your family celebrate any Chinese holidays (such as Chinese New Year) in any form (such as going out for dinner or Karaoke, inviting friends home, making big feasts, taking part in the activities organized by various Chinese organizations)?

[ ] Yes [ ] No

14. Do you play any popular Chinese games (such as Mahjong)?
[ ] Frequently
[ ] Occasionally
[ ] Rarely
[ ] Never

15. Are you a member of any voluntary Chinese organizations (such as clan, locality, religious, political or entertainment associations)?
[ ] Yes [ ] No (Please go to Question 16)
|
└——— How often do you participate in activities of your organization(s)?
[ ] Frequently
[ ] Occasionally
[ ] Rarely
[ ] Never

16. Do you still have relatives in either China or Hong Kong or both?
[ ] Yes [ ] No (Please go to Question 17)
|
└——— How often are you in contact with them?
[ ] Frequently
[ ] Occasionally
[ ] Rarely
[ ] Never

17. How often do you visit China or Hong Kong?
[ ] More than once a year
[ ] Once a year
[ ] Occasionally
[ ] Rarely
[ ] Never

Questions 18---22 deal with your use of the Chinese media in Edmonton.

18. How often do you read Chinese language newspapers?
[ ] Frequently
[ ] Occasionally
[ ] Rarely
[ ] Never

19. How often do you read Chinese language magazines/books?
- [ ] Frequently
- [ ] Occasionally
- [ ] Rarely
- [ ] Never

20. Do you listen to any Chinese radio programs?
- [ ] Frequently
- [ ] Occasionally
- [ ] Rarely
- [ ] Never

21. Do you watch Chinese language programs on TV?
- [ ] Everyday
- [ ] Frequently
- [ ] Occasionally
- [ ] Rarely
- [ ] Never

22. Do you borrow/rent/purchase any Chinese language videos?
- [ ] Frequently
- [ ] Occasionally
- [ ] Rarely
- [ ] Never

Questions 23---24 ask you about your social participation.

23. Are your closest friends (to whom you would like to tell your personal problems) Chinese or Non-Chinese?
- [ ] Non-Chinese
- [ ] Mainly non-Chinese
- [ ] Each about equal numbers
- [ ] Mainly Chinese
- [ ] All Chinese

24. Please indicate (∨) the space which corresponds to your attitude towards the statement "Canadians are generally friendly".

strongly agree						strongly disagree

Questions 25--27 are about your Employment.

25. Your employment status is
- [ ] Employed (Please go to the next question)
- [ ] Unemployed (Please go to
- [ ] Retired Section II---Questions About Residence)

26. Are you self-employed?
[ ] Yes
[ ] No

26(a). Customers of you or your company are
[ ] Mainly Chinese
[ ] Chinese & Non-Chinese (each about equal)
[ ] Mainly Non-Chinese

26(b). What kind of business do you provide? Please specify.

26(c). Owner of your company or your employer is
[ ] Chinese
[ ] Non-Chinese

26(d). Other employees are
[ ] Chinese
[ ] Non-Chinese
[ ] Both

26(e). Customers of your company are (if applicable)
[ ] Mainly Chinese
[ ] Chinese & Non-Chinese (each about equal)
[ ] Mainly Non-Chinese

27. The location of your employment is (Please give the intersection of the avenue/street nearest to where you work).
_____Avenue/_____Street

II. Questions About Residence

1. How many times have you changed your address in Edmonton?
[ ] Once
[ ] Twice
[ ] Three times
[ ] More than three times

2. Please give details about your present and your last two dwelling places in Edmonton (Start with the present one)

	Area	Type* (H/A/C/T/O)	Tenure (owned/rented)
Present	___ave/___st		
Previous	___ave/___st		
The One before Previous one	___ave/___st		

* H = Single Detached Home
A = Apartment
C = Condominium
T = Townhouse
O = Others

3. There are a number of factors which determine why you live in the place where you live now. How important are each of the following to you (Circle one number for each factor).

	Of Great Importance		Of Some Importance		Of No Importance
It has enough living space	1	2	3	4	5
We can afford the rent/mortgage	1	2	3	4	5
It has easy access to other parts of the city	1	2	3	4	5
It is close to work	1	2	3	4	5
It is close to the children's school	1	2	3	4	5
It is near friends and/or relatives	1	2	3	4	5
It is in a pleasant neighborhood	1	2	3	4	5
Other(s). Please specify_____					

III. Personal Information

1. How old were you when you arrived in Canada? Please specify.

_____years of age

2. How old are you now? Please specify.

_____years of age

3. Which country did you last reside in before coming to Canada? Please specify.

Country_____

4. Your immigration status is
[ ] Permanent Resident
[ ] Citizen
[ ] Other

5. What is your sex?
[ ] Male [ ] Female

6. Marriage status
[ ] Single [ ] Married [ ] Divorced
[ ] Widowed

7. Is your spouse of Chinese origin? (If you do not have a spouse, Please go to Question 8).
[ ] Yes [ ] No [ ] Mixture

8. Number of children you have
[ ] none [ ] 1 [ ] 2
[ ] 3 [ ] 4 and over

9. Your education status (No matter whether English or Chinese)
[ ] Completed University or College
[ ] Some University or College
[ ] Completed high school
[ ] Some high school
[ ] Elementary

10.The approximate income of your household (Please include all sources)
[ ] Under $10,000
[ ] $10,000--24,999
[ ] $25,000--49,999
[ ] $50,000 and over

Many thanks for your help!
Remember, do not sign your name.

Appendix A The Survey Questionnaire (Chinese Version)

(請家庭中的主要收入者回答所有問題)

1. 有關日常生活及社會生活的問題

第一組問題是有關語言基礎及語言使用。每個問題祇有唯一答案，請對該答案打勾(√)。

1 您說中文的程度如何？
[ ]很流利
[ ]相當不錯
[ ]能被別人聽懂和理解
[ ]一點不會說

2 您讀中文的程度如何？
[ ]很流利
[ ]相當不錯
[ ]能基本理解大意
[ ]一點不會讀

3 您寫中文的程度如何？
[ ]很流利
[ ]相當不錯
[ ]能被別人讀懂和理解
[ ]一點不會寫

4 您說英文的程度如何？
[ ]很流利
[ ]相當不錯
[ ]能被別人聽懂和理解
[ ]一點不會說

5 您讀英文的程度如何？
[ ]很流利
[ ]相當不錯
[ ]能基本理解大意
[ ]一點不會讀

6 您寫英文的程度如何？
[ ]很流利
[ ]相當不錯
[ ]能被別人讀懂和理解
[ ]一點不會寫

7 您同配偶用哪種語言交談？（如果您無配偶，請轉到第九題）
[ ]祇用英文
[ ]主要用英文
[ ]英文同中文有差不多使用機會
[ ]主要用中文
[ ]祇用中文

8 您同子女用哪種語言交談？（如果您無子女，請轉到第九題）
[ ]祇用英文
[ ]主要用英文
[ ]英文同中文有差不多使用機會
[ ]主要用中文
[ ]祇用中文

9 您上過多少年中文學校？ 請指明年數。
_____ 年

10 您上過多少年英文學校？ 請指明年數。
_____ 年

現在請您回答一組有關飲食及購物習慣的問題。

11 您家多長時間喫一次西餐？
[ ]每餐都是西餐
[ ]每天有一頓是西餐
[ ]經常喫
[ ]偶爾喫一下
[ ]很少或從不喫西餐

12 您家通常在哪里采購中國食品及雜貨？
（中國城在本文中被定義爲東至95街，西至97街，南至Jasper街，北至107街間的地區）
[ ]祇在中國城
[ ]主要在中國城
[ ]在中國城內及城市其它地區采購的機會差不多
[ ]主要在中國城以外的地區
[ ]從不采購中國食品及雜貨

問題13至17是有關您參加中國社區活動及與家鄉聯系的情況。

13 您的家庭是否以任何形式（比如外出赴宴或去卡拉ok，邀請朋友來家，做豐盛的晚餐，參加中國組織的活動等）來慶祝一些中國節日（比如農曆新年，元宵節，中秋節等）
[ ]是的 [ ]不是

14您參加任何中國式的娛樂活動嗎（比如說麻將）？
[ ]很經常
[ ]有時
[ ]很少
[ ]從不

15您是否是一些自發性的中國社團或組織的成員？（比如同鄉會，宗親會，教會及娛樂組織等）
[ ]是的　　[ ]不是

您多長時間參加一次您所在社團或組織的活動？
[ ]很經常
[ ]有時
[ ]很少
[ ]從不

16您是否還有親戚在中國或香港？
[ ]是的　　[ ]沒有（請轉到第十七題）

您多長時間與他們聯系一次？
[ ]很經常
[ ]有時
[ ]很少
[ ]從不

17您多長時間訪問一次中國或香港？
[ ]一年兩次或兩次以上
[ ]一年一次
[ ]很經常
[ ]有時
[ ]很少
[ ]從不

問題18至22是有關您使用中文傳播媒介的問題。

18您多長時間閱讀一次中文報紙？
[ ]很經常
[ ]有時
[ ]很少
[ ]從不

19您多長時間閱讀一次中文雜志書刊？
[ ]很經常
[ ]有時
[ ]很少
[ ]從不

２０您收聽任何中文廣播嗎？
〔〕很經常
〔〕有時
〔〕極少
〔〕從不

２１您收看電視上的中文節目嗎？
〔〕每天
〔〕很經常
〔〕有時
〔〕極少
〔〕從不

２２您是否借／租／購買一些中文錄像帶？
〔〕很經常
〔〕有時
〔〕極少
〔〕從不

問題２３至２４是有關您的社交活動及傾嚮。

２３您最親近的朋友（您愿嚮其傾訴私人生活中的問題的朋友）是中國人還是外國人？
〔〕全部是非中國人
〔〕主要是非中國人
〔〕中國人和非中國人的數量差不多
〔〕主要是中國人
〔〕全部是中國人

２４請在下面這個尺度的空間上把您對“加拿大人總體來講很友好”這句話的態度打勾（√）。

強烈同意 ☐☐☐☐☐ 強烈不同意

問題２５至２７是有關您的工作的情況。

２５您的工作的情況是
〔〕工作
〔〕失業　（請轉到下一個部分－－有關居住的問題）
〔〕退休

26您是自己開業嗎？
〔 〕是的　　〔 〕不是

26(A) 您的顧客或您公司的顧客來源
〔 〕主要爲中國人
〔 〕中國人和非中國人差不多數量
〔 〕主要爲非中國人

26(B) 您主要做什么生意或提供什么服務？ 請指明。

26(C) 您的僱主或公司老板是
〔 〕中國人
〔 〕非中國人

26(D) 公司的其他僱員是
〔 〕中國人
〔 〕非中國人
〔 〕中國人和非中國人都

26(E)公司的顧客來源是（如果您是在公司工作的話）
〔 〕主要是中國人
〔 〕中國人和非中國人差不多
〔 〕主要是非中國人

27請指明距您工作地點最近的交叉路口

_____街(ST) _____道(Ave)

II 有關居住的問題

1 您在埃德蒙頓共換過幾次住址？
〔 〕從未換過
〔 〕一次
〔 〕兩次
〔 〕三次
〔 〕四次以上（包括四次）

2 請給出您在埃德蒙頓現在和上兩個住所的情況（從現在的開始）

	地區 (__St__Ave)	類型* (H/A/C/T/O)	房屋占有權情況 (擁有／租借)
現在	___街___道		
上一個	___街___道		
再上一個	___街___道		

* H=獨立式房屋 (Single Detached House)
A=公寓 (俗文，Apartment)
C=標準單元 (Condominium)
T=復式房屋 (Townhouse)
O=其它

3 有相當一些原因決定了您住在現在所住的地方。下面的每一個原因對您的重要程度如何？ （請在您所選擇的數碼上劃圈）

	很重要		比較重要		不重要
現在的居所有足够的空間	1	2	3	4	5
現在的居所的房租或房屋抵押在短期承受能力之內	1	2	3	4	5
從現在的居所去城市其它地方交通方便	1	2	3	4	5
現在的居所離上班的地方近	1	2	3	4	5
現在的居所離孩子的學校近	1	2	3	4	5
現在的居所離朋友或親戚的住處近	1	2	3	4	5
現在的居所在一個環境良好的居住區內	1	2	3	4	5

其它，請指出。_____

III 有關個人的情況

1 請指明您來加拿大時的年齡

_____歲

2 請指明您現在的年齡

_____歲

3 請指明您來加拿大前的最後一個永久居住的國家

_____

4 您的移民狀況
[ ] 永久居住
[ ] 加拿大公民
[ ] 其它

5 您的性別是
[ ] 男　　[ ] 女

6您的婚姻狀況
[ ]未婚
[ ]已婚
[ ]離婚
[ ]喪偶

7您的配偶是（如您無配偶，請轉到第八題）
[ ]中國血統
[ ]非中國人血統
[ ]混血兒

8您有多少個孩子？
[ ]沒有孩子
[ ]一個
[ ]兩個
[ ]三個
[ ]四個或四個以上

9您受教育的情況（無論是中文或英文）
[ ]完成了大學或學院教育
[ ]受過一些大學或學院教育
[ ]完成了高中教育
[ ]上過一些高中
[ ]受過初等教育

10您的家庭收入情況（請包括所有來源）
[ ]$10,000以下
[ ]$10,000--$24,999
[ ]$25,000-$49,999
[ ]$50,000以上

多謝您的合作！請您不要簽名！

Appendix D. The Covering Letter

May 1992

Dear Sir or Madam,

I am a graduate student studying Geography at the University of Alberta. As part of my graduate research, I am conducting a survey into the social and economic differences of the Chinese at different locations in Edmonton. The general purpose of this research is to find out if people living in different parts of the city behave differently and whether this has anything to do with the extent they have maintained the Chinese culture in adapting to the host society. So far very little is known about these issues and your information will be very important in helping understand them.

The information you give is fully confidential. No government agency is involved and the results will be reported in such a way that individual respondents can never be identified.

Please let the major wage earner in your family fill out the questionnaire. If you require further information regarding the questionnaire, please do not hesitate to contact me at 432-0951 or 492-5626. You can also contact my supervisor Dr.Fairbairn at 492-0343.

Thank you very much for your participation.

Sincerely,

Jane-Qing Fang