A STRUCTURED CONCEPTUALIZATION APPROACH TO SURVEY DESIGN

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Concept mapping is a structured conceptualization method where a set of diverse stakeholders may develop a conceptual model or map that can be used for a variety of strategic planning and evaluation purposes. This dissertation illustrates a novel approach using concept mapping to develop a survey instrument with improved participant collaboration, questionnaire wording and order as opposed to traditional best practices of survey design. Typically, the content and structure of a survey instrument represents the ideas of one or two primary investigators charged with its design and perhaps formed with committee input. In this case, concept mapping provides a structured and efficient process to form a set of statements from a diverse group of participants which become the raw material for survey questions. The clustering of statements via the multidimensional scaling and hierarchical cluster analysis of the concept mapping routine provides order to the survey sections based upon the cognitive proximity between clusters. In this dissertation two survey instruments were developed from the proposed method. The first project entailed the development of a 47 question survey instrument to evaluate Home Energy Use in Central New York for the New York State Energy Research and Development Authority (NYSERDA). The second project was the design of a 14 question survey instrument to aid the

development of a municipal comprehensive plan. Both surveys were implemented successfully with the proposed method avoiding many of the issues of poor design, low response and missing information that frequently hamper such efforts. A structured conceptualization approach to survey design potentially provides a more systematic repeatable method for the design of survey instruments in further contribution to a general theory of survey design.

BIOGRAPHICAL SKETCH

David Filiberto was born on Long Island, New York and is very much a product of the 1970's and 80's era he grew up in. Raised by his mother Patricia, he developed an appreciation for independence and scientific inquiry at an early age, entering and winning many a science fair competition with her support. David first made his acquaintance with Cornell University when his best friend and childhood neighbor Robert Guazzo was admitted. David followed suit after transferring form Boston College and an association as important as any was formed. Earning a Bachelor's in 1993 was only a beginning. After a stint on Wall Street during the 'dotcom' period, David met a woman that transformed his character and continues to inspire him to ever greater heights. Heather and David came to Ithaca in August of 2001, where he pursued a Masters of Public Administration in the CIPA program and she contributed her professional planning expertise to the Tompkins County Planning Department. David continued on with the doctoral program in Policy Analysis and Management where he met his mentor and friend Professor William Trochim, Chair of his special committee. David and Heather were married in Sage Chapel in 2003 and by 2005 received the greatest gift life can offer, a little girl named Olivia. David has been active in the community serving as a Trustee for the Village of Trumansburg where he and his family live. He looks forward to the next chapter wherever that may be and however it may be written.

To the loves of my life, Heather my inspiration and Olivia who has been at my side (or on my lap) from page one

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Many thanks must first go to my special committee, who without their support this dream might not have been realized. Bill Trochim has been here from the beginning of this audacious undertaking. Coaching, supporting, listening and teaching not only on the topic of this dissertation but providing an example of a man that succeeds at any endeavor all the while having a good time. I thank you Bill for being a Chair and mentor in everyway. The second member of my special committee, Jerry Ziegler has a love for his students that I have seen in no other. Jerry always goes the extra mile providing support when and where it is most crucial. Without Jerry, I would never have been admitted to the program. You are a wise and trusted counselor that I know everyone of your students take away a graciousness they can never repay. Finally, David Pimentel provided the inspiration to pursue this Ph.D. He is recognized as one of Cornell's treasures, tirelessly working for the environment since the beginning of the movement. After taking his class I knew I wished to stay at Cornell to learn and work with him. I only hope I can spread his lessons and contribute in my small way to protecting this fragile planet. If I had to do it all over again I would not have been able to (nor desired) to gather such an inspiring well rounded special committee. Thank you all, now and forever.

I also must mention the support and care of Geysa Smiljanic, Judy Metzgar, Cheryl Miller and Tom O'Toole in PAM and CIPA respectively. They have been behind the scenes from the beginning. Lastly, many thanks go to David Lewis and the late Arch Dotson of CIPA. They welcomed me back to Cornell and provided that initial encouragement to get the ball rolling.

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CHAPTER 1

Introduction and Framing

Introduction

The quest for a more systematic method of developing a survey instrument has been a desirable endeavor in survey research for several decades. Many primary data gathering activities in the social sciences begin with a survey as the instrument to fulfill the need. A researcher is often faced with a problem of what questions to ask and in which format to phrase, present and order them when attempting to acquire this data. Survey or questionnaire development has a voluminous literature devoted to the instrument design. Yet current scholarship lacks a systematic and orderly method where ideas that inspire the organization of the survey become the complete and ordered questions within the survey instrument. A structured conceptualization approach to survey instrument design is put forward as a potential improved method for a more collaborative, more successfully written and ordered end survey product. This dissertation critically discusses the current methods of survey question writing and ordering, provides a specific outline of the proposed method and demonstrates the method by completing two independent survey instruments. Background for the impetus of the method along with two surveys is provided in this introduction.

Statement of the Problem

The history of survey instrument design has established best practiced rules and methods to author a good survey. A good survey is one that is reliable, valid and avoids bias. Many of these best practices are undisputed in this dissertation. However, one area of scholarship concerning survey design, the writing and ordering of good questions, is fraught with arbitrary rules developed from the fields of linguistics and psychology. The scholarship lacks a systematic method that may be employed to potentially enhance these tasks while also bringing an alternative improved method to the overall design of a good survey instrument.

A survey instrument is also often designed by the principal investigator(s) or a collaborative group that proceeds to offer a multitude of ideas for content which ultimately formulates a survey's questions and structure. This format often lacks a formal organizational method and is fraught with difficulties from group interactions. Transparency suffers where the finished product is potentially a narrow extension of the principal investigator's ideas. Formally in a group process collaboration often leads to consensus surrounding a minority of voices due to various psychosocial processes at play (Pagliari et al 2001). Many times organizations and principal investigators typically delegate key decisions to groups, subcommittees or several junior researchers because they are often able to pool their intellectual resources and make better decisions in a group setting. A primary benefit of group interaction is the shared knowledge and information that may be gained from disparate individuals working together on a group task. Furthermore, group problem solving leads to greater acceptance of a solution due to the heightened participation and better comprehension of the decision when

realized (Maier 1967). Maier (1967) has also observed that a critical factor in a group's potential lies with how well it is organized and integrated. Yet a group member's status may negatively affect this purposeful interaction. Status may be signaled through social cues that group members exhibit along with physical cues such as a person's body language, facial expressions or tone of voice which can be strong indicators of status that affect the overall survey design process. Where a person sits at a conference table, what they dress or wear, or their gender can also influence others perceptions of his or her status (Patterson 1983). Groups designed to be egalitarian also have a disadvantage in that minority opinions often have little influence on the final solution (Maier and Solem 1952). When groups are confronted with a problem to solve, individuals develop their own personal solutions. These alternatives manifest themselves as a desirable preference by the individuals that usually produced them. Typically a discussion ensues to convert those with more neutral viewpoints. Unfortunately, gaining the winning position by an individual or subgroup does not always correspond to a quality solution and hence a quality survey. When a survey instrument is designed by more than one individual, the process potentially faces these undesirable traits of group collaboration.

Since, group interactions can be fraught with difficulties and liabilities brought about by interpersonal influences, such as differences in the social status of group members, individual domination, the variety of individual ideas, and winning of an argument by specific members, a method which assists in eliminating these harmful processes is advantageous. A method that also concurrently provides a more systematic method of question writing and ordering within the survey by the authors is more valuable than potentially

solving just one of these problems. The Structured conceptualization approach toward survey design presented in this dissertation attempts to do just that.

Research question, potential threats and design

Designing a survey instrument utilizing a structured conceptualization method has the potential to develop a survey instrument with greater collaboration and buy-in than traditional best practices of survey design. A structured conceptualization can help a survey design team describe their ideas into survey questions and much more. Concept mapping[1] is a structured conceptualization that generally allows groups to develop and detail their ideas for research. It is used extensively in the program planning and evaluation discipline. However, concept mapping is more than a methodology for program planning and evaluation. Some believe it is a principal method of a social movement that is directing researchers away from top down thinking, from a command and control environment towards an inclusive, multi-stakeholder approach to solving problems (Gallagher 2002).

The purpose of this dissertation then is to answer the research question *can the structured conceptualization process improve survey content development, design and framework from standard best practices within a group format?* The author puts forward that a structured conceptualization approach to survey design further improves survey composition and structure, reducing negative group interactions. This alternative approach may be measured and observed in a variety of ways. For instance, the design of this

[1] Throughout this document the term 'Concept Mapping' is referred to as the method developed by Professor William Trochim, Ph.D., Professor of Policy Analysis and Management at Cornell University unless otherwise stated (Trochim 1989a; 1989b; Trochim and Linton 1986).

study will focus on describing observed improvements of the alternative method over the standard method. It will compare the effectiveness of the proposed method having the same objective of the standard method(s), yet will utilize a similar set of outcome measures in describing any successful survey. No direct causal relationship between the two methods is sought per se to test a potential improvement, although it may be argued that the specific differences in a structured conceptualization design are the cause of the difference (improvement) over the standard survey method if one exists. A succinct discussion on whether the proposed method is deemed successful is saved for the Results and Analysis chapter. However, before venturing further in discussion of the basic design of this methodological dissertation, several threats to this proposed project design are mentioned.

Since the study is attempting to demonstrate improvement to standard methodology, two examples were undertaken to generalize, strengthen and clarify the end result. Without running two separate and simultaneous survey development teams, two controls and two teams of the proposed method, a difference in difference test is not possible where validity concerns are inherent. Trochim defines validity as, "the best available approximation to the truth of a given proposition, inference or conclusion" (Trochim 2001). Validity asks the question is what a researcher observes for conclusive evidence of improvement actually measured correctly and accurately?[2] Reliability on the other hand is concerned with the accuracy of the actual instrument or procedure, while validity is concerned with the study's success at measuring what the researchers set out to measure. In this case since a controlled design

[2] For a full discussion on validity and threats to it please see Trochim, W.M.K. 2001. The research methods knowledge base. 2nd edition. Atomic Dog Publishing, Cincinnati, Ohio.

has been ruled out, will the proposed research design threaten the overall validity of the study?

Internal validity refers to the rigor with which the study was conducted and the extent to which the designers of a study have taken into account alternative explanations for any causal relationships they explore (Campbell and Stanley 1963). .Internal validity would be in question if cause and effect relationships were sought. Many of the threats to internal validity are taken into account in this study by the lack of a controlled or quasi – experimental design. The proposed method utilizes the standard best practices of survey design with detailed systematic alterations with respect to question writing and order in this design. Rigor is accounted for if these practices are followed and altered only in practice where there is a proposed improvement. Any success observed in the proposed methodology may then be due to proposed alterations over the tried and true method.

External validity is more of a concern for this study. External validity refers to the approximate truth of conclusions that involve generalizing to a population of interest (Trochim 2001). Since this study is concerned with observed improvements over standard methods, it is necessary to be aware that conclusions reached from the observed state are in fact reasonable and then generalizable. Employing a design that takes into account the very best practices of the standard methods may have increased overall success because of the augmented attention to rigor that might be absent in a study where methods are not the focus of the research. As importantly, will the conclusions that are reached be generalized to future similar studies employing the proposed method? Improving reliability and implementation of each survey advances the chances that external validity will be credible.

Keeping in mind the various threats to validity, the most appropriate research design for this study is an observational and descriptive study comparing the structured conceptualization approach to standard measures of best practice survey design. If the structured conceptualization method compares effectively to the standard measures of best practice survey design it may then be deemed a worthwhile contribution to the literature on survey design methods. Again this assumption is discussed fully in the Results and Analysis chapter.

Discussion of the policy contexts behind the surveys

Each survey instrument designed in this dissertation was born of real world necessity. Neither survey was solely an academic exercise. Each was commissioned by the specific agencies desiring a better understanding of the policy context they operate in. The surveys that will be discussed in detail throughout this document are referred to as the Home Energy Use Survey or HEU and the Comprehensive Plan Survey or CP. The policy realm underlying the HEU survey demands further explanation of the background of general domestic energy use as well as the current debate encouraging energy conservation and energy efficiency. The CP survey requires further elaboration on the community based planning process discussed later in this chapter. A comprehensive plan informed by a community wide survey, produces enhanced information for local policy and decision makers in addition to providing the basis for a legal document that guides future community efforts with the force of local code.

Each of these policy realms is unique, yet shares in common the desire for information to enhance the decision making ability of policy makers. The

policy makers the specific surveys will inform are first those at the New York State Energy Research and Development Authority (NYSERDA) and second the members of the Village Board of Trustees in the Village of Trumansburg, New York.[3] NYSERDA administers the New York Energy $mart program, designed to support public benefit programs regarding energy efficiency services, including those directed at the low-income sector, research and development, and environmental protection activities. The HEU survey is directly commissioned from the NYSERDA Energy $mart team in Tompkins County, New York and co-sponsored through Cornell Cooperative Extension of Tompkins County, New York. The CP survey is commissioned by the Trumansburg Village Board of Trustees to better inform the comprehensive planning committee on the current state of affairs and future vision of the citizens of the Village. Survey insights and findings inform the inventory of relevant topics that comprise the comprehensive plan as well as provide a basis for 'visioning statements' necessary to developing a citizen driven plan. The specifics of each survey are discussed in the Methodology and Results sections of this document. The rest of this chapter focuses on relevant historical and policy issues that underlie the need for efforts of energy efficiency and conservation undertaken by organizations such as NYSERDA and a descriptive history of the comprehensive planning process as it relates to enhancing local policy maker's ability to generate informed political decisions.

[3] At the time of this writing, the author is a member of the Trumansburg Village Board of Trustees. The author is responsible for introducing and initiating the comprehensive planning project to the Village Board.

ENERGY POLICY CONTEXT:

The end of cheap oil

Petroleum is the substance that fuels virtually our every move, influences global economics, international politics and the health of the planet. The United States presently accounts for about 17% of the world's total annual energy production and about 23% of the world's total annual energy consumption (EIA 2006a). The production of domestically based oil peaked the year the author was born, 1970. Since that time the United States has increased its net imports from almost 35% to approximately 60% today (EIA 2007b). World demand for petroleum is predicted to increase by 71% from 2003 to 2030 while easily accessible reserves are declining (EIA 2006b). The future of the United States and the world requires a technological advancement to enhance oil discovery and production, or one where a substitute is provided, greater reliance on renewable forms of energy, and a commitment to increased conservation of petroleum and efficiency of the products that use it if undesirable consequences are to be avoided.

It is generally agreed that world production of oil and natural gas will begin an era of irreversible decline occurring now to some time within the next few decades. In 1956, a geologist for the Shell Oil Company named M. King Hubbert published a paper where he predicted that US oil production would peak in 1965-1970 (Hubbert 1956). The actual peak was 1970 (figure 1). He also predicted that world oil production would peak sometime around the year 2000 (figure 2). A world production peak occurring in the early part of the 21st century proposed by some geologists has the peak behind us, having occurred in 2005 (Deffeyes 2006).

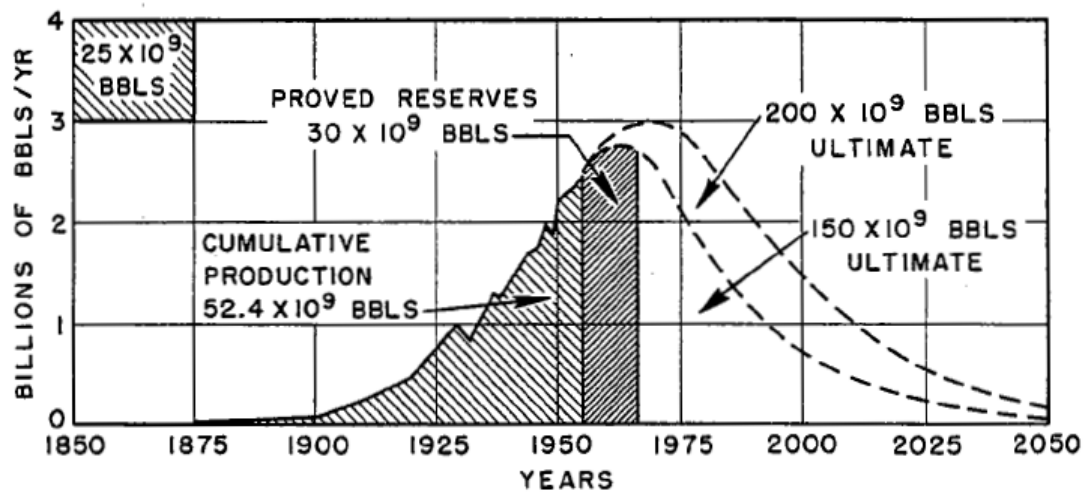

Figure 1 Hubbert's Curve, US Crude Oil Production, 1956

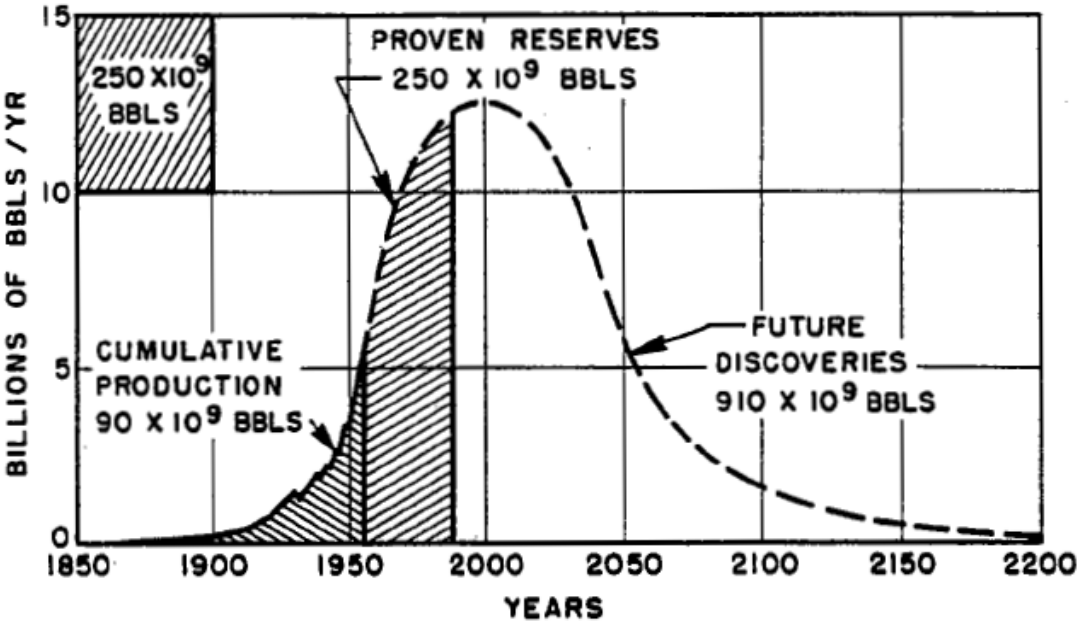

Figure 2 Hubbert's Curve, World Crude Oil Production, 1956

The US government believes that world oil production is several decades away. The Untied States Geological Survey estimates that a little over 3,000 trillion barrels of recoverable oil remain in the earth, where the Energy Information Administration (EIA) estimates the peak of world oil production is

anticipated after the year 2030 (EIA 2006b). How far after cannot be claimed with any certainty.

It is clear that with the demand of petroleum predicted to rise and the supply predicted to peak in the near future, prices will rise if no alternative substitute or complement is provided. A report summarized here in figure 3 by the ExxonMobil Corporation predicts that demand for oil increases by 2–4% annually; supply from existing fields declines 4–6% annually; while discovery does not keep pace with the decline by 2015 (ExxonMobil 2004).

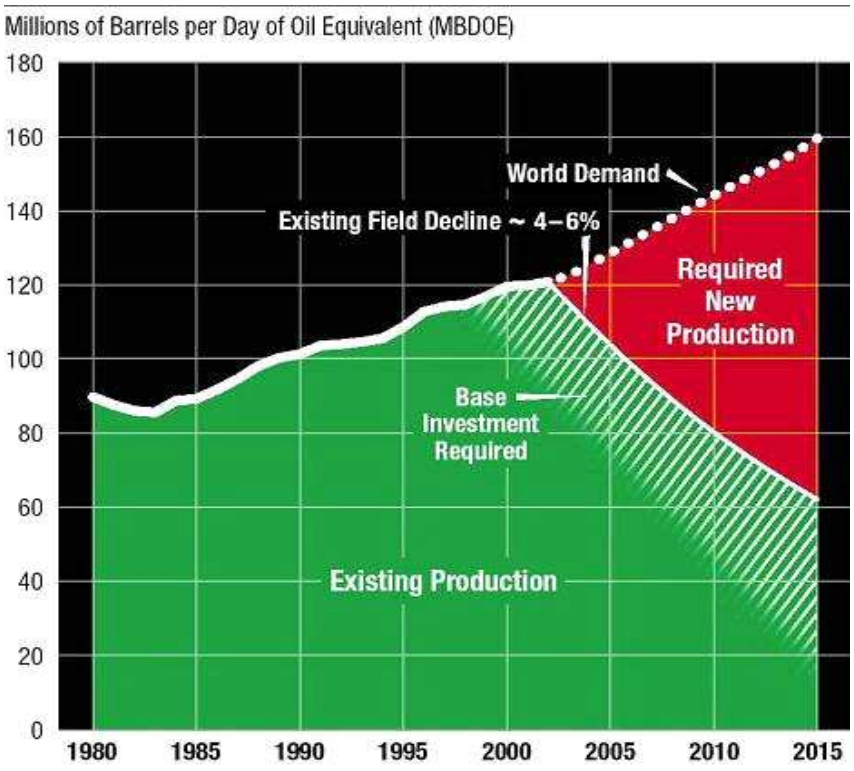

Figure 3 Oil Demand and Production

Source: ExxonMobil, 2004

John Thompson, President of ExxonMobil in 2003 further explained,

> “To meet projected demand in 2015, the industry will have to add about 100 million oil-equivalent barrels a day of new production. That's equal to about 80 percent of today's production level. In other words, by 2015, we will need to find, develop and produce a volume of new oil and gas that is equal to eight out of every 10 barrels being produced today." John Thompson, President of ExxonMobil. Published in the Lamp, 2003, Vol. 85 No. 1.

Basic economic theory tells us that if the above continues unabated, the price of oil advances rapidly. Oil industry supporters and peak oil believers alike are not in disagreement over the idea that peak production is approaching. They just disagree on when it will happen. In the mean time policy makers are beginning to heed the evidence that someday soon oil will not be plentiful and cheap.

The current administration is advocating ethanol produced from corn as one domestic substitute for imported oil, claiming this will advance the country toward the goal of reducing America's gasoline consumption by 20% over the next 10 years, better known as the twenty in ten policy as introduced in the 2007 State of the Union presentation. The United States currently consumes about 140 billion gallons of gasoline a year (EIA 2007a). To achieve the twenty in ten target, the president will propose a major boost in the production of renewable fuels such as corn and cellulosic based ethanol over the next 10 years. The proposal calls for the equivalent of 35 billion gallons of ethanol and other alternative fuels to be blended into the nation's gasoline supplies in 2017

(White House 2007). This mandate would lead to a 15% reduction in the gasoline consumption levels projected for 2017 (White House 2007). In a speech delivered to the National Renewable Energy Laboratory at Golden, Colorado on February 21, 2006, President Bush mentioned corn based ethanol production specifically:

> "…there is a fantastic technology brewing -- I say brewing, it's kind of a catch on words here -- (laughter) -- called ethanol. I mean, it's -- there's a lot of folks in the Midwest driving -- using what's called E85 gasoline. It means 85 percent of the fuel they're putting in their car is derived from corn. This is exciting news for those of us worried about addiction to oil. You grow a lot of corn, you're less dependent on foreign sources of energy. Using corn for fuel helps our farmers and helps our foreign policy at the same time. It's a good deal."
>
> President Bush Participates in Energy Conservation and Efficiency Panel. National Renewable Energy Laboratory Golden, Colorado Office of the Press Secretary, February 21, 2006.

However, the president's plan may be flawed with respect to reducing petroleum consumption when the potential biomass stores and the energetics of the process are examined more closely. The 35 billion gallons of ethanol and other alternative fuels to be blended into the nation's gasoline supplies is supposed to come from converting 1.3 billion tons of biomass each year (Perlack et al. 2005). Yet, Cornell University researcher David Pimentel along with a team of graduate students report that only 2 billion tons of biomass are

produced in the U.S. per year (Pimentel 2007 personal conversation). This indicates that Perlack et al. are planning on harvesting more than half of all biomass each year including all food crops to meet the goal outlined by the Administration. The 2 billion tons of biomass produced each year in the U.S. represents about 32 quads of thermal energy. Therefore, the U.S. is currently consuming about 3 times the total solar captured each year as fossil energy. Our green plants collect only about 0.1% of the total solar energy reaching them each year. Replacing even 20% of the current liquid fossil fuel consumption with biomass appears to be impractical.

Some researchers also believe that fuels produced from biomass are uneconomical as they use much more energy in their creation than the resulting ethanol they generate. Many of the processes that are used to grow corn require the input of petroleum, such as fertilizer and the energy for irrigation, planting and harvest. Then there is the actual energy required to convert corn to liquid ethanol. According to Professor David Pimentel of Cornell University, "There is just no energy benefit to using plant biomass for liquid fuel." He adds, "These strategies are not sustainable."[4]

Pimentel finds that corn requires 29% more fossil energy than the fuel it produces (Pimentel 2005). In a survey of leading studies on the net energy value of corn based ethanol, Hosein Shapouri economist for the USDA, found several conflicting reports on the energy balance required to produce corn ethanol (table 1).

[4] Comments by Professor Pimentel made to the *Cornell Chronicle* July 5, 2006. Accessed online at: http://www.news.cornell.edu/stories/July05/ethanol.toocostly.ssl.html

Table 1 Energy input assumptions of corn-ethanol studies (negative net energy highlighted)

Source: Shapouri et al. 2002

Study/year	Corn yield	Nitrogen fertilizer application rate	Nitrogen fertilizer production	Corn ethanol conversion rate	Ethanol conversion process	Total energy use	Coproducts energy credits	Net energy value
	Bu/acre	lb/acre	Btu/lb	gal/bu	Btu/gal	Btu/gal	Btu/gal	Btu/gal
Pimentel (1991)	110	136	37,551	2.5	73,687	131,017	21,500	-33,517
Pimentel (2001)	127	129	33,547	2.5	75,118	131,062	21,500	-33,562
Keeney and DeLuca (1992)	119	135	37,958	2.56	48,470	91,196	8,078	-8,438
Marland and Turhollow (1990)	119	127	31,135	2.5	50,105	73,934	8,127	18,154
Lorenz and Morris (1995)	120	123	27,605	2.55	53,956	81,090	27,579	30,589
Ho (1989)	90	NR	NR	NR	57,000	90,000	10,500	-4,000
Wang et al. (1999)	125	131	21,092	2.55	40,850	68,450	14,950	22,500
Agri. and Agri-Food Canada (1999)	116	125	NR	2.69	50,415	68,450	14,055	29,826
Shapouri et al. (1995)	122	125	22,159	2.53	53,277	82,824	15,056	16,193
Shapouri et al. (2002)	125	129	18,392	2.66	51,779	77,228	14,372	21,105
NR: Not Reported								

Another concern in utilizing corn as the base material in ethanol production is the competitive pressure the ethanol industry places on other downstream users of corn. Strong demand for corn from ethanol plants is driving up the cost of livestock and will raise prices for beef, pork and chicken (Shagam 2007). Shagam (2007) also reports that ethanol production is consuming 20% of last years corn crop and is expected to consume more than 25% of this year's crop. The average price of corn is $3.20 a bushel, up from $2 last year, with the corn futures market reacting accordingly to the upside (figure 4). As farmers of livestock and ethanol producers compete for the feedstock without an increase in supply, the price of both goods becomes more costly.

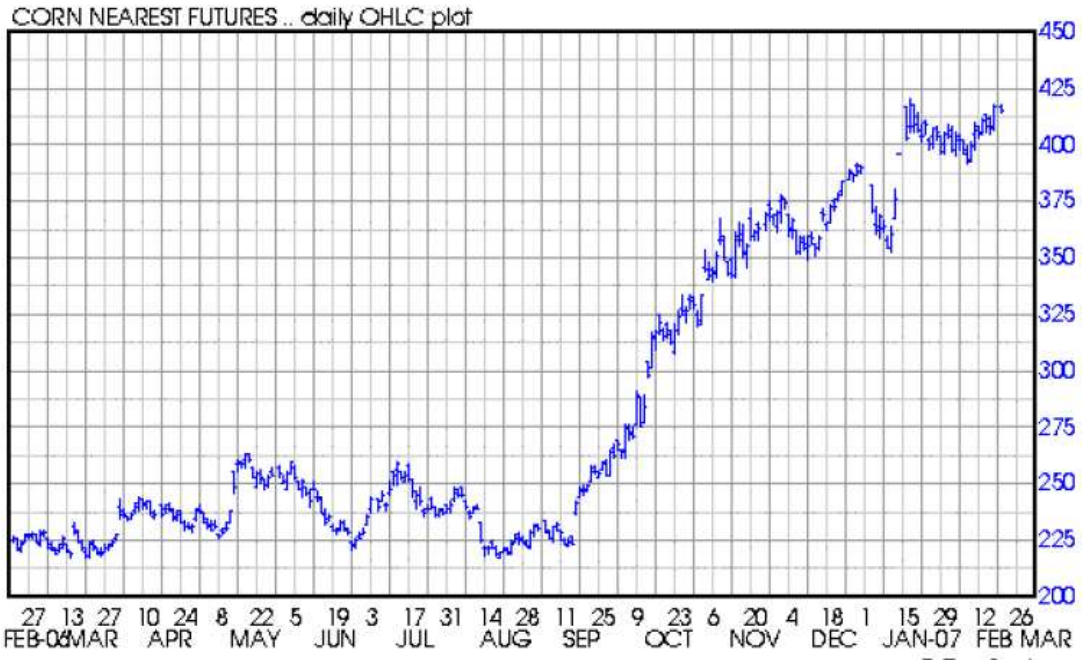

Figure 4 Corn futures market 2006- 2007

Source: Barchart Advanced Commodities Service

With the scientific community in disagreement regarding the energy balance of ethanol, coupled with the price increases ethanol production will cause on the feedstock, the energy policy proposed by the White House might be reconsidered if the primary goal is to reduce the use of imported fossil fuels.

Climate Change Occurring

In addition to the need the desire by the SU government to reduce the use of imported fossil fuels, another overarching issue is directly tied to the burning of fossil fuels. In a scientific community group assessment report released in early 2007, the Intergovernmental Panel on Climate Change (IPCC) says that global climate change is "very likely" (90% certain) to have a human cause; temperatures are probably going to increase by 1.8-4C (3.2-

7.2F) by the end of the century; with a subsequent rise in sea level by 28-43cm (11-16.9in) (IPCC 2007). Global climate change is driven by the release of greenhouse gasses into the atmosphere, many of which are created by the combustion of fossil fuels. The visible effects of the massive influx of greenhouse gasses into the atmosphere since the dawn of the industrial revolution (1750) can be seen in figure 5.

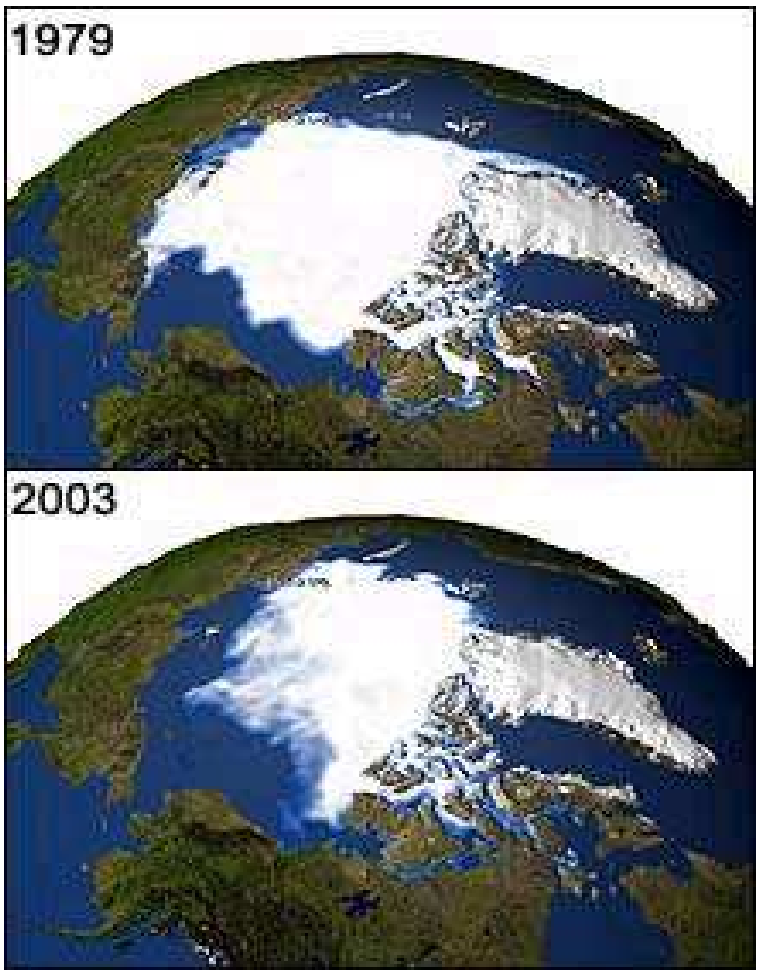

Figure 5 Disappearance of Sea Ice

Source: NASA

The first image shows the minimum sea ice concentration for the year 1979, and the second image shows the minimum sea ice concentration in 2003. Much of this sea ice holds the majority of the earth's fresh water. As it is released into the oceans, sea currents and climate patterns stable for millennia may change rapidly, altering the habitability of the earth for the current inhabitants.

The U.S. produces about 25% of global carbon dioxide emissions from burning fossil fuels; primarily because our economy is the largest in the world and we meet 85% of our energy needs through burning fossil fuels (EIA 2004). The end use sectors which contribute to CO_2 emissions (the gas which contributes most to global warming) is illustrated in figure 6.

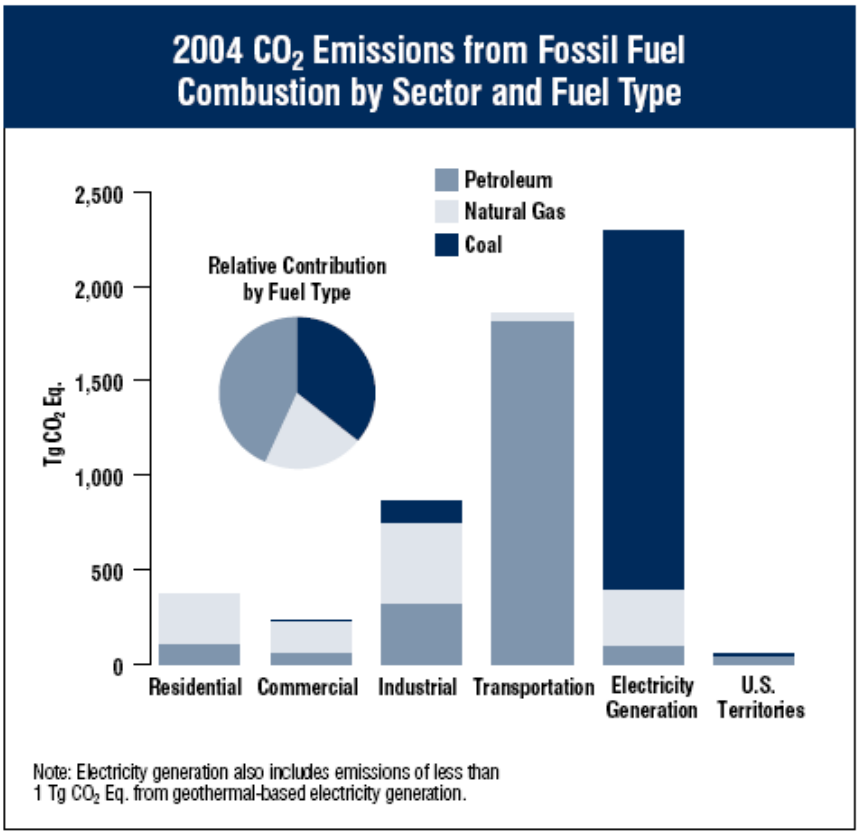

Figure 6 US Emissions by Sector

Source: US EPA, 2006

Of specific relevance to the HEU survey, the residential end use sector accounts for 21% of CO_2 emissions from fossil fuel combustion in 2004 (EPA 2006). Residential energy use also relies heavily on electricity for meeting energy demands, with 68% of residential emissions attributable to electricity consumption for lighting, heating, cooling, and operating appliances. The remaining emissions are due to the consumption of natural gas and petroleum for heating and cooking. Electricity use also illustrated in figure 6 is a major source of greenhouse gases in the US. The electricity industry is the largest single source of GHG emissions, produced mostly from coal burning power plants.

Now that consensus has been established over the link between global climate change and fossil fuel combustion emissions, inevitably steps will be taken to alleviate the climate change pressure or dire consequences will be faced. As nations face the consequences of limiting the use of fossil fuels they also face the scarcity of existing fossil fuel resources for growing and developing economies. This last situation has an effect on international politics.

Resource Scarcity . . . a harbinger of war?[5]

In total the Middle East accounts for approximately 60% of proven oil reserves (Oil and Gas Journal 2005). No other nations can come close to matching the reserves found in the Middle East, with Saudi Arabia, Iran and Iraq accounting for the top three nations worldwide.[6] Iraqi oil is extremely

[5] A caption borrowed from James J. Puplava, author of *Powershift - Oil, Money, and War.*
[6] Canada has a large supply of tar or oil sands at 174.1 billion barrels, placing it second behind Saudi Arabia for proven reserves. However, it is largely at the present time not cost effective to recover and therefore not included in the top three easily recoverable proven reserves.

cheap to recover compared to other regions of the world. The majority of its oil sits just 600 meters below surface and needs no pumping, creating a cost to recover at $1.50 / barrel where recovery in the rest of the world averages $6 to $15 / barrel (Yeomans 2004). The rising dependence of China on Middle East oil supplies coupled with the United States' current demand may have future geo political impacts for the two nations, the region and the world as a whole.

One observer of the link between the decline in easily recoverable oil and the future tensions that may occur says,

> "At a time of tremendous population growth and escalating demand for commodities of all types, resource scarcity will become a harbinger of war. The wars of the 21st century will arise over the scarcity of resources like water, oil and food as much as they will religion and economics. National security will become aligned and directed towards the securing and protection of global resource flows. It is become a prominent feature of American national security. As America imports more of what it needs to fuel its industries and economy, its military presence will grow even larger. Carrier battle groups now protect the flow of oil, raw materials and trade routes around the globe. American legions are stationed in over 100 countries and on all the major continents. As a major superpower, America has been both an arbiter and maker of peace. It is that position which is now being challenged."
>
> James J. Puplava Powershift - Oil, Money, and War (2002)

If Mr. Puplovsa is correct in his assessment, then it becomes clearer that the United States is not immune to fighting wars over resource scarcity. The Project for the New American Century (PNAC), a Washington think tank, wrote in 1998 a letter to President Clinton urging him to depose Saddam Hussein of Iraq. The founding principles of the PNAC were "to shape a new century favorable to American principles and future challenges; a foreign policy that boldly and purposefully promotes American principles abroad; and national leadership that accepts the United State' global responsibilities."[7] A link could be argued that Iraq was chosen by the PNAC because of its strategic importance to future economic health of our nation and that the invasion meets the above stated goals.

The PNAC is not the only organization calling for preemptive action to protect and garner future oil reserves for the US. The Reverend Pat Robertson, host of the Christian Broadcasting Network's The 700 Club and founder of the Christian Coalition of America, called for the assassination of Venezuelan President Hugo Chavez on his broadcast in 2005. Chavez, the leader of Venezuela which possesses the seventh largest proven oil reserves at 79.7 billion barrels, currently does not have friendly relations with the United States.

> "You know, I don't know about this doctrine of assassination, but if he (Chavez) thinks we're trying to assassinate him, I think that we really ought to go ahead and do it. It's a whole lot cheaper than starting a war. And I don't think any oil shipments will stop. But this man is a terrific danger and the United ... This is in our

[7] Excerpt from the Statement of Principles of the Project for a New American Century's website: http://www.newamericancentury.org/statementofprinciples.htm

> sphere of influence, so we can't let this happen. We have the Monroe Doctrine, we have other doctrines that we have announced. And without question, this is a dangerous enemy to our south, controlling a huge pool of oil that could hurt us very badly. We have the ability to take him out, and I think the time has come that we exercise that ability. We don't need another $200 billion war to get rid of one, you know, strong-arm dictator. It's a whole lot easier to have some of the covert operatives do the job and then get it over with."
>
> From the August 22, 2005 broadcast of The 700 Club

If this is a future to be avoided, the United States and other fossil fuel dependent nations presently have several options or face greater uncertainty coupled with increasing hardship. These options being increased conservation, development of alternatives to fossil fuels and improved efficiency of current technologies.

Conservation and Efficiency Efforts

The Home Energy Use Survey was commissioned to provide a snapshot of current energy conservation and efficiency efforts underway in households of the Southern Tier region of New York State. NYSERDA, charged with supporting public benefit programs regarding energy efficiency services, is interested in the knowledge and practices of homeowner energy efficiency and conservation efforts. Subsequent chapters of this document contain information on comparative home energy use findings as well as

specifics relating to the details of home energy use with respect to conservation and efficiency.

Conservation and efficiency are related yet differ in concept. Typically energy conservation is defined as "using energy resourcefully or prudently; saving energy" while energy efficiency means "technologies and measures that reduce the amount of electricity and/or fuel required to do the same work."[8] Therefore examples of energy conservation would mean reducing the amount of fuel oil or natural gas to heat a home due to the action of turning the thermostat down. Whereas energy efficiency (in the same context) means upgrading to a more resourcefully manufactured furnace that provides the same comfort level while consuming less oil or gas.

Current public rhetoric suggests an urgent goal of US energy policy is a move to replace fossil fuels as energy sources for transportation and electricity generation. In the meantime the greatest opportunities for conserving petroleum and reducing the environmental impacts of fossil fuel consumption lie in expanding the efficiency of internal combustion engines. Over 96% of the petroleum consumed in the US is for the transportation sector (EIA 2007c). If fuel economy standards for vehicles in America were raised to 40 miles per gallon by 2012, US oil consumption could be cut by 2 million barrels a day in the next decade and create over $45 billion in net savings to US consumers by 2012 (UCS 2005). Increasing vehicle efficiency is a fundamental example of the link between energy efficiency and conservation; the former results in the latter.

[8] Both definitions come from the Natural Resources Defense Council glossary of terms, accessed online here: http://www.nrdc.org/reference/glossary/e.asp#energyefficiency. Similar definitions are provided by the EIA here: http://www.eia.doe.gov/emeu/efficiency/ee_ch2.htm

Increased commercial and residential efficiency and conservation also go a long way in decreasing consumption of fossil fuels. The concept of negawatts – a measure of energy saved through conservation and efficiency efforts –relies on "small" and "large" technologies.[9] Small include activities such as installing compact fluorescent lights, low flow showers, reducing phantom loads, and lowering the thermostat. The "large" residential technology strategies include utilizing Energy Star appliances, on demand water heaters, energy efficient furnaces, solar and wind, and employing green building design. Changing behavior is perhaps the most effective attempt at energy conservation. This may include turning off lights and appliances, altering travel patterns, turning down the thermostat, using less water, and performing routine energy audits. The Rocky Mountain Institute, a nonprofit organization that fosters the efficient and restorative use of resources, claims that up to 90% of the current residential energy cost can be reclaimed if energy efficiency practices are put in place.[10]

The United States has done a reasonably fine job at conserving energy in some respects. Today the US uses far less energy than it did in the 1970's to heat and its homes and offices as well as run its power plants. Some attribute this energy savings due to the shift in the US economy to a service and technologically based one rather than industrial and manufacturing. However, all the savings have been squandered because American drivers consume more gasoline than any other people on the planet. As long as gasoline is inexpensive, there is not likely to be a consumer movement to end

[9] The word "negawatt" was coined by Amory Lovins, an experimental physicist who is CEO of the Rocky Mountain Institute (http://www.rmi.org/).
[10] The average American family spends nearly $1,500 per year on utility bills. This expense can be reduced by 10–90%, depending on how inefficient you are and how aggressive you want to be about getting efficient. (http://www.rmi.org/).

the extravagant use of it. Time will tell what confluence of factors will shift the current energy use of not only Americans but all world citizens before repercussions once thought unimaginable occur.

COMMUNITY PLANNING POLICY CONTEXT:

Community based planning, the need for enhanced information

Like the HEU survey exercise, the Comprehensive Plan survey was initiated by an agency in need of further information on a population. The CP survey as mentioned earlier was requested by the Trumansburg Village Board of Trustees to better inform the comprehensive planning committee on the current state of affairs and future vision of the citizens of the Village. The survey insights and findings are used to inform the inventory of relevant topics that comprise the comprehensive plan as well as provide a basis for 'visioning statements' necessary to developing a citizen driven plan for the foreseeable future. In any planning process there is a sense of organized community that is addressed. Developing a comprehensive plan for a community entails such organization. The remainder of this section provides the relevant community planning background to better understand the comprehensive planning process utilized by local policy makers.

Introduction to Planning

Community planning, as it is often termed, is consensus building, problem solving and future driven, with plans made to prepare for and avoid any undesirable consequences (Kelly 2004). Another more concise definition of planning is:

> “Planning is a rational way of preparing for the future. It typically involves the gathering and analysis of data, the examination of possible future trends, the consideration of alternative scenarios, some sort of analysis of the costs and benefits of those scenarios, choosing a preferred scenario, and a plan for implementation.” (Kelley and Becker 2000)

The planner therefore has an interest in the social and physical problems of organized communities. The second sentence of this definition is the primary reason for the wide use of the survey instrument in the planning profession and one of the motivations for utilizing a structured conceptualization approach here. The analysis of primary data gathered from an appropriate survey aids the planner in choosing and implementing preferred scenarios. However, before a conversation of the advantages the structured conceptualization approach brings to the relevant stakeholders when designing a comprehensive plan, the background of the planning profession is first discussed.

The city and regional planning profession can trace its roots back to the World's Columbian Exposition in Chicago in 1893 commemorating the 400th anniversary of the discovery of the New World (Wilson 1989). Here the City Beautiful movement, a renewal of civic design and grand planning, was on display by such planning visionaries as Frederick Law Olmsted and Daniel Burnham. Cities throughout the nation inspired by the movement appointed special civic art commissions. These art commissions became the forerunners of today's planning commissions. They were charged to carry out local improvement projects such as civic and cultural centers, tree-lined avenues,

and waterfront improvements. Many of the original 'planners' advocated the advantages of town or city planning (Olmsted 1914), treating the city as a whole singular unit as opposed to a disparate group of citizens (Howe 1913), taking into account the technical, artistic, social, economical and sanitary elements of planning a city (Bottge 1910) and ensuring a systematic, scientific approach to the process (US DOL 1918). As the planning profession grew and became accepted, the legal structure of such commissions was soon to be established.

The legal framework for modern city planning by the planning commissions began with the zoning ordinance. The original zoning laws were based on the authority of the police to control land use in order to balance the interests of the individual and the community. In 1916 the New York City planning commission had adopted the first zoning ordinance. In 1926 the US Supreme Court in Village of Euclid v. Ambler Realty Company upheld the constitutionality of municipal zoning. With land use authority established at the local level, the city planning profession diverged from the related fields of architecture, landscape design and engineering. Planning was now part of a greater public entity rather than a private enterprise.

The deliberate separation (or attempt) of disconnecting the planning commissions from direct political office early in the profession resulted in removing the planner from the short sighted and reactive reality of politics. Democratic government is often motivated by short term political gain. Removing planners from the direct election of the people and having them be assigned by elected officials causes the planners to be twice removed from the people, often causing a conceptual problem for the profession. The planning professional assists in the planning of communities usually through

comprehensive or master plans with a desire to represent the collective planning will of the people. When preparing a comprehensive plan additional aid to establishing direct community involvement is advantageous for greater community buy in.

Introduction to the Comprehensive Plan

Put simply the comprehensive plan is a representation or guideline for what a community wishes to be in the future. A more professional definition describes the 'general plan' as a document of local government that:

> "sets for the major policies concerning desirable future physical development; the published general plan document must include a single, unified general physical design for the community; and it must attempt to clarify the relationships between physical development policies and social and economic goals." (Kent 1964)

The comprehensive planning process assists a community to prepare for its future needs and sets forth recommendations to guide growth and development in rational and efficient ways. As the community changes it is important to understand and plan for the effects of this change. The comprehensive plan may address and guide,

- Altered zoning regulations
- Expansion of infrastructure
- Location of new infrastructure
- Annexation of additional territory
- Decisions on public investment

Other than the obvious relationship the comprehensive plan has to land use zoning regulations, there are many other suitable reasons for developing a comprehensive plan. The plan can attempt,

- To attract the right future and help avoid the wrong future
- To establish a community vision
- To ensure economic stability
- To provide direction to other agencies
- To avoid surprises by understanding the municipalities assets and liabilities
- To improve access to government and non-government assistance
- To provide a back up to land use tools

There is some confusion about the terminology associated with the term ‘comprehensive planning’. In New York for many years the overall plan for a community was commonly referred to as a "master plan." Other interchangeable terms for this same plan include comprehensive plan, land use plan, development plan, vision plan, or general plan (NYS DOS 1999). With the passage of new State legislation in 1995, the term "comprehensive plan" became accepted as the legal reference for such plans when adopted by a municipality.[11] While the comprehensive plan sets forth recommendations for how a community should develop and might include a variety of maps, the plan itself is not a regulation. The 1995 language in the statutes significantly strengthens the role of comprehensive planning in municipal land use decision

[11] NYS Municipal Home Rule Law §10 (MHRL), allows cities, villages and towns general power to adopt local laws pursuant to MHRL for the purposes therein. Those powers are quite broad, especially useful to assure local control of planning laws.

making.[12] Notably any new land use regulation in a municipality with a plan adopted prior to the new regulation must be in accordance with the written comprehensive plan. Prior to 1995 only zoning had to be in accordance with a comprehensive plan, and the plan itself did not have to be a written document. This legislation establishes a legal significance of the comprehensive plan, found in its relationship to the community's land use. Rarely are zoning revisions now enacted prior to the update or development of a comprehensive plan.

Composition of the Comprehensive Plan

The process of developing a comprehensive plan starts with an analysis of existing conditions and trends regarding the physical, environmental, social, and economic aspects of the municipality in question. This inventory is broken down into six major sections: Environment, Recreation, Community, Economic Development, and Land Use (Kelley and Becker 2000), however many other concerns may be identified in the inventory. Similar sections to those listed above along with the major issues addressed under each section were identified by the Trumansburg Comprehensive Plan Committee based on the results of the 2006 CP resident survey, to be discussed further in the Results section.

Which of the above inventory elements are included in the comprehensive plan? All of them may be addressed or only the most relevant ones given budgetary, manpower and time constraints. There is no set formula for what to

[12] In 1995 Chapter 418 of the NYS Laws of 1995 amending General City Law §28-a, Town Law§272-a, Village Law §7-722 and General Municipal Law §119-u make specific note and conditions for the development and use of a comprehensive plan by a municipality.

include or consider, but New York State statutes offer the following suggestions:

- Include general statements of goals, objectives, principles, policies and standards
- Consider regional needs, historic and cultural resources, sensitive environmental areas, utilities and infrastructure, park and recreational facilities, population trends and future projections, plans of other agencies and communities, agricultural uses, coastal and natural resources, transportation facilities, housing resources and needs, and commercial and industrial facilities
- Include strategies for improving the local economy.
- Proposals and programs to implement the community's policies
- Any and all other relevant issues[13]

Considerations when writing the Plan

The suggested process for preparing or updating a comprehensive plan follows similar steps and recommendations as discussed in NYS DOS 2006; Kelley and Becker 2000; and Church and Traub 1996. The Trumansburg Comprehensive Plan follows a similar process, one laid out by the Tompkins County Planning Department (TCPD) who was commissioned to assist in drafting the plan. In beginning any project, it is often recommended to get well organized. TCPD suggested addressing the key issues listed below to help assist in preparing a plan that will have the most likely chance of being

[13] The enumerated considerations were gleaned from the Guide to Planning and Zoning Laws of New York State, James A. Coon Local Government Technical Series, accessed online at: http://www.dos.state.ny.us/lgss/books/zoning.htm#gcl20 as defined in Chapter 418 of the Laws of 1995 amending the General City Law §28-a, Town Law §272-a, Village Law §7-722 and General Municipal Law §119-u.

adopted. The following issues should be at the forefront of the committee's intentions from the beginning and throughout the entire planning process.

First the comprehensive planning committee should determine if the municipality can simply update an older comprehensive plan or whether a new start is warranted. They should also consider how to involve the public in the process, how to coordinate with the municipality and with surrounding municipalities and never lose focus on relevant issues to the community. Involving the public is paramount to the plan's success. Public involvement helps build a constituency to identify the goals of the plan, instills a sense of responsibility for the success of the plan, and creates a greater interest in the realization of the plans goals. Finally, involving a wide variety of people in the process helps ensure that the goals of the plan are more relevant to the needs of the community. A community is likely to feel resentment if there is the perception that the plan was mandated upon them by a few individuals.

A proven way to obtain public participation throughout the planning process as identified by professional planners is to utilize a community wide survey (Kelley and Becker 2000). In addition all outlines, inventory documents, vision statements and preliminary drafts of the plan should be made available to the public. The greater the initial public involvement, the increased likelihood the largest number of people are involved in the process and ultimately may result in successful adoption of the proposed plan. The following checklist provides the many constituents with corresponding interests whose perspective should be considered by the comprehensive planning committee:

CONSTITUENT	INTERESTS
Elected Officials	Lead Responsibility, Budgeting Implementation Needs
Planning Board	Long Term Goals, Trends Project Review Issues, Plan Drafting
Zoning Board of Appeals	Zoning Issues/Trends
Building and Zoning Enforcement Officials	Administrative Issues Practical Field Advice
Assessor	Property Tax Implications
Staff/Consultants (Lawyer, Engineer, Planner, etc.)	Technical Advice and Research Writing/Editing/Mapping
Highway Superintendent	Traffic/Road Issues
Conservation/Environmental Commission	Environmental Issues
Historian / Historical Society	Historic Preservation
Recreation Commission	Recreation and Park Needs
Sewer/Water Superintendent	Infrastructure Needs
Chamber of Commerce and Business Groups	Economic Development Issues
Civic Associations	Strategic Concerns
Neighborhood Associations	Neighborhood Issues
School District Administration	Property Tax/Infrastructure Needs
Builders/Developers/Engineers	Development Issues/Market Realities
Knowledgeable individuals/ Locally Unique Groups	

Figure 7 Constituents to consider throughout the drafting process

Source: Church and Traub 1996

Elements of the Comprehensive Plan

In order to prepare the plan, the committee will need to gather data, represent it on maps, formulate recommendations and put the results into a readable document. This sometimes causes problems in an all volunteer group where depth of experience is limited. It is suggested that smaller municipalities, when possible, take advantage of local planning departments (as in this example), appointed planning commissions or even consider hiring a planning consultant to provide expertise and professional guidance.

Collecting the necessary information starts from the moment the plan is begun and continues until the end. As much information as possible about the community should be collected before the planning process is undertaken in order to ascertain the relevant inventory of existing conditions. Some Types of Information to collect include:

- Open space/natural resources
- Historical data
- Economic trends
- Transportation facilities
- Demographics
- Utilities
- Housing
- Commercial and Industrial facilities

In many cases the planning commission or committee would go about collecting information on the above elements from existing public sources. A similar approach was used in development of the Trumansburg Comprehensive Plan. Rather than utilize the survey portion of the planning

process after the inventory of existing conditions is identified and collected, the survey was designed as the first step, a minor departure from general practice.

The community wide survey not only informed the committee on what *would you like Trumansburg to look like in the future* (where do we want to go) but was utilized to inform the existing inventory of conditions. For instance during the structured conceptualization process it was discovered that Trumansburg's identity along with zoning and economic development is important topics on which to gather information. The inventory of existing conditions was now more focused and appropriate to the specific needs and desires of the Village. The preamble to the Inventory of Existing Conditions reads:

> "This inventory is broken down into six major sections: Environment, Recreation, Community, Economic Development, Housing and Land Use. These sections, and the major issues addressed under each section, were selected by the Comprehensive Plan Committee based on the results of the 2006 resident survey."
>
> Taken from the *Trumansburg Comprehensive Plan, Draft Inventory of Existing Conditions*, December 1, 2006.

The concept mapping process revealed these major themes while the specific sections (Environment, Recreation, Community, Economic Development, Housing and Land Use) were derived directly from the survey results.

Another important facet of the information collection process is holding public information workshops. These workshops attempt to engage the community directly. Every effort should be made to let the community know

about the workshops. Getting citizens involved at this stage is essential for community "ownership" of the plan and will help shape a plan that fully reflects the community's goals. Two public workshops were held for the Trumansburg plan: a workshop to present the six inventory items, and discuss community vision and goals followed by a land use mapping workshop. The first workshop allows the community members to communicate their own vision of the future regarding each of the six inventory action items. The land use workshop provides participants with an opportunity to help develop a land use map.[14] Small groups work together to create a future land use map, based on community goals and existing conditions. Follow-up discussions with the larger group combine these various future land use maps into a combined map.

Assessment, Analysis, Recommendations and the initial Draft

The assessment and analysis step brings together information gained from the public meetings, inventory, and survey. This information will be used to identify community strengths and challenges and community values. Based on this assessment, a vision statement, goals and objectives will be drafted with input from the Village.

The analysis of the plan begins when consideration is given to existing land use laws and considering what the community would look like if nothing was done. At this point it is also wise to review what goals or visions were set forth by the community in the beginning of the project. These may be referred from the original survey results or from the public workshop on inventory.

[14] A land use map is one showing land-use classes (agricultural, residential, and commercial) as well as other earth surface features such as roads, manufacturing plants, and harbors.

Consideration of what programs or techniques may be used to achieve these goals is recorded. Discovering trends from public data i.e. census Figures or other community data, may also help determine where the community is heading given a business as usual strategy. Lastly any regulatory changes that might be necessary to enact the future visions should also be considered and recorded.

The policy recommendations section of the plan will guide future development or actions within the community. The comprehensive plan will be a reference for future legislative assemblies to refer to when making policy decisions. These recommendations will also influence the zoning and other land use ordinances. The comprehensive plan can recommend the desired future look and feel of the community and may have profound effects. It may ensure the traditional character and scale of the community or lead it to a completely different direction.

When taking a first stab at writing the plan, the committee may wish to have the professional help (if so hired) assist in this step. This draft should incorporate the vision, goals, objectives, key issue areas, inventory, selected implementation strategies, and implementation schedule and monitoring program. Specific implementation recommendations should also be included in this draft, along with a timetable, and list of potential funding sources if recommendations require the expenditure of public monies to achieve stated goals. The public should have one last opportunity to comment on the draft plan before a final plan is written for review by the legislative authority. Since the composition of legislative bodies changes at the will of the public, it is imperative that the process is done in a timely manner and key elected

officials (constituents) are apprised of the progress from time to time. In this manner the plan has the greatest likelihood of being adopted.

Promoting the community's future and building consensus

Government officials are constantly striving to promote an agenda, work effectively with other managers and constituents, create a legacy and at the same time continuously strive for economic viability and sustainability. There have been numerous examples in recent and past times where government officials allow personal ego, internal squabbles or even questionable behavior to affect the wellbeing of the community they serve. A descriptive and colorful figure which illustrates this point is the tenure of famed public builder Robert Moses.

Robert Moses' lust for power throughout most of the 20th century in the State of New York put him at odds with many mayors, governors and future presidents. Moses was not only a savvy politician and broker of power but also a builder with great vision. At one point he presided over 80,000 people working for him building the lasting landscapes, infrastructure and parks that New York City and State are revered for (Caro 1974). Mayor William O'Dwyer of New York City faced Moses in such a conflict, one that is germane to this dissertation topic. In a struggle for political power and dominance over O'Dwyer's City Planning Commission, Moses through his influence, thwarted the city's master plan all because he had differences with O'Dwyer and his appointed commissioner of planning. A costly plan that was years in the making, was allowed to be tabled because the desires of one constituent (Moses) and whom he represented (real estate developers) outweighed those of the greater public.

Robert Moses is a remarkable example at how the politics of personality can make or break a community vision. There are however, processes and tools that attempt to short circuit a despotic group or individual from dominating a 'community' vision. One of the primary methods of promoting an inclusive community future is embracing the planning function of municipal government (Newell 2005). The comprehensive planning process is a useful and effective vehicle for building community ownership of the future, gathering new ideas and opinions, and most of all creating a democratic voice from several disparate constituents.

The governing body makes many of the critical decisions that determine whether a plan becomes a reality. To avoid the type of critique leveled at Moses, disparate constituents should attempt to be heard and contribute in an egalitarian manner. As illustrated in figure 7 (constituents to consider throughout the drafting process) it is vital to hear from as many of these members as possible if there is to be a shared community vision or hope of the final plan's adoption. By running through the checklist in figure 7, a planning commission may be able to invite and integrate such constituents into the structured conceptualization survey development process. The standard model of the appointed planning commission fails in this regard in several ways (Kelly and Becker 2000). Many planning commissions are overwhelmed with zoning maps, site plan reviews and permit review. They have lost much of the function or ability to provide or facilitate a community wide vision. The more collaborative process envisioned here aims to alleviate such concerns.

Conclusion

In the attempt to gain broader consensus among diverse constituent groups along with gauging the knowledge, attitudes and beliefs of the population of interest, the method that is the subject of this dissertation is the use of the sample survey. A survey instrument designed in the standard way does not address the building of consensus or attempt to minimize negative group interactions. The structured conceptualization approach to survey design inherently seeks out diverse stakeholders and constituents to contribute to the process. The details of the ancillary benefits of the structured conceptualization approach to survey design and the aid it brings in building inter- and intra-group consensus is discussed in later sections of this document.

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CHAPTER 2

Literature Review

Introduction

The critical review of the scholarly literature surrounding survey design and development is meant to illuminate the advantages of current best practices while identifying specific areas which may be improved upon with the proposed structured conceptualization method of survey design in this dissertation. This chapter is an analysis and synthesis of the source materials, flowing from broad to narrow, while taking into account both the theoretical and empirical issues on the subject of survey design. Current best practices of survey design are reviewed with a brief description of how they were applied to this dissertation's surveys. Best practices undisputed here are directly incorporated into the design of the dissertation surveys and reported on in subsequent chapters. After a discussion of the historical review of survey design and the current best practices, attention is turned toward question development and the order in which survey questions are placed within the questionnaire. Question development and design is critically singled out since the structured conceptualization method potentially provides a valuable addition to this area of scholarship. The chapter concludes with a review of the structured conceptualization literature associated the design of measurement instruments. There are instances where scholars have suggested the potential benefits of instruments developed from a structured conceptualization. The impetus for this research attempts to formalize this contribution.

Genesis of Survey Research

To describe best practices of survey design the definition of a survey must first be ascertained. A survey in the simplest terms is a method of gathering information from a sample of individuals. Information, accurate and purposeful, is desired by government, academia, business, social institutions and the individual in society. Typically the field of survey research includes any measurement procedure that involves asking questions (verbally or written) of respondents. There are several ways to gather information, but the "survey" as described for this document's purpose, is a specific instrument that has the following purpose and characteristics as described by Fowler (1984):

1. The survey's purpose is to produce quantitative and qualitative descriptions on aspects of the study population.
2. The main way of collecting these statistics or data is to ask people questions, written or verbally.
3. The information is collected from a sample of the underlying population of interest rather than from every member of the population.

The concept of a survey has also been described by Dalenius in the following seven steps (1985). According to Dalenius a research project is a survey if the following prerequisites are met:

1. A survey concerns a set of objects comprising a population.
2. The population under study has one or more measurable properties.
3. The goal of the project is to describe the population by one or more parameters defined in terms of the measurable properties – requiring observation of a sample of the population.

4. To get observational access to the population, a frame is needed, i.e. business and population registers, maps where land has been divided into areas with boundaries.
5. A sample of objects is selected from the frame in accordance with the sampling design that specifies a probability mechanism, and a sample size.
6. Observations are made on the sample in accordance with a measurement process.
7. Based on the measurements, an estimation process is applied to compute estimates of the parameters when making inference from the sample to the population. [15]

What separates the sample survey from other methods of data collection, direct measurement or observation, is the reliance on the discipline of statistics. Sampling theory is used to pare down a manageable subset of a population in order to discern the underlying characteristics of interest for the larger population. The collected data is often analyzed with statistical methods for inference testing.

History

The historical development of the survey has ancient roots and ancestors. Governments were probably the first to utilize straight population counts to assess taxes and conscript soldiers as long as 2000 years ago

[15] In addition to the sources listed, the American Statistical Association published a layman's guide to answer the question *What is a Survey?* By Fritz Scheuren in 2004. Available online at:
http://www.whatisasurvey.info/

(Converse 1987). The beginning of "scientific" or what we term today sample surveys, that is ones that are unbiased and objective, may trace an ancestry back to an English study of social conditions titled *Life and Labour of the People in London* (Booth 1902) and the publishing of a monograph on the representative method of sampling from a Norwegian statistician (Kiaer 1895). Charles Booth's scope to gather "an avalanche of facts"[16] from then the world's largest city, London, became a predecessor to many subsequent social surveys in the late 19th and early 20th centuries. His methodology was original and complex for the time, examining three social observations of Londoners (work, home and religious life), which provided a broader more accurate picture of the social context than any previous efforts (Simey and Simey 1960). The use of statistical sampling to acquire unbiased information was first developed by Kiaer in the same era. He laid out the methods of applied representative sampling to include a discussion on stratification, cluster and multistage sampling, and post-stratification (Kiaer 1895).

The combination of techniques that comprise present day survey research can be traced to several related developments in the 1930's and 1940's. Building upon Kiaer's work, Neyman (1934) presented the first well-formed discussion of inferences from samples of a set population founded upon randomization, what is known today as probability sampling. Neyman was able to show that sampling error could be measured by calculating the variance of the estimator. Neyman also importantly illustrated that through randomization it is possible to make inferences about the population with known probabilities of being correct. A second significant event for survey

[16] A complete history on Charles Booth, English philanthropist and social researcher, and his seminal work may be found at the *Charles Booth Online Archive* from the London School of Economics website: http://booth.lse.ac.uk/

research was the marriage of probability sampling with controlled interviewing techniques performed at the Division of Program Surveys at the US Department of Agriculture (Warwick and Lininger 1975). Formal attitude scales, the measuring or ordering of entities with respect to quantitative attributes, were also developed at this time by Likert (1932), Guttman (1941) and Thurstone (1928).

Focusing in on the history of survey research in the United States, the first known survey completed was the U.S. Census of 1790. However, it was not until World War II that the growth of survey research in the US was accelerated and developed with attributes common today to all sample surveys. The war effort in the United States required polls on military conduct of the war, wartime rationing, sale of war bonds, and the current state of national hope and soldier morale (Converse 1987). Social scientists working for government became involved in opinion and attitude research, which included factual and behavioral measures, that later became labeled survey research. Civilian polling agencies also came into being at the time making survey research mainstream. Most notable of the public opinion polling agencies, the Gallup Organization founded in 1935 by Dr. George Gallup, pioneered the use of scientific polling techniques to ensure that their samples represented a cross section of the American public. Gallup utilized stratified random sampling methods employed by a large staff of interviewers to ascertain very accurate conclusions about Americans as a whole (Katz 1941). With the use of the voting precinct as a sampling unit, Gallup was able to accurately forecast Presidential and Congressional elections (Gallup 1957). As a result interest in public opinion flourished and the dramatic successes of the new polling organizations in predicting the 1936 presidential election

convinced both the public and political leaders of the accuracy of the methods. Gallup and other polling organizations encouraged the use of surveys to become widespread, allowing greater acceptance by the public of the surveys power to inform. Today polls and opinion organizations are well established, with Gallup, Harris and major television and newspapers conducting various polls relied upon by many sectors of society.

During and immediately after the war, policy research relying on survey research was in transition from governmental based organizations to academic institutions. The federal government housed the majority of survey research efforts in the Office of War Information (OWI), a wartime information, intelligence and propaganda agency and the Division of Program Surveys at the US Department of Agriculture. Partisan politicians, wary of the OWI's social control and policy initiatives increasingly curtailed funds until the office was terminated in 1945 (Converse 1987). The Division of Program Surveys was abolished soon thereafter for similar reasons. Rensis Likert, who had been working at the Division for Program Surveys noted:

> "We had developed survey research methodology to a point where it was a new, important, powerful research tool. No university in the U.S. was training people in basic methodology…So we thought that there was a great need for survey research methodology in its entirety to be taught in a single institution to use it in a coordinated way" (ISR 1998)

Many of the researchers for the government were formally trained in the social sciences and were now looking for a place to expand the field. They naturally gravitated toward the academy once the federal work was eliminated.

However, many university colleagues felt that survey research was impossible to differentiate from that of the work of pollsters and in need of serious scientific overhaul. Some were outright hostile to the idea believing there were inherent conflicts between the academic, business, and government culture (Converse 1987). The newly returned researchers were determined to establish survey research as a new methodology, rich in substance and scientific potential, despite the misgivings of the established social science disciplines.

Figures most notable which emerged from the wartime experience in survey research, Paul Lazarsfeld, Rensis Likert, and Harry Field, spearheaded the founding of survey research centers at universities. Lazersfeld helped found the Bureau of Applied Social Research at Columbia University, Field the National Opinion Research Center (NORC) at the University of Chicago and Likert the University of Michigan's Institute for Social Research. Each of these academically sponsored research organizations allowed the survey research field to grow while leaving intact the more established and entrenched academic departments they technically were not part of. In time survey research would become a vital methodology to academic sociology, political science, economics and psychology research.

Each of these academic research centers can claim some important contribution to survey research. Lazersfeld and “the Bureau” are credited with the quantification of the discipline of sociology. The NORC conducted research on question wording, standardized interviewer performance and most notably founded the professional association the American Association for Public Opinion Research (AAPOR) (NORC 1991). The Institute for Survey

Research further refined open-ended questioning by a large national staff and pioneered probability sampling as a preferred best practice (Converse 1987).

By the end of the 1950's the sample survey was a firmly established research tool. In the 1960's three important developments further refined the field. The advent of computers allowed for faster processing of data and more complicated statistical analyses. Computer programs such as the Statistical Package for the Social Sciences (SPSS), developed in 1968 at Stanford and further refined at the NORC helped "drive the widespread use of data in decision-making" (SPSS 2007). In the 1960's the federal government increased the use of sample surveys and the funding of social science research in general. The War Against Poverty initiative of Lyndon Johnson increased the need for surveys to provide information on the extent of social problems and evaluation of the effectiveness of programs put in place (Rossi et al. ed. 1983). A final development in the modern period of survey research development was the melding of sample surveys with other methods. Economists began to use econometric modeling of survey data, helping to further the interdisciplinary use of the sample survey.

The many contributions listed here are the basis for best practices of sample survey research design today. The development of the methodology continues to this day with contributions coming from many disciplines and the melding of various methodologies to create more powerful and specific tools for the gathering of information. The sections that follow in this chapter describe some of the best practices utilized in this dissertation's surveys. Question design and order are singled out and critiqued for potential improvement by the proposed structured conceptualization method.

Contemporary Best Practices

Several texts by survey methodologists provide lists of best practices for developing and conducting a good survey (Dillman 2006; Rea and Parker 2005; Bradburn et al 2004; Groves et al 2004; Fowler 2001; Fowler 1995; Salant and Dillman 1994; Rossi et al. 1983; Hansen 1953; Payne 1951). Many of the prerequisites for designing a survey are descended from the work of researchers and institutions previously discussed above. The American Association for Public Opinion Research (AAOPR) lists twelve considerations that constitute best practices and standards', noting quite appropriately that each is a constant work in revision (AAOPR 1997):

1. *Have specific goals for the survey.*
2. *Consider alternatives to using a survey to collect information.*
3. *Select samples that well represent the population to be studied.*
4. *Use designs that balance costs with errors.*
5. *Take great care in matching question wording to the concepts being measured and the population studied.*
6. *Pretest questionnaires and procedures to identify problems prior to the survey.*
7. *Train interviewers carefully on interviewing techniques and the subject matter of the survey.*
8. *Construct quality checks for each stage of the survey.*
9. *Maximize cooperation or response rates within the limits of ethical treatment of human subjects.*

10. *Use statistical analytic and reporting techniques appropriate to the data collected.*
11. *Carefully develop and fulfill pledges of confidentiality given to respondents.*
12. *Disclose all methods of the survey to permit evaluation and replication*.

Another easily accessible inventory of survey design best practices comes from Salant and Dillman (1994). They list ten essential steps and elements for a successful survey to include:

1. *Understand and avoid the four types of error.*
2. *Be specific about what new information you need and why*
3. *Choose the survey method that works best for the project.*
4. *Decide how to sample.*
5. *Write good questions*
6. *Design and test the questionnaire.*
7. *Put together the people and equipment able to carry out the survey in the necessary time frame.*
8. *Code, computerize and analyze the data.*
9. *Present results in a way that is informative to the target audience.*
10. *Maintain perspective while putting plans into action.*

Many of the best practices utilized in this dissertation's surveys, the Home Energy Use (HEU) and Comprehensive Plan (CP) surveys, follow the above guidelines with additional insight from Dillman's other available survey manuals (Dillman 1978; Dillman 2006) and Peterson (2000). Unless otherwise

noted, the validity of the surveys designed for this document are controlled when the above ten guidelines are followed without variation. Therefore each survey was designed, sampled and administered with consideration for error(s) and pre-tested for in the manner described in the reference texts without variation. Further discussion on how these methods were specifically adhered to may be found in Chapter 4 Methods Implementing Surveys. This chapter continues with the central focus of this literature review, a critical discussion and review of the pertinent literature surrounding survey question development and order. This is followed and concluded by a discussion of the brief literature revolving around concept mapping and its use in other measurement procedures.

Question Design and Order

It is at this juncture after noting and discussing the more salient established survey research methods that a desire to improve upon specific best practices is critically examined. A structured conceptualization, in this dissertation's specific form of concept mapping, is a participatory approach that combines the group processes of brainstorming, sorting and group interpretation. These group processes are potentially a useful method for improving question wording and order in survey questionnaire design.

Question Design

At the core of survey research is the question development process. The key considerations are the wording of the question and its placement within the questionnaire. Question wording and placement have several volumes devoted specifically to the topic (Fink 2005; Bradburn et al. 2004;

Peterson 2000; Tourangeau et al. 2000; Schuman and Presser 1996; Sudman et al. 1995; Fowler 1995; Tanur 1994; Foddy 1993; Converse and Presser 1986; Fink and Kosecoff 1985; Sudman and Bradburn 1982; Payne 1951). They all consider, starting with Payne (1951) as the classic reference, the development of language, syntax and the cognitive interplay between sets of phrases. These rules of question wording have been refined over the years striving to provide a systematic approach to writing good questions. A good question is one that produces answers that are reliable and valid measures of what the researcher wishes to describe (Fowler 1995) as well as one which avoids bias at all costs (Blankenship 1943). Furthermore, surveys are susceptible to error, while one of the most preventable threats to their validity comes from the design of their questions (Fowler 1995). A good question in essence is the heart and soul of the survey design process

Common throughout the question development literature are several rules that are commonplace among best practices: questions should be short, avoid ambiguity, not be double barreled, not be leading and ones that are not beyond the respondents capabilities.[17] Cognitively questions should ask information that respondents can access readily (Tourangeau 2000). Several themes of research in the questionnaire development literature focus on the treatment of questions concerned with behavior and attitudes (Bradburn et al. 2004; Tourangeau et al. 2000; Foddy 1993; Tanur 1992), the advantages of either open or closed ended questions (Peterson 2000; Schumann and Presser 1996; Foddy 1993) and the placement of questions within the questionnaire affecting the context of the answers (Peterson 2000; Tourangeau et al. 2000; Schumann and Presser 1996; Sudman et al. 1996).

[17] All common best practices culled and summarized from the cited literature.

Each of these doctrines of best practices was considered when constructing the final dissertation questionnaires. However, these rules do not alone provide a systematic method of question development and ordering within the questionnaire. Rather they offer a set of guidelines open to interpretation.

Although question development has more than a half century of experimentation and refinement, the established practices have come from several disciplines sometimes isolating the advances from one another, creating a disjoint and somewhat incoherent methodology. Psychologists, sociologists, political scientists all have their own disciplinary take on the writing of a good question. For this reason as well as others, question writing unlike sampling techniques which has rigorous mathematical formulations as a foundation, is as much an art as it is a science as Sheatsley (1983) and Sudman and Bradburn (1982) have noted. Schwarz (1996) neatly summarizes this idea:

> "Survey methodology has long been characterized by rigorous theories of sampling on the one hand and the so called 'art of asking questions' on the other."

Finally, Rea and Parker (2005) characterize good questionnaire construction as a "highly developed art form within the practice of scientific inquiry." Question writing being as much art as hard science, the use of language, syntax and context for question development is open to unique cognitive approaches such as the one presented in this dissertation for an evolving approach to questionnaire design. This author maintains where there is art there is opportunity for innovation.

A framework for constructing an effective questionnaire, one that focuses on the question development and ordering process specifically is provided by Peterson (2000). The seven distinct tasks he lists in figure 8 are the culmination of many of the best practices for question design and one that provides an outline where a structured conceptualization attempts to provide further refinement and organization.

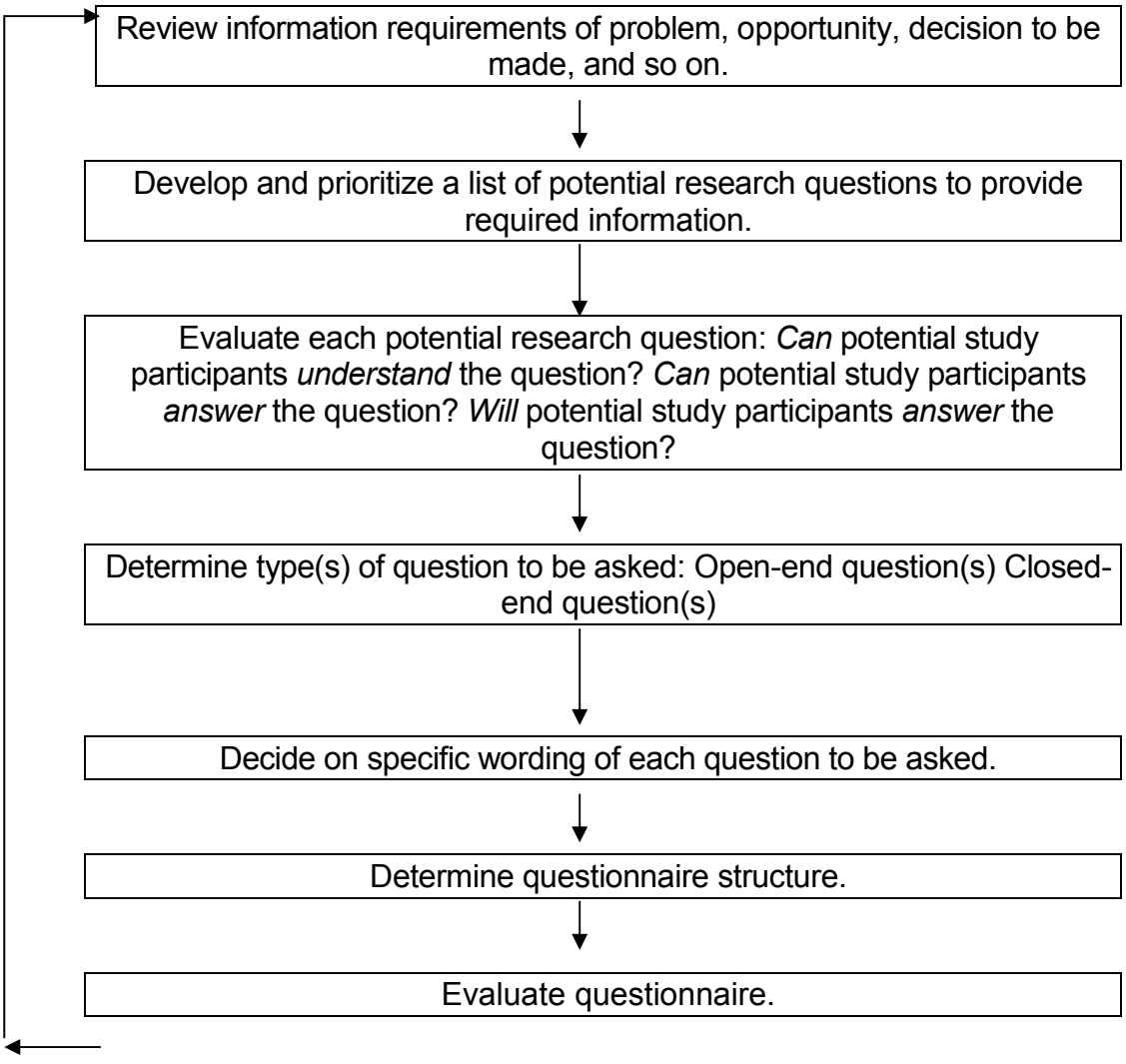

Figure 8 Seven Tasks When Constructing a Questionnaire, Peterson 2000

Utilizing Peterson's template and associated instruction for completion of each task, it becomes apparent that there is a wide degree of latitude and ambiguity when considering task 5 and 6 – decide on the specific wording of each question asked and determine questionnaire structure. To paraphrase his method of effective question construction a researcher should have common sense, knowledge of psychological and linguistic phenomena and experience in constructing questions (Peterson 2000). In further support of the idea that rules for question content development are vague and ambiguous, further examination of the literature provides more evidence. Fink and Kosecoff (1985) describe their rules for question writing as to be mindful that each question should be meaningful, use standard English, be concrete and avoid bias. Foddy (1993) echoes the sentiment that formulated questions should be as specific and concrete as possible. Fowler (1995) and Tourangeau (2000) reiterate the importance of understanding the cognitive element when designing good questions. They both implore researchers to write questions that ask people about their firsthand experiences with information they can easily access.

In this critical analysis of the literature it becomes apparent that there is lacking a systematic method that may provide an alternative method of good question development and ordering of the questions. The proposed method may provide an appropriate alternative method for individual question development and systematic guidance when ordering questions within the questionnaire other than the vague rules to be applied as illustrated in the above discussion. How exactly the structured conceptualization approach addresses these shortcomings is saved for the Results and Analysis chapter.

Question Ordering

As discussed in the previous section, there are no universal principles to follow when constructing questions as are none when structuring the order of questions within the questionnaire. Research on survey methods has either ignored the issue altogether (Weisburg and Bowen 1977; Smith et al. 1976) or has only given unsupported, common sense instructions for the ordering of questions (Rea and Parker 2005; Bradburn and Sudman 1979; Dillman 1978; Kornhauser and Sheatsley 1976; Miller 1970; Backstrom and Hursh 1963). What hard and fast rules do exist for ordering of questions pertain to awareness of context effects (ordered so as to minimize the effect of respondents' answers on subsequent questions) (Bradburn et al. 2004; Tourangeau et al. 2000; Converse and Presser 1986) and to guarantee that the opening question is an easy, non-threatening one (Rossi et al. 1983). McFarland (1981) found question order effects significantly influence responses, providing a concern to carefully plan question order within every survey.

From the review of the above literature, it is clear there is a cognitive component to the ordering of questions within a questionnaire. Prior questions can influence answers to subsequent questions. The meaning or facts of the current question can influence interpretations of following questions, while thoughts or feelings brought to mind while answering a question may influence answers to subsequent ones (Tourangeau et al. 2000). In other words when respondents are asked to answer a question they must retrieve some cognitive depiction of the question stimulus, and at the same time determine a standard of comparison to evaluate it. Much of what is called to mind is

influenced by preceding questions and answers, leading to context effects. The problem is well understood; the solution much less so.

After deciding on the wording of each question then, the questionnaire is assembled following the current best practices: arrange questions from general to specific, those most agreeable to those most objectionable, and group questions of the same topic together (Salant and Dillman 1994 Dillman 1978, 2006). Another regarded method instructs the researcher to first organize separate questionnaire topics, decide on the order, and then order the questions carefully within each topic (Weisberg et al. 1996). Further bolstering the cognitive association of question order to good survey design, Rossi et al. (1983) clarifies the theme that questions should flow in some kind of psychological order, where one question leads easily and naturally into the next. Questions on one subject, or one particular area of a subject, should be grouped together and asked consecutively before proceeding to the next subject. Again, there is no more systematic direction to achieve these tasks then to make sure questions flow naturally and that each question not influence the next.

Structured Conceptualization in Instrument Design

Structured conceptualization methods, in this dissertation's specific form concept mapping, have an emerging tradition related to the development of social science measurement tools and instrument creation. The fundamental weaknesses identified in this literature review regarding survey instrument design focus on the lack of a systematic method to develop questions and order them within a survey instrument. The Trochim Concept Mapping method (discussed fully in Chapter 3 Methods of a Structured

Conceptualization for Survey Design) provides a possible systematic cognitive framework to develop survey questions and order them within a group framework in a potentially more meaningful way. Subsequently, concept mapping has been used to create many alternative measurement tools for use in the program planning and evaluation field. Upon review of the current concept mapping scholarship, an orderly efficient method has yet to be put forward where a marriage of concept mapping with survey instrument design may specifically produce a better survey instrument. Similar approaches utilizing a structured conceptualization method to construct measurement tools and evaluation instruments have occurred. Other scholars have directly identified the power of matching sorting and scaling procedures (like concept mapping) that may prove useful for questionnaire development and evaluation. Where these scholars have left off this dissertation attempts to embellish these ideas and formalize a method. Details of the literature are described below.

The Trochim (1989a; 1989b; Trochim and Linton 1986) concept mapping method has a tradition of being utilized for the development of various measurement and evaluation instruments. The technique has been involved in the assessment of the construct validity in measurement procedures (Davis 1989; Marquart 1989), as a tool to analyze open ended survey responses (Jackson and Trochim 2002) and used to develop an indicator instrument for addiction treatment centers (Nabitz et al. 2005).

In addition the idea of employing concept mapping to develop measurement tools and instruments has been explored indirectly in several doctoral dissertations. Concept mapping has been utilized in dissertations to measure community living among psychiatric patients (Dumont 1993) and reform within the National Park Service (Weir 2001). Torre (1986) comes closest to

resembling the ideas put forth in this dissertation. Torre utilized the structured conceptualization process to develop an empowerment instrument consisting of four multiple-item scales. This process was similar to the one employed in this dissertation by utilizing concept mapping to develop a scaling instrument, however the primary purpose of this document is solely to defend an improved method of question development and order for survey instruments from a structured conceptualization process rather then a byproduct of evaluation efforts.

Furthermore, Marquart (1989) provides an insightful observation when using concept mapping to determine the correspondence or validity between observed data and data based upon theory. In this paper observed measurements were received from a questionnaire while the theoretical and observed measurements generated through concept mapping were offered as proof of the questionnaire's validity. Marquart concludes that,

> "The approach could be used to guide the entire instrument development and validation process by involving the program constituents in conceptualizing the major concepts of interest, using those concepts to construct an instrument, and then using the data collected to provide evidence for the construct validity of the instrument as well as to assess program outcomes." (Marquart 1989)

Marquart's keen observation outlines the fundamental insight and purpose of this dissertation: developing a survey instrument with a structured conceptualization process.

Marquart's observations are further echoed by Brewer and Lui (1996) where they identify the potential usefulness of conceptualization methods applied to survey design. They propose the strengths of sorting and scaling techniques may inform decisions about the structure and ordering of questions but also provide a technique to understand the differences in interpretation of questions between different respondent populations in questionnaire design. Although Brewer and Liu did not set out specifically to design an instrument from a structured conceptualization method, they and Marquart (1989) saw the real potential of developing a systematic method of designing a questionnaire from structured conceptualization techniques.

Finally, Rosas and Camphausen (2007) and Kane and Trochim (2007) in two similar studies illustrate how concept mapping may be utilized for scale development. Rosas and Camphausen (2007) integrated concept mapping and traditional scale-development processes by actively engaging the program staff and managers in the specification of the content domain of a scale that would ultimately be included within a larger evaluation instrument. Kane and Trochim (2007) in a case study performed by Concept Systems, Inc. (parent company to Concept Mapping software), undertook an evaluation for the Transdisciplinary Tobacco Research Centers (TTURC) which exposed several questions that needed to be addressed. Concept Systems utilized the concept map from the evaluation to identify specific questions and organize them so TTURC would better effectively meet their organizational needs. Both study's utilized similar methods described here to create a measurement instrument (Chapter 3 Methods of a Structured Conceptualization for Survey Design), yet the logical framework of devising questions directly from statements while breaking the survey into defined ordered sections referring to cognitive

cleavages from the map is unique to this dissertation. This dissertation attempts to further build upon these examples and refine the method into a systematic repeatable procedure to generate survey instruments of all types.

Conclusion

The majority of the standard best practice rules for question development and question ordering within surveys can be approached with a respectful dose of skepticism. Much latitude is left to the researcher's individual preferences and judgment on how a question is to be worded and where it is to be placed within the questionnaire. This may lead many critics to unjustly denigrate survey design as an art that has little scientific validity. Science appreciates systematic methods that provide valid and reliable results; those that may be generalized and are repeatable. The proposed structured conceptualization process for survey design attempts to address several of the more 'artistic' approaches to survey question construction, ordering and overall purposeful development. Utilizing a group cognitive process to accomplish the task of designing a survey instrument provides structure with a foundation rooted in the very cognitive processes survey researchers independently cobble together when constructing questionnaires. With a structured conceptualization, the specific tasks of question writing and order are provided a potential systematic solution to this effect. These processes are discussed fully and defended in the following chapters.

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CHAPTER 3

Methods of a Structured Conceptualization for Survey Design

Introduction

The following chapter provides a discussion of the underlying method for a structured conceptualization approach to survey instrument design. Concept mapping, a type of structured conceptualization developed by William Trochim of Cornell University, is a method that provides a visual representation of relationships between a set of ideas or concepts (Novak 1998, Trochim 1989a). The term "structured conceptualization" refers to any process which can be described as a sequence of concrete operationally-defined steps which yields a conceptual representation (Trochim and Linton, 1986). Planning and evaluation efforts rely on many of the relevant methodologies that comprise the larger umbrella of conceptualization. For both planning and evaluation efforts, multiple stakeholders often collaborate to conceptualize the effort leading to the identification of key variables, goals, objectives, and hypotheses.

One of the most relied upon measurement tools in the evaluation field is the sample survey. Survey instrument design is often haphazard or arbitrary, lacking a structured systematic approach toward development of the survey questions and the ordering of those questions. Sheatsley (1983) emphasizes that unless the investigator has a conceptual or analytical framework to guide the decision making process, there is no particular reason for the inclusion of certain items in the instrument. Without a clear conceptual grounding, investigators run the risk that the content domain may not accurately reflect the phenomenon under study. Concept mapping offers a unique prospective

method of conceptualizing the survey development process, providing questionnaire content and a routine for ordering the questions while taking advantage of the multiple collaborative efforts found in the mapping process; it informs the survey developers of dimensions of the instrument often overlooked. Specifically negative group interactions which often result when two or more people gather to solve problems. The method coupled with current best practices potentially results in a potentially more rich and valid survey instrument designed within a group format.

The Concept Mapping Methodology

There are many methods in the social sciences that go by the name 'concept mapping'. These vary from informal processes where a group will brainstorm statements around a focus prompt and arrange those casually using printed cards or 'post its' in a hierarchical organization (Novak and Cañas 2006) to the other extreme of utilizing mathematically derived proximities ((dis)similarities between ideas) with the statistical technique of multidimensional scaling (MDS) (Kruskal and Wish 1978). Whether the form of structured conceptualization is called concept mapping, mind mapping, causal mapping, or cognitive mapping they all share a common theme. The concepts are represented visually where the relationships between the concepts are shown by the spatial relationship between shapes and links.

Concept mapping, the Concept System® and a concept map, as it relates to and formulates the structured conceptualization method of survey design discussed throughout this dissertation, refers to the methodology developed by Professor William Trochim of Cornell University. The Concept System® software developed by Trochim has been used in a variety of

research contexts and situations. The Trochim concept mapping methodology has enabled researchers to address substantive issues in several fields with various themes found in the following sample of published reports: in the social services (Savaya and Waysman 1995, Galvin 1989; Marquart 1989), mental health (Corcoran 1999; Florio 1996, SenGupta 1996; Shern et al. 1995, Colebaugh et al. 1995, Lassegard 1993; Marquart et al 1993; Cook 1992; Trochim and Cook 1993; Kane 1992; Marquart 1992; Penney 1992; Ryan and Pursley 1992; Shern 1992; Valentine 1991; Trochim 1989b; Marquart 1988; Trochim et al. 1998), health care (Valentine 1992), community development (McClintock 1998), education (Brossard 1998; Trochim 1996; DePuy 1996; Grayson 1993; Kohler 1993; Kohler 1992), educational administration (Gurowitz et al 1988), training development (Kane 1996; Fellows and Setze 1996), curriculum planning and evaluation (Trochim et al. 1998), religious inquiry (Kunkel et al 1999), human resource management (Warzynski 1998;), organizational development (Trochim 1998; Kolb and Shepherd 1996, Michalski 1996), organizational decision making (Berg 1998), code and word-based text analysis (Jackson and Trochim 2002), and theory development (Witkin 1996; Linton 1989). Concept mapping has proven valuable in the evaluation of processes, the planning of programs and the organization of ideas. It is this organization of ideas which is tantamount to successful survey instrument development. By marrying the standard structured conceptualization process of concept mapping with the best practices of survey instrument design, the researcher is allowed to engage several diverse participants, resulting in a potentially more thorough, collaborative, informed survey instrument.

Typical Steps in Developing any Concept Map

The process of concept mapping allows a disparate group of individuals to meld their ideas into an easily interpretable pictorial representation. There are many external benefits attributable to the concept mapping process with respect to survey instrument design which will be discussed in detail later. Some of the external benefits of a concept mapping process are an assurance that a group stay focused on the primary task in its charge; produce results quickly in an interpretable framework; express the framework in the language of the participants; and many times improve group cohesiveness and morale (Trochim 1989a).

A standard concept mapping process includes a sequence of structured group activities linked to a series of multivariate statistical analyses that process the group input and generate maps. Clusters are developed around themes culled statistically from the statement set as generated by respondents. The process begins with participants brainstorming a large set of statements relevant to the topic of interest in the form of a focus prompt which are then individually sorted into piles based on conceptual similarity (a free or single-pile sort technique) (Weller and Romney, 1988). The analysis includes a two-dimensional multidimensional scaling (MDS) of the sort data and a hierarchical cluster analysis of the MDS coordinates performed by the Concept System® software. The resulting maps represent a "structured conceptualization" or a multidimensional graphic representation of the group's set of ideas. Within these maps are dots or points which represent each idea from the statement set. Ideas that are more similar determined by the multivariate analysis of the participants' sort data are located more proximally. These ideas are clustered statistically into larger categories that are overlaid

on the base maps. In summary, employing the Concept System® typically involves six defined steps.[18]

1. Preparation for the project.
2. Brainstorming around a focus prompt by relevant stakeholders to generate a list of statements.
3. Unstructured sorting of similar statements and rating of statements.
4. Computation of the map utilizing multidimensional scaling.
5. Interpretation of the cognitive maps
6. Implementation of the cognitive insight gained from the maps and process.

Structured Conceptualization Approach to Survey Design

Similar to the standard concept mapping process, a structured conceptualization approach to survey design incorporates all the original steps except rating of the sorted statements. Additionally, this unique approach to the design of a survey instrument borrows from the inherent synergies of standard concept mapping to make a potentially more robust rich survey. Specifically, it is put forward that the brainstormed statements provide a substantive body of survey question material. The conceptualized group map may provide a significant method of ordering question groups within the survey. The following examples will lead the reader through the application of concept mapping coupled with the best practices of survey instrument design.

[18] Concept Systems Incorporated owns the license to the concept mapping software used in this document to create the various concept maps. The Concept System® was developed by William Trochim, Ph.D., Professor of Policy Analysis and Management at Cornell University. Further information on the suite of services provided by Concept Systems Incorporated may be found online at: http://www.conceptsystems.com/

The standard concept mapping exercise has been refined by Trochim in several papers (Trochim 1989a, Trochim 1989b, Trochim 1993, Trochim and Linton 1986) making it unnecessary to reexamine in specific detail the standard use of the method here. The following two examples in this dissertation employ the standard concept mapping procedures. To assess the proposed methodology, two separate surveys were developed employing the structured conceptualization process. The first was undertaken as a joint project of Cornell Cooperative Extension (CCE) of Tompkins County and the New York State Energy Research and Development Authority (NYSERDA) from June 2005 to August 2005. The survey instrument required was one that evaluated the residential energy use, practices and patterns of households in the Southern Tier region of New York State. Cooperative Extension and NYSERDA would utilize the knowledge gained from the survey to better target services aimed at home energy conservation. This survey is titled the Home Energy Use Survey or HEU for short. The second survey instrument produced with the method was to aid in the development of a new comprehensive plan for the Village of Trumansburg, New York titled Comprehensive Plan Survey or CP for short. The Village required a 'snapshot' of attitudes and desires from residents regarding their outlook for the future of the Village. The comprehensive plan will incorporate the survey knowledge into a legal document which provides a roadmap for future governance.

As mentioned previously, each standard step of the concept mapping process was followed with the exception of rating of the brainstormed statements. In planning and evaluation projects it is often helpful to encourage participants to rate each brainstormed item on how important it is or how much effort or emphasis is to be placed on the specific action (Trochim 1989a). The

assumption by designing a survey with the structured conceptualization method lacking the rating step is that the statements themselves would be vetted or internally rated during the question development process. Rather than invoke any prior bias into the group statement set with rating scales, this step was eliminated so as to facilitate the unique process of survey questionnaire development. What follows is the several steps involved in the structured conceptualization process of survey instrument design.

1) Preparation for the Project

The design of a successful survey instrument shares a common set of best practices. Both survey development exercises required the assembly of useful information for the specific projects. Equally CCE/ NYSERDA and Trumansburg desired further knowledge and insight on the beliefs, attitudes and behaviors of the populations in question. The survey questionnaire was chosen as the best vehicle to achieve this end. Dillman (1978, 2006) has been at the forefront of contributing to the development of modern mail, telephone and internet survey methods for over three decades as discussed in the literature review. Dillman describes ten successful steps when developing an instrument that is likely to determine the characteristics, opinions and behaviors of a particular population. According to Dillman and his colleague Priscilla Salant (1994), steps for a successful survey include[19]:

1. Understand and avoid the four types of error. Avoid coverage error, where a sample drawn does not include all elements of the population.

[19] Priscilla Salant and Don Dillman (*How to Conduct Your Own Survey*, John Wiley and Sons 1994) have written an accessible reference for construction of survey instruments. Many of the best practices described in this section and literature review are draw from this text along with Dillman's other seminal work *Mail and Telephone Surveys: The Tailored Design Method* , John Wiley and Sons 1978 and 2006.

Minimize sampling error which always occurs short of performing a census. Ensure that measurement error is minimized with accurate and precise answers. Lastly, non-response error may be avoided by ensuring a significant number of people respond to the survey.

2. Be specific about what new information you need and why. In the case of each of the pilot surveys, factors and concerns that might influence energy consumption and conservation and what future vision do the residents of the Village of Trumansburg have, was desired information.
3. Choose the survey method that works best for the project. Telephone, drop off or mail among several hybrids. This choice potentially has the greatest effect on response rate.
4. Decide how to sample.
5. Write good questions and order them. Arguably a significant criterion to the success of a survey instrument. It is hypothesized that question writing and order is improved significantly with the use of the structured conceptualization approach.
6. Design and test the questionnaire.
7. Put together the people and equipment able to carry out the survey in the necessary time frame.
8. Code, computerize and analyze the data.
9. Present results in a way that is informative to the target audience.
10. Maintain perspective while putting plans into action.

Although each of the above steps is critical in delivering a complete product, this methodology is focused on the beginning steps of the process up to writing and ordering good questions. The Tailored Design Method (TDM)

(Dillman 2006) additionally presents several considerations to keep in mind when designing a survey instrument. The primary purpose of the Tailored Design Method is to create a survey that fosters trust and perceptions for increased rewards and reduced costs for the respondents. The TDM draws from Homans' social exchange theory (Homans 1958) where he conceived that all human relationships are formed by the use of a subjective cost-benefit analysis and the comparison of alternatives. The likelihood that a respondent will complete a questionnaire is greater when the respondent trusts that the expected rewards of responding outweigh the costs. In order to establish trust a token of appreciation is encouraged for the respondents. The TDM also suggests that the questionnaire be sponsored by a legitimate authority. Cialdini demonstrated that people are more likely to fulfill a request if it comes from an authoritative source (Cialdini 1984). Whereas, Heberlein and Baumgartner (1978) found that surveys sponsored by a governmental authority achieved higher response rates. Lastly, Dillman recommends that the task appear important. A visually appealing professional looking survey has been proven to enhance response rates over poorly designed, sloppy attempts. All of these factors are accounted for or taken into consideration with the two dissertation surveys.

With the above considerations in mind, both survey groups settled on employing a structured conceptualization method which not only allowed strict adherence to many of the best practice concerns of successful survey writing but provided a potential improvement to question writing, order and group processes. Alternative approaches to questionnaire design were discussed with the constituent agencies. These typical methods included traditional top down approaches from a dominant committee or group members attempting

initial drafts of the documents for future committee review. As previously mentioned, a proven strength of the structured conceptualization approach utilizing concept mapping short circuits the top down approach in group processes and encourages the greatest number of relevant stakeholders to provide input. Both constituent groups overwhelmingly decided to attempt the newly devised structured conceptualization process based upon the hypothesized improvements.

The two foremost tasks in preparation for the concept mapping procedure then involve deciding on who will participate in the process and secondly, settling on the specific focus for the conceptualization. Selecting participants for each survey required a different approach. The HEU survey was to ascertain energy use patterns, consumption and conservation practices by households in the Southern Tier. NYSERDA anticipated utilizing the information to market energy conserving educational seminars and products to homeowners, landlords, nonprofits and municipal officials. Acting as facilitator for the concept mapping process, the author suggested sampling participants from the potential audience the information would eventually serve. As Trochim (1989a) discusses, it is not necessary for all participants to participate in every step of the conceptualization to realize valid results. With the case of the HEU survey it proved to be infeasible to include landlords, municipal officials and homeowners in each step of the process given the time constraint of the project.[20] The final decision made by NYSERDA and Cornell Cooperative Extension personnel was to include several diverse community

[20] The HEU survey was commissioned to be completed as a summer project which utilized hired interns from local universities. This time factor constrained many facets of the program, yet none of the concept mapping procedures or methods suffered due in part to strict organizations and adherence to a predetermined timeline.

members in the statement generation process yet limit the sorting to a select sub group of accessible participants. Following in no particular order were the participants for the HEU concept mapping process: community educator, retired homeowner, landlord of residential property, economic development coordinator, county legislator, chamber of commerce coordinator, non profit organization personnel, cooperative extension personnel, NYSERDA personnel, interns and facilitator of the project. Eighteen total participants participated in the statement generation exercise.

The CP survey required a similar approach in attempting to assemble a diverse group for the mapping process. The CP survey anticipated receiving a varied set of opinions from several residents in the Village of Trumansburg from the completed survey. To that effect a comprehensive plan committee was established as a sub committee of the Village Board of Trustee's to devise and administer the survey. The only criterion for membership was that the committee was composed of residents of the Village or those in the Trumansburg School District. Final group composition consisted of eight to twelve steady participants from their early twenties to early eighties, equally split gender, various occupations and racially homogeneous. All committee members were encouraged to participate in the entire concept mapping process. The time commitment to the process was scheduled with a two year work plan, while the survey design aspect of the broader comprehensive planning process was to be the first task completed.

The second preparatory step in the concept mapping process was to develop the focus or domain of the conceptualization for each group. The purpose of each survey is to further knowledge and insight on the beliefs, attitudes and behaviors from a population on a question of interest. Several

sessions were devoted to the development of the focus prompt or focus statement as it is often called. With the widespread availability of computer technology at the time of the process, the standard for communication between the facilitator and participants would be electronic mail. Face to face meetings when necessary were scheduled, however it has been demonstrated that the concept mapping process may entirely be achieved through electronic communication.[21] Various alternatives were discussed for the HEU focus prompt with the following e-mailed letter settled upon (figure 9):

To: Community Advisory Panel on Energy Conservation

From: Energy$mart Team of Tompkins County Cornell Cooperative Extension

Date: May 16, 2005

Re: Guidance for development of our energy surveys

We would appreciate your help in identifying the many issues involved in energy conservation in Tompkins County. Please take about ten minutes to help us by completing the following exercise.

Note: if you are a service provider, please try to answer from the perspective of your average client or sector representative (e.g. homeowner, tenant, business, landlord, etc.)

Please generate short phrases or statements to finish the following sentence:

"Specific factors and concerns that influence my energy consumption and energy conservation are…."

There are no right or wrong answers – the general rules for brainstorming apply! You are encouraged to generate as many statements as possible without second guessing your responses. We would appreciate your effort to be as clear as possible and to define any technical or unfamiliar terms in your statements.

Figure 9 Instructions to HEU Survey Participants

[21] Concept Systems software allows for a complete web based concept mapping experience.

Figure 9 (Continued)

Please note that your responses will be treated as anonymous and confidential. Results will be pooled without attribution to the source. With your permission, we'd like to contact you again next week for your help in thinking about how to organize the concepts, once we have identified the common themes. From this information, we will be developing qualitative surveys to assess interests, concerns, barriers, and opportunities for energy conservation in various target audiences.

Please send your brainstormed list of factors and concerns to…

The focus prompt, *'Specific factors and concerns that influence my energy consumption and energy conservation are….'* drives the thought process to the specific purpose in undertaking the concept mapping exercise. The prompt is oriented toward eliciting a broad set of statements relating to that prompt. It maintains the required brevity while being instructive to the group and remaining single focused.

The CP exercise shared a similar format in creating a successful prompt involving collaboration by the comprehensive plan committee. However members of the CP group undertook the whole mapping exercise whereas the brainstorming and sorting members of the HEU group were made up of different individuals. This second prompt is also focused and directed to the purpose of the exercise (figure 10). It indirectly requested statements that encourage contemplation of questionnaire content for the survey. This focus prompt revealed a more straightforward method of developing survey questions when the time came to do so.

Please generate 5-10 short phrases or statements to finish the following sentence:

"Key issues and concerns that makeup the Trumansburg Comprehensive Plan Survey include…"

There is no right or wrong answer – the general rules for brainstorming apply! You are encouraged to generate statements without second guessing your responses.

Figure 10 Instructions to CP Survey Participants

In summary, it is imperative to discuss best practice survey design methods prior to the mapping process with the stakeholders of the survey development team in order to lay a foundation for how the proposed structured conceptualization may contribute. The mapping process is then clearly understood with a direct connection to steps 2 and 5 through 7 of the Dillman successful survey elements. Focusing the purpose of the survey, thinking toward a prompt which in turn generates a domain of statements all leads to a systematic design of the questionnaire which will be discussed in the following sections.

2) Group Brainstorming

Once the participants and focus prompts have been defined, the actual concept mapping process begins with the generation of a set of statements that ideally represent the complete conceptual domain for the topic of interest. Group brainstorming is the preferred method of generating the conceptual domain in the structured conceptualization process for survey design. Not only does the generation of a free list by participants allow group thinking focused on a particular subject, but it provides a statement set useful to the design of

the ensuing survey questions. The brainstorming session actually begins with the development of the focus prompt in the previous preparatory step. Guidelines for the discussion concerning the free list generation or group brainstorming exercise are established from the work of Osborn (1948) on creativity and imagination.

The brainstorming concept deserves further explanation given the important role the statement set plays in the generation of the survey questions. The rules for brainstorming established by Osborn provide a useful foundation for instruction of a group brainstorming session (Osborn 1948):

1.) Judicial judgment by participants is discouraged. Criticism of ideas is withheld.
2.) "Wildness" is welcomed. Creativity is sparked during unstructured erratic thinking as opposed to a top down regimented effort.
3.) Quantity is desired. The more ideas gathered, the greater likelihood the entire conceptual domain is realized.

That is, participants are encouraged to generate a lot of statements and told there should be no criticism or discussion regarding the legitimacy of statements generated during an open group session. Creativity and imagination are spurned to produce ideas that may often go unstated in the typical survey question development process. Before brainstorming however, participants are encouraged to seek final clarification for any unfamiliar terms or jargon in the focus prompt so all who participate may understand what was intended by a given statement.

As per the preparatory step, the statement generation is accomplished through electronic mail. Participants are sent the introductory email with the

focus prompt and a reminder of the brainstorming rules as listed above. There is no limit to the number of statements generated, however Trochim (1989a) recommends a final group statement set of 100 statements or less. The facilitator may restrict the number of statements requested from each participant accordingly.

Once the statement set is returned via email and recorded by the facilitator, it is usually necessary to 'clean' the completed conceptualization set of errant or similar ideas. Furthermore, statements that express two or more ideas, referred to in the concept mapping literature as 'double-barreled statements', are split such that each statement conveys a single idea. Double-barreled statements may be problematic for the sorting activity. A statement that is illogical or incoherent may also be eliminated at the discretion of the group. Paring down the set from over 100 statements is often necessary to provide the suggested 100 or less final statements in the conceptual domain.. This is where the concept mapping facilitator will use their best judgment in combining like statements for further review. For example, responding to the prompt,

> "Please generate short phrases or statements to finish the following sentence: *'Specific factors and concerns that influence my energy consumption and energy conservation are….'*", [22]

many of the HEU survey group generated the following similar statements:

- Costs for conservation practices
- Costs of fuel and other energy sources

[22] The complete list of generated statements for each concept mapping exercise may be found in the appendix.

- Costs
- Lack of financial resources to pay for sufficient energy needs
- Costs involved with upgrades

Such a list might generate the common statement, "the costs related to changing my behavior." This not only trims the master list but maintains the essence of several statements with one concise addition. It is advantageous for the facilitator to compile these like statements and bring to the group's attention for a final edit if time is constrained. In both survey groups an additional meeting was required to aggregate similar statements and edit double-barreled responses.

3) Unstructured Sorting

Once the statement set is acceptable to the group, each member who participates sorts the brainstormed statements. Each statement is printed, numbered and duplicated for each member on a card. N participants will receive N decks of randomly shuffled cards, one for each sorter. The participants are instructed to sort all of the statements into piles in a way that makes sense to them. There are two guidelines for this activity.[23] First, all statements must be sorted into a pile even if the statement itself serves as a pile. Second, a statement can only be placed into a single pile. The result is an unstructured similarity sort of all the statements in the set for each participant.

Again, there is an electronic approach to collecting the sort data form the group rather than a manual group meet up approach. The Concept

[23] See Weller, S., and Romney, A. K. in Systematic Data Collection. Thousand Oaks, CA: Sage, 1988, for a full discussion on sorting technique.

System® allows sorting by each participant via a personal computer when personal meetings are not desired or possible. In the conceptualization method for survey design it is advantageous to sort face to face, because the facilitator may observe the ease or lack thereof of sorting the statement set by participants. A problem that may arise in sorting is a good indicator of the ease with which question composition will be accomplished.

In a manual sort, the following instructions (figure 11) are provided to sorters:

Step 1 - Sorting the Task Statement Cards.

Enclosed in your package is a deck of cards with one statement per card. Each card has a statement and an ID number. We would like you to group the statements into piles in a way that makes sense to you, following these guidelines:

- Group the statements for how similar in meaning they are to one another. Do not group the statements according to how important they are, how high a priority they have, etc.
- There is no right or wrong way to group the statements. You will probably find that you could group the statements in several sensible ways. Pick the arrangement that feels best to you.
- You cannot put one statement into two piles at the same time. Each statement must be put into only one pile.
- People differ on how many piles they wind up with. In most cases, anywhere from 10 to 20 piles usually works out well.
- A statement may be put alone as its own pile if you think it is unrelated to all the other statements or it stands alone as a unique idea. Do not have any piles of “miscellaneous” statements.
- Make sure that every statement is put somewhere. Do not leave any statements out.

Step 2 - Recording the Results. You also have in this packet a Sort Recording Sheet for recording the results of your groupings. On that sheet, please write the results as described below. An example of how to record a pile is shown in the first box on the Sort Recording Sheet.

- Pick up any one of your piles of statements. It does not matter what order the piles are recorded in.

Figure 11 Sorting Instructions

Figure 11 (Continued)

Quickly scan the statements in this pile, and write down a short phrase or title that describes the contents of the pile on the line provided after Pile Title or Main Topic in the first available box on the Sort Recording Sheet.

- In the space provided under the pile name, write the statement identification (ID) number of each card in that pile. Separate the numbers with commas. When you finish with the pile, put it aside so you don't mistakenly record it twice.
- Move on to your next pile and repeat the three steps above, recording the statement numbers in the next available box on the Sort Recording Sheet. Continue in this way until all your piles have been named and recorded.
- Your Sort Recording Sheet has room for you to record up to 20 piles or groups of cards. As mentioned above, any number of piles (usually 10 to 20) is fine. If you have more than 20 piles, continue recording your results on a blank sheet of paper and be sure to attach this extra sheet to the ones provided.
- Please write legibly and clearly. Most of the errors that find their way into the program and results are made at this stage and are due to data that is hard to read.

The HEU survey group had a total of eight sorters while the CP group totaled twelve individual sorters. Participants were observed to sort ideas into similarities among several piles on average in fifteen minutes. Once each sorter became comfortable making their piles, the pace quickened with nary a word spoken. Recording of the sorts onto the standard Sort Recording Sheet[24] proved unremarkable and without incident. The relative smooth process each group displayed in their first concept mapping exercise provides evidence that the preparation was sound, the statements comprehensible and the direction clear.

[24] Relevant materials for performing a concept mapping project may be found on the Concept Systems Inc. website: http://www.conceptsystems.com/software/software.cfm

4) Computation of the Maps

Brainstorming and sorting steps in the concept mapping process on the whole are both straightforward and easily understood by participants. However, the analysis step is often obscure to mapping participants. In this step the individual sort data is run through a computer algorithm to perform a nonmetric multidimensional scaling (MDS) function resulting in the pictorial maps. When developing a survey with the structured conceptualization approach, it is not necessary to spend valuable face to face group meeting time providing an in depth explanation of the MDS process. In essence, it is sufficient to explain to participants that each individual's sort data is used to generate all of the concept map results with the Concept System®.

However, the underlying algorithms that convert ideas or statements to pictorial maps arranged according to (dis)similarities is a necessary discussion, one that bolsters the foundation of survey design using a structured conceptualization.

The Concept System® and MDS

Multidimensional scaling has proven valuable when used to examine the structure underlying interrelationships between objects or ideas. It has been used to examine the psychosomatic responses of speech (Shepard 1972), sounds (Howard and Silverman 1976) and works of art (O'Hare 1976). The method is particularly useful in discovering the psychological underpinnings that compose the cognitive processes of a diverse group when stimulated by a prompt or focus.

The Concept System® employs a non metric multidimensional scaling algorithm making it a useful software program to bring order to group cognitive

processes such as the examples listed previously and hypothetically in this document, the development and organization of a survey instrument. Each participant sorts the statements into similar piles as described in the previous step. They do this by sorting a deck of cards that has one statement on each card. They can have as few or as many piles as they want. Each participant names each pile with a short descriptive label. Once this basic sort information is entered into the Concept System®, each participant's unstructured similarity sort is converted into a square binary matrix with as many rows and columns as there are statements. Square, in that the vertical and horizontal axis is equal to N number of statements. Binary, in that a ‘1’ is entered for a statement for that row and column that a participant sorted or placed together, ‘0’ otherwise. Finally, these individual matrices must be combined across all participants, to provide a group similarity matrix.

In most concept mapping exercises there are roughly 100 statements in the brainstormed statement set, so the final matrix would be 100 rows by 100 columns. Figures 12 and 13 give a simplified example of a 10 statement set sorted into 3 piles by a single participant. The matrix is perfectly symmetrical along the diagonal axis because each statement must by definition be sorted with itself. Thus, each participant's sort information is converted into an N x N matrix. This explains why the value '1' appears at every statement row-column intersection along the diagonal of the matrix.

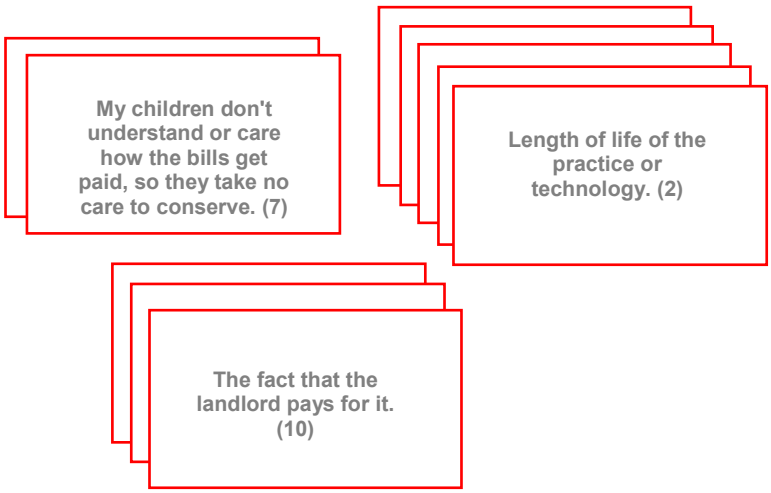


Figure 12 Participant Sort Piles

Source: Trochim 1989

	1	2	3	4	5	6	7	8	9	10
1	1	0	0	0	0	0	0	0	0	1
2	0	1	1	0	0	1	0	0	0	1
3	0	1	1	0	0	0	0	0	0	0
4	0	0	0	1	0	0	0	0	1	0
5	0	0	0	0	1	0	0	1	0	0
6	0	1	0	0	0	1	0	0	0	0
7	0	0	0	0	0	0	1	0	0	1
8	0	0	0	0	1	0	0	1	0	0
9	0	0	0	1	0	0	0	0	1	0
10	1	1	0	0	0	0	1	0	0	1

Figure 13 Binary Square Similarity Matrix for One Sorter

Source: Trochim 1989a

By decomposing a participant's sort data into a binary square similarity matrix, a common data structure is created that can be repeated for all participants. Next, each participant's binary square similarity matrix is

combined horizontally with all others to form a two dimensional total square similarity matrix. Figure 14 illustrates how the total binary square similarity matrix looks when aggregating sort results from five participants who sorted the original 10 statement set. Any cell in this matrix could take integer values between 0 and 5. The sum of any cell in the total similarity matrix is then the total number of times sorters placed any two items, i and j, in the same pile.

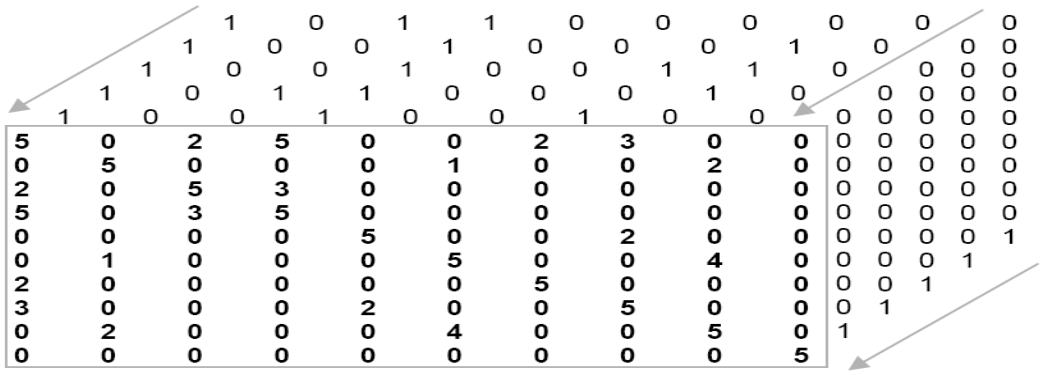


Figure 14 Total Square Similarity Matrix for Five Participants

Source: Trochim 1989a

Kruskal and Wish (1978) explain why two dimensions are more easily interpretable. Pictorial representations in two dimensions, which the cluster map in the concept mapping process is, are easier to comprehend than 3, 4 or greater dimensions. Statements piled together most often are located more closely in the two dimensional spatial representation and easily symbolized pictorially. This fact is of conjectured to be very useful when ordering sets of questions.

All MDS techniques represent the relations between a set of ideas, objects, tasks, statements, etc. in terms of a geometric model. This is most often represented by a map of points (the statements) and the distances between the points represent the similarity between the statements. The Concept System® utilizes a non metric step in the MDS algorithm as opposed to just a metric step. Non metric MDS is concerned with analyzing ordinal (dis)similarities, whereas metric data are defined at the interval or ratio levels of measurement. A non metric set of data is said to be ordinal if the values belonging to it can be ranked (put in order) or have a rating scale attached. Ordinal data may be counted and ordered but not measured. A Likert[25] rating scale of say 1 to 5 for an object, representing strongly dislike, dislike, neutral, like, strongly like is an example of ordinal data. A more thorough discussion of the history and differences between metric and non metric multidimensional scaling methods may be found in Young and Hamer (1987).

The following illustrative flowchart demonstrates the steps in the non metric MDS process, seen in figure 15. First, all points in the total similarity matrix are arranged to obtain a starting configuration utilizing Torgerson's (1952) original MDS method. Once the starting configuration has been obtained the first standardizing iteration begins. The orders of the distances between the points are compared with the order of the original proximity data. The next steps essentially attempt to minimize the distances between points utilizing Kruskal's (1964) stress function[26]. Initially this distance is very high,

[25] The Likert scale is a type of psychometric response scale often used in questionnaires and surveys. When responding to a Likert questionnaire item, respondents specify their level of agreement to a statement. The scale is named after Rensis Likert, who published a report describing its use (Likert, 1932).

[26] Please see the appendix for the underlying mathematical formulae that comprise the concept mapping process.

however as the algorithm goes through several iterations this stress distance falls. The desired solution is obtained when the change in from one iteration to the next reaches a predetermined minimum.

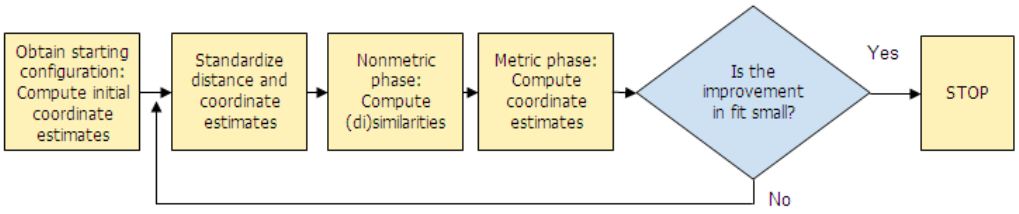


Figure 15 Nonmetric MDS algorithm

Source: Davison 1983

The output of a non metric MDS process takes the total square matrix of similarities for a set of items, objects or ideas as the input to produce a point map in two dimensional space.

The Concept System® provides a second step that allows greater control and insight over the original data. The ability to form several 'clusters' from the MDS output allows individual statements to be grouped on the map into clusters of statements which presumably reflect similar concepts. This has proven very valuable in a number of research inquiries and is thought to be a defining strength of the structured conceptualization process to survey design. Hierarchical clustering employs the multivariate linking technique called Ward's algorithm. Ward's Algorithm (Ward 1963)[27] is a commonly used procedure to form hierarchical groups of mutually exclusive subsets. It is particularly useful for large scale (n > 100) statement sets when a precise optimal solution for a specified number of groups is not practical. This hierarchical clustering approach can be applied to create a hierarchy of

[27] See appendix for further explanation.

clusters, thereby grouping similar data items, e.g., ideas into one or more clusters.

Clustering starts with a set of single points, each containing a single statement di for D, from i=1, ..., N, where D equals the entire set of statements, N equals the number of all statements and 'i' the single specific statement. The two most similar clusters over the entire set D are merged to form a new cluster that covers both. This process is repeated for each of the remaining N -1 statements. Merging of all statement clusters continues until a single, all-inclusive cluster remains. Given N sets, this procedure reduces them to N - 1 mutually exclusive sets by considering the union of all possible N(N - 1)/2 pairs and selecting a union having a maximal value for the objective function that reflects the criterion chosen by the researcher.

5) Interpretation of the Map(s)

The interpretation and subsequent application of the concept maps is essential to explaining the structured conceptualization approach to survey design. Best practices of survey design by Salant and Dillman (1994), specifically sections on how to write good questions and order them effectively, provide guidelines on survey language and what type to avoid. This is discussed in Chapters 2 and 4 of this dissertation. However these guidelines along with others fail to offer a systematic approach to these tasks. A primary goal of this dissertation is to test whether a successful survey can be designed and improved upon through the concept mapping (structured conceptualization) process. Hypothesizing that statement sets provide relevant material for survey question composition and the final cluster solutions provide the cognitive order or roadmap for the completed survey, are the primary

propositions to be tested. There is sound evidence in the literature that the proximity data generated in the sorting procedure represents ideas as points in a continuous multidimensional space where the distances between points represent psychological similarity (Tversky and Hutchinson 1986). Those points aggregated as clusters would naturally be more similar to a cluster nearby than one farther away in Euclidian distance. The interpretation step of the concept maps lends itself to the above tasks desired in the design of the survey instrument.

Before attempting to write the survey it is necessary to assemble the core participants and provide an inclusive interpretation of the maps. Trochim (1989a) recommends a set of materials from the concept mapping process which aid in the interpretation.

- The Statement List. The original list of brainstormed statements, each of which is shown with an identifying number.
- The Cluster List. A listing of the statements as they were grouped into clusters.
- The Point Map. The numbered point map which shows the statements as they were placed by multidimensional scaling.
- The Cluster Map(s). The cluster map which shows how statements were grouped by the cluster analysis.

Since rating is not undertaken, it is not necessary to include those typical steps or maps in this exercise.

Examination of the point map occurs first as an important step in the interpretation of the mapping output (figures 16 and 17).

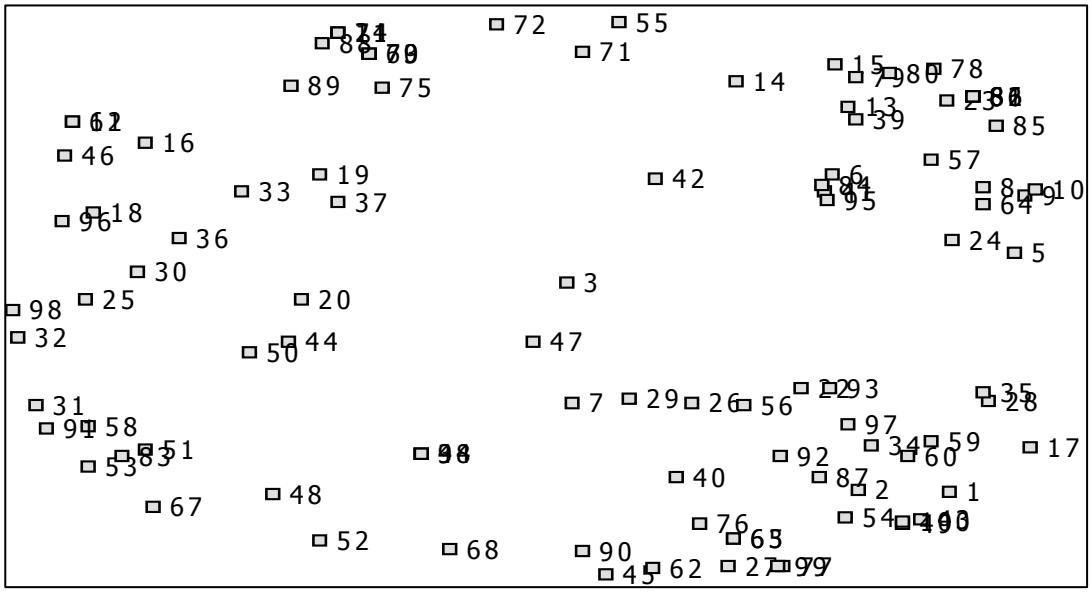


Figure 16 HEU point map

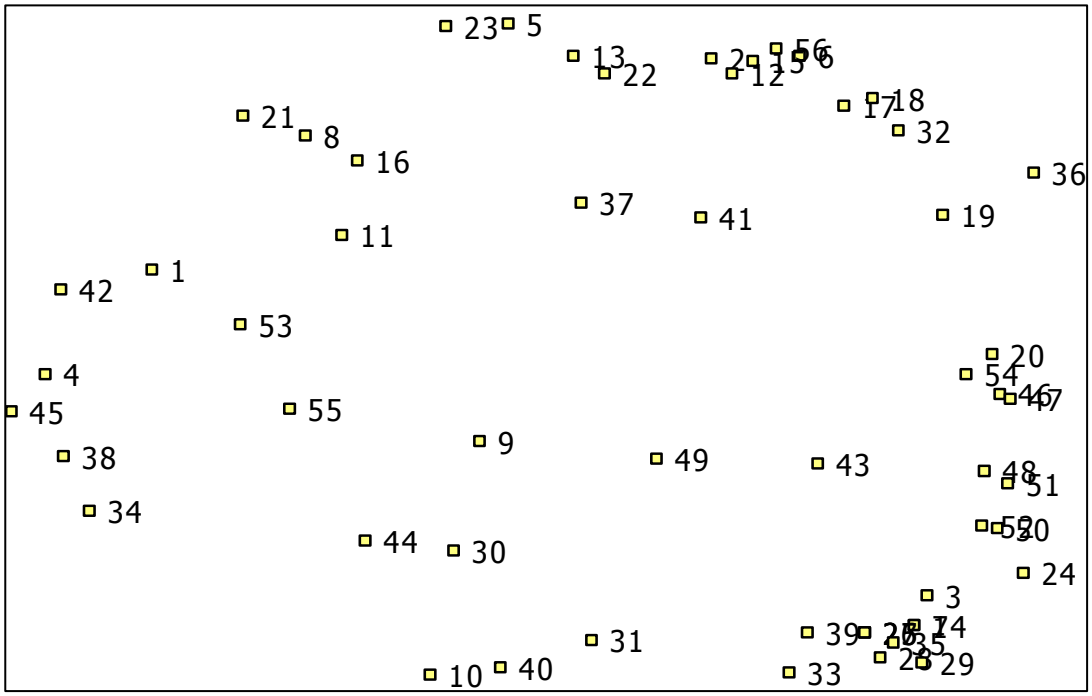


Figure 17 CP point map

Each point represents a brainstormed statement or idea, with a number beside it corresponding to a statement in the set. Points on the map closer to each other were sorted together more frequently than points farther apart. The close proximity of a statement to another or a set of statements represents statements that were sorted into the same piles more often by the participants. An overview of these cluster maps is used to orient the group to the formal conceptualization output.

The hierarchical cluster analysis illustrated in the cluster map outputs groups the points into clusters of adjacent similarity (figures 18 and 19). The point map and several versions of the cluster maps should be examined by the group for further refinement and to examine different levels of abstraction.

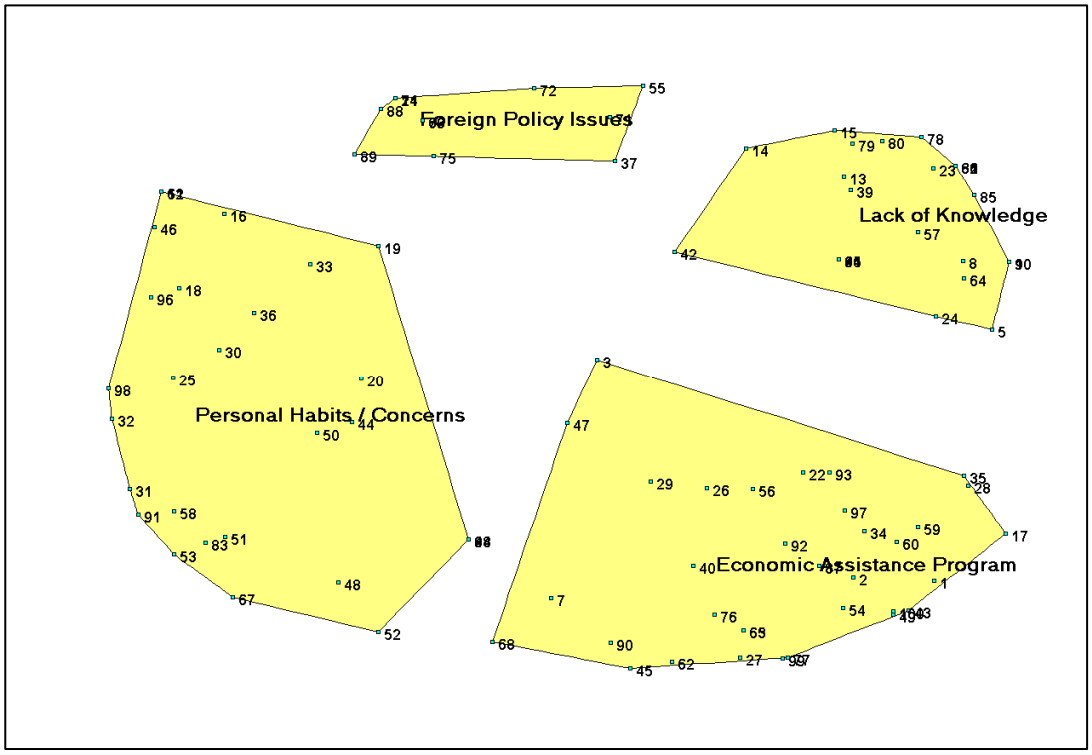


Figure 18 Four cluster HEU solution with software generated labels

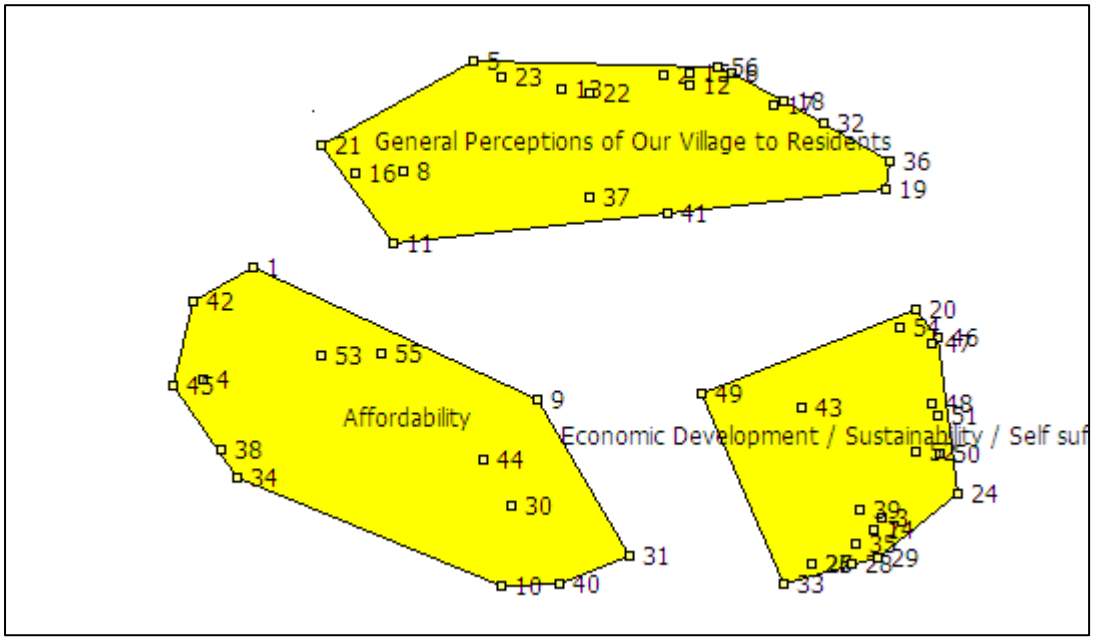


Figure 19 Three cluster CP solution with software generated labels

A maximum number of clusters thought to be useful for interpretation is recommended for an initial review. Successively lower cluster solutions may then be examined based on how reasonable and desirable to the specific situation they may be. In multivariate analysis, cluster analysis refers to methods used to divide up objects into similar groups. The concept mapping process by the group at this stage is no different. In the cluster analysis of the concept maps, the group and facilitator do not start with any a priori notion of grouping or cluster characteristics. The definition of clusters emerges entirely from the cluster analysis - i.e. from the process of identifying "clumps" of objects which may or may not go together. Providing several cluster maps with as little as two clusters to those with several unique clusters, ensures that a final cluster solution is chosen from a broad scope of generalized levels of abstraction by the group.

The discussion during both projects centered on identifying a cluster solution which would provide necessary and relevant survey sections. Just as there is no prior conception of the number of clusters that make the final solution, there is no prior outline for relevant survey sections. For instance the above three cluster solution for the CP survey included ‘affordability’, ‘general perception of our village to residents’, and ‘economic development’. If this were to be the agreed upon final cluster map, survey sections would follow those three themes in the order they are placed on the map.

Clusters on the map are ordered depending on how close conceptually a set of statements are to each other. The four cluster HEU map (figure 18) places ‘foreign policy issues’ further from ‘economic assistance programs’. This reveals to the group that cognitively the set of statements in each of these clusters are less alike and therefore further apart. Is it possible to construct a reasonable sequence of questions based on the ordering of the clusters? The results of this process indicate it may not only be possible but also advantageous.

The Concept System® allows several cluster solutions. Each solution gives a numbered order to the clusters (that is 1, 2, 3, etc.). Since the structured conceptualization in the form of the cluster maps represents the group cognition to the focus prompt, the order or sequence of this cognition holds a useful significance. There are many ways to arrange the different parts of a subject or how to sequence several ideas. Sometimes, a chronological arrangement works. At other times, a spatial arrangement is best suited to the material. When ordering, a common technique in outlines is to go from the general to the specific. Many writers find it useful to begin with a general idea and then support it with specific examples. The writing of a questionnaire

subsequently may follow the familiar practices of section ordering found in many textual writing examples. A systematic method to accomplish a useful sequence of ideas in the written questionnaire would be to utilize the order of the clustered statements from the maps as survey section markers.

In defense of using the cluster order for the survey instrument order of sections, the theory behind a sequence must first be defined. A sequence simply is an ordered list of elements. In mathematics, a sequence would be concerned with an ordered list of objects or events where the order matters. The exact same elements may appear multiple times at different positions in the sequence. In the cognitive realm like concept mapping, a sequence exists where events do not repeat. The entire universe of events or ideas in this case, independently exists and has a finite combination. The psychological literature provides further evidence that knowledge stored in the brain is a hierarchical sequence (Ausbel 1986; Novak and Gowin 1996). Concept maps are created to reflect the organization and sequence of the elements of knowledge. Hence sequence matters and the resulting cluster map that sequences the clusters provides a potentially appropriate sequence for ordering sections within a survey instrument. The sequence of the clusters may be represented with arrows on the map, illustrating the flow from cluster 1 to N (see figures 20 and 21).

Cluster Labeling

The last step of interpretation before undertaking the written survey involves developing appropriate labels for the clusters. Since these labels will define the section markers and be the cognitive primer for survey questions written in that section, extensive contemplation by the group on the final label

should be considered. The Concept System® generates a list of potential labels drawn from each participant's sort data as a starting point for this stage of the interpretation session (see figures 18 and 19 labeled). As mentioned, the labeling of the clusters with appropriate titles provides a section marker throughout the written survey. The ‘markers’ as they are termed here, represent a unique section identified in the cognition process and consequently the survey. Survey questions are developed under the umbrella of the specific marker. What usually emerges from a discussion of statements within a cluster is a theme that captures the essence of those statements. Both the HEU and CP survey development groups were directed to interpret clusters as themes and an outline for the future survey instrument. Being cognizant of the primary purpose of the survey, budget and time considerations inform the group on the number of cluster themes that might be appropriate, yet does not commit them to any set amount. A longer survey may entertain several unique attributes in the conceptualization process, leading to a greater number of clusters in the final solution or vice versa.

The HEU survey team required a survey that could be completed in fifteen minutes by a participant but also one that identified key areas, attributes and concerns of home energy use and conservation. This is a great deal of information to be gathered in a fifteen minute drop off survey. Given these criteria, the Concept System® four cluster solution yields several observations. What immediately comes to view is that the four cluster labels assigned by the software program might not be the most appropriate labels for this specific conceptualization (figure 18). The HEU final cluster solution illustrated to the group that two distinct loci of information was desired by the group: social/psychological and technical/ analytical. The cleavage between

these two specific group cognitions provided two primary groupings with three and four sub-clusters as the final solution decided upon by the HEU group (figure 20). Cluster labels for these seven groups began with the Concept System's® top ten best fitting labels based on the sort pile labels the participants developed. Deciding upon a label that best summarizes the ideas in that cluster may come from the top ten list or from an agreed upon group generated label. Examination of the statements within a cluster also provides direction when labeling a cluster if the top ten computer chosen statements does not suffice. For example cluster 7 of figure 20, 'Social and Environmental Awareness' as a label was determined by the group after examination of the following top ten choices developed by the software:

- 'Environmental Concerns',
- 'Foreign Policy Issues',
- 'Global Concerns',
- 'Environmental',
- 'Environmental Degradation',
- 'Environmental Concerns',
- 'Public Policy Implications'.
- 'Conservation of Resources / Environment',
- 'Attitudes', and
- 'Household and Living Arrangement'

It was felt that a label and subsequent survey section that informs on environmental and social awareness was most desirable. Both the HEU and CP survey teams developed cluster labels and final cluster solutions in the manner described above. The flow of the survey sections or question group ordering is represented by the corresponding arrows in figures 20 and 21.

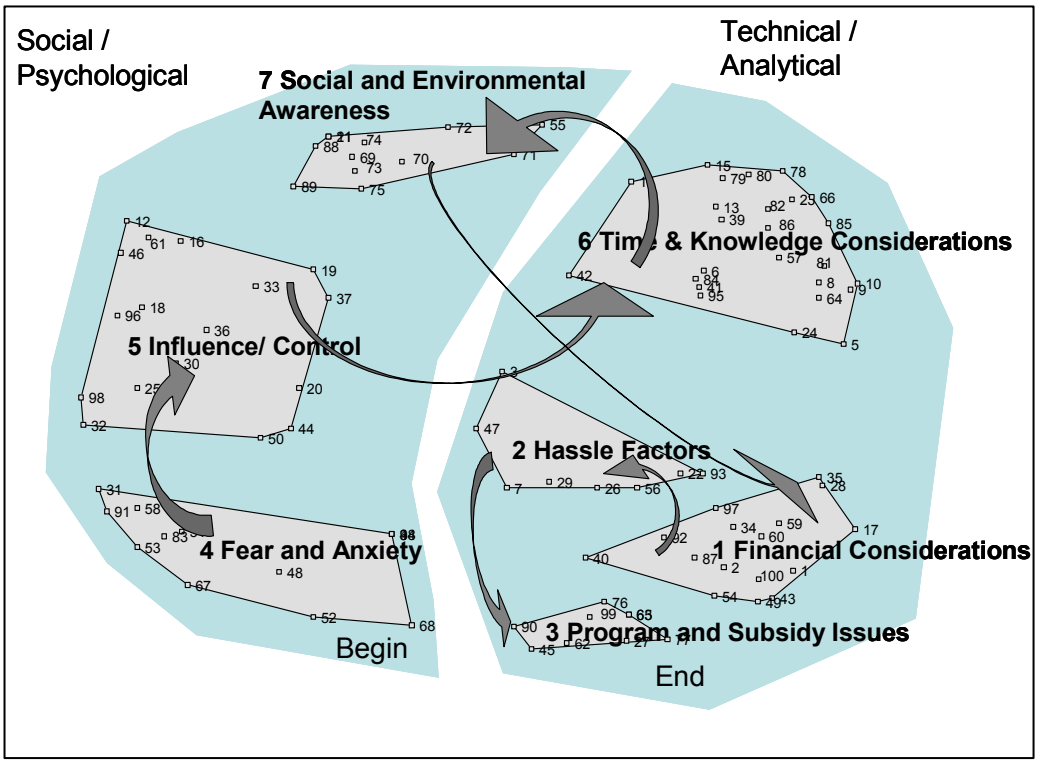


Figure 20 HEU final cluster solution

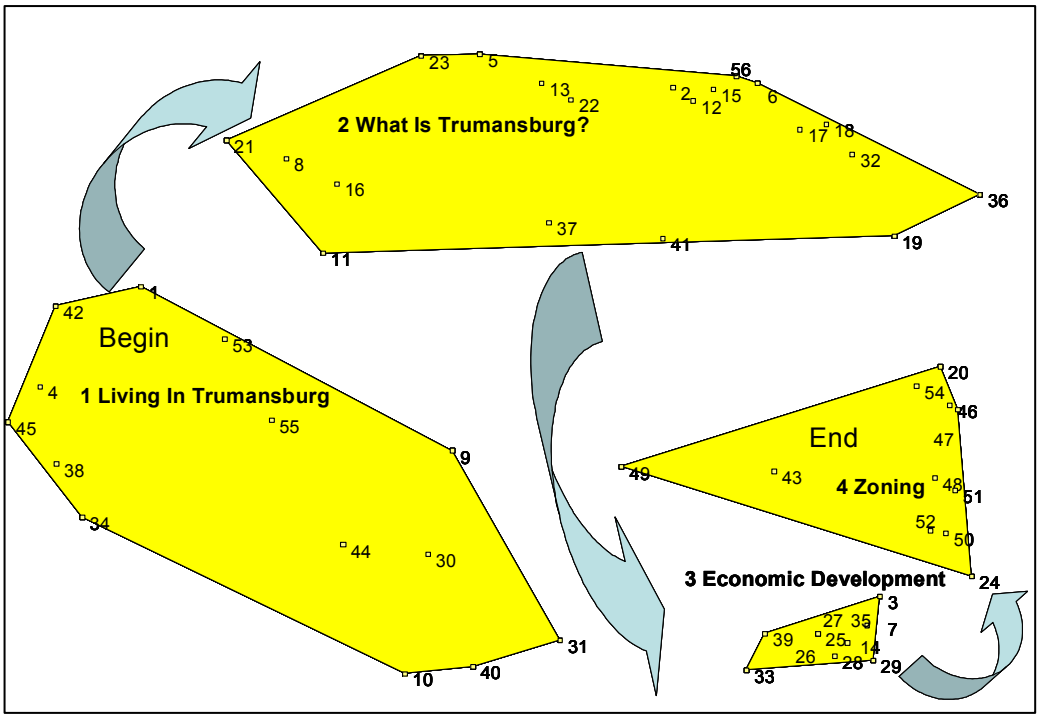


Figure 21 CP final cluster solution

It has been argued that clusters arranged in a sequence by the concept mapping software's hierarchical clustering algorithm cognitively places clusters that are more alike closer to each other in a desirable sequence, numbering them accordingly. The concept mapping cluster analysis is a multivariate analysis technique that seeks to organize ideas from the mapping process so that relatively homogeneous groups or clusters can be formed. One of the outcomes of a cluster analysis is a dendrogram or tree diagram. By examining a dendrogram and the corresponding cluster solution from the concept mapping software, it is apparent that branches from a similar ancestor have more in common with their own group than with other groupings farther away in Euclidean distance. Interpretation of the various cluster solutions provides similar insight as to the cognitive homogeneity between sets of ideas. Clusters closer together are more alike than those farther apart. This insight is potentially useful when developing a scheme to order sections of questions within the questionnaire, as has been proposed in this work and section.

The survey development teams utilized the illustrated sequences (figures 20 and 21) as a desirable outline for the completed survey sections. Initially it was conjectured that a literal interpretation of the numbered sections might best represent the desired survey order. However, this might be too narrow an interpretation. Cluster proximity alone potentially provides guidance as to which sections should follow one another. This cluster sequencing analogous to survey sections is posited as one of the two major contributions of the structured conceptualization process to survey instrument design expounded upon in the Discussion chapter.

6) Implementation of the Insight from the Map(s)

The implementation step in the structured conceptualization process of survey design unites the concept mapping process with survey instrument authorship. At this stage the group has several cluster themes for survey sections, an order or outline for the final survey, and 100 or so statements where individual survey questions may be created from. In the previous interpretation step a final cluster solution was agreed upon. Taking the final cluster solution with the appropriate flow pattern of survey sections allows the group to commence the writing of the final survey instrument.

The survey development groups were directed to interpret the clusters as themes and as an outline for the final survey instrument. The facilitator to begin the writing process transfers the cluster labels as survey section headings in the flow pattern they are originally ordered on the final cluster solution to handouts for each survey group member to examine. The group now has for its use an outline to populate with essential survey questions. Figure 22 illustrates the basic outline for the HEU survey group.

Home Energy Use Survey
Outline interpreted from Structured Conceptualization Process
I. Fear and Anxiety
II. Influence and control
III. Time and knowledge considerations
IV. Social and environmental awareness
V. Financial considerations
VI. Hassle factors
VII. Program and subsidy issues

Figure 22 HEU Survey Section Outline

The careful reader will notice that the HEU outline does not follow the sequence 1 to N on the final cluster solution map. Rather the set that identifies

the sequence of the survey sections is determined by the group discussion on cleavages within the cluster solution and an agreeable desirable beginning point for survey development. The HEU survey exemplifies this experience. A cognitive cleavage was apparent to the HEU group between clusters 4, 5, 7 and 3, 1, 2, 6, that being social/psychological and technical/analytical respectively (figure 20). After thoughtful deliberation with consideration of survey design best practices, members of the group desired to begin the survey instrument with the topic 'fear and anxiety'. Once a starting point is established and secured, the ordering of the clusters for survey sections followed the standard ordinal numerical flow, beginning at cluster 4 and ending at cluster 3, completing the loop.

The literature review of this dissertation describes the standard best practice methods for wording of survey questions. In this approach one of the possible more pertinent contributions to survey instrument design is question material generated during the statement set brainstorming session in the concept mapping process. The survey authors are provided a template for an individual survey question in the form of a specific statement within a cluster. For example the HEU survey section cluster 'fear and anxiety' has the following statement set associated with it (the number in parentheses is the numbered statement from 1 to N, in this case 1 to 100):

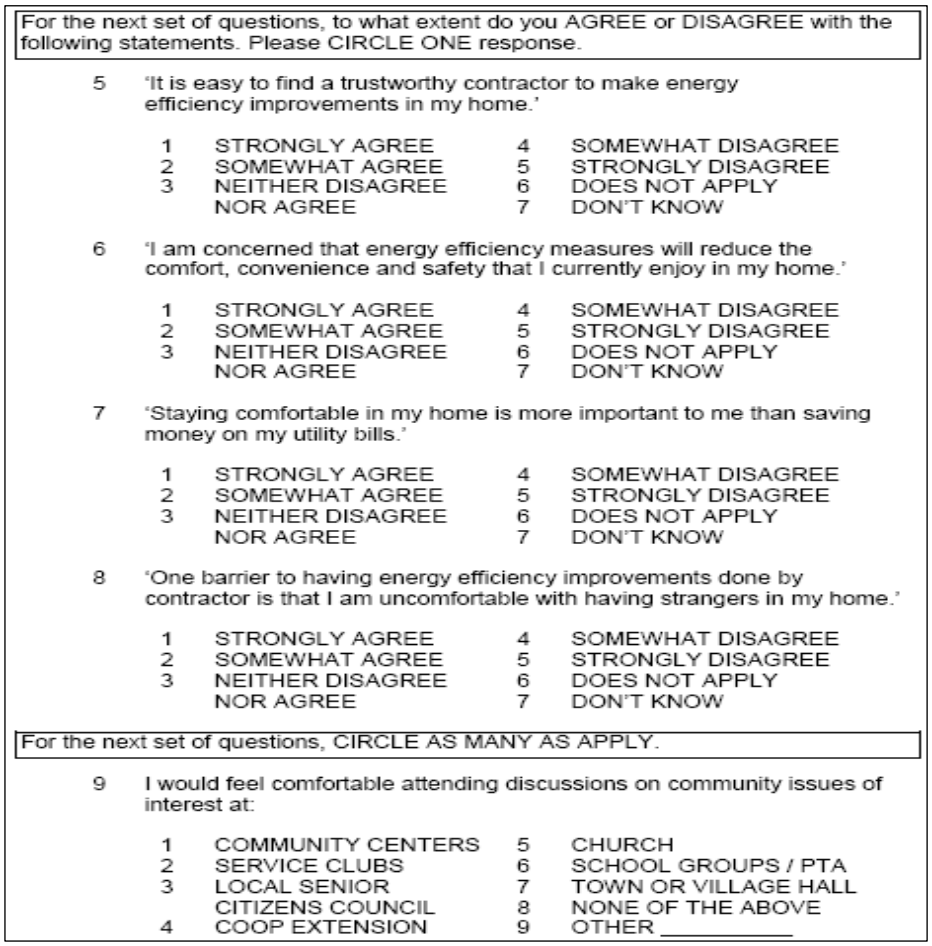
- Who can you trust to do a good job (4)
- Staff comfort (31)
- Capability of local installers - Quality and workmanship (38)
- Housing costs in Tompkins County are very high-- forcing me or my staff to live outside the county and to spend a large amount on transportation. (48)
- Fear of being a victim of crime (51)
- The fact that the landlord pays for it (52)
- My age. I am a senior citizen and need more warmth and light than younger folks (53)
- I need my little comfort since I don't have much else (58)
- For seniors on oxygen, energy costs are very high because oxygen concentrator is running constantly (67)
- Seniors' physical limitations affect some of the energy saving measures they otherwise might employ. (68)
- I don't like to be home alone in a dark house, so I leave lights on in several rooms. (83)
- Appearance and comfort of retail store (91)
- Hard to find competent, affordable contractor to do insulation work (94)

Figure 23 Statement set for HEU cluster 'fear and anxiety'

From this statement set (figure 23) the group is instructed to collaboratively craft relevant survey questions under the section 'fear and anxiety'. The final wording of the question is to be determined after a set of questions for each section is developed. Final deliberation on specific questions is relegated to future discussion once a broad set of survey questions is initially crafted from the statements.

Once a group of questions is determined for each survey section, crafted from the individual statements within a set, attention is then turned to question order, formatting and ultimately refinement of final question wording. Overall survey formatting and question refinement is determined according to best practice survey design as discussed in Chapters 2 and 4. Every attempt to minimize the four sources of error when designing a survey instrument

should be achieved by an easy to read, smooth flowing document with question and answer choices appropriate for the objectives at hand. Ordering of the questions within a survey section, developed from the cluster analysis and underlying statements, provides a cognitive framework (unknown consciously to the respondent) that offers what survey researchers define as a 'logical' and smooth flowing instrument. Figure 24 illustrates the final survey questionnaire section 'fear and anxiety' in the HEU survey.[28]



For the next set of questions, to what extent do you AGREE or DISAGREE with the following statements. Please CIRCLE ONE response.

5 'It is easy to find a trustworthy contractor to make energy efficiency improvements in my home.'

1	STRONGLY AGREE	4	SOMEWHAT DISAGREE
2	SOMEWHAT AGREE	5	STRONGLY DISAGREE
3	NEITHER DISAGREE NOR AGREE	6	DOES NOT APPLY
		7	DON'T KNOW

6 'I am concerned that energy efficiency measures will reduce the comfort, convenience and safety that I currently enjoy in my home.'

1	STRONGLY AGREE	4	SOMEWHAT DISAGREE
2	SOMEWHAT AGREE	5	STRONGLY DISAGREE
3	NEITHER DISAGREE NOR AGREE	6	DOES NOT APPLY
		7	DON'T KNOW

7 'Staying comfortable in my home is more important to me than saving money on my utility bills.'

1	STRONGLY AGREE	4	SOMEWHAT DISAGREE
2	SOMEWHAT AGREE	5	STRONGLY DISAGREE
3	NEITHER DISAGREE NOR AGREE	6	DOES NOT APPLY
		7	DON'T KNOW

8 'One barrier to having energy efficiency improvements done by contractor is that I am uncomfortable with having strangers in my home.'

1	STRONGLY AGREE	4	SOMEWHAT DISAGREE
2	SOMEWHAT AGREE	5	STRONGLY DISAGREE
3	NEITHER DISAGREE NOR AGREE	6	DOES NOT APPLY
		7	DON'T KNOW

For the next set of questions, CIRCLE AS MANY AS APPLY.

9 I would feel comfortable attending discussions on community issues of interest at:

1	COMMUNITY CENTERS	5	CHURCH
2	SERVICE CLUBS	6	SCHOOL GROUPS / PTA
3	LOCAL SENIOR CITIZENS COUNCIL	7	TOWN OR VILLAGE HALL
		8	NONE OF THE ABOVE
4	COOP EXTENSION	9	OTHER _____

Figure 24 Screenshot of final HEU questionnaire section on 'fear and anxiety'

[28] The complete questionnaires developed in this study are found in their entirety in the appendix.

Examining the screenshot (figure 24) of the final HEU questionnaire above with the original statement set in figure 23, it is clearly illustrated that question 5, 'It is easy to find a trustworthy contractor to make energy efficiency improvements in my home', maps closely to the following statements, 'Hard to find competent, affordable contractor to do insulation work (statement 94)' and 'Who can you trust to do a good job (statement 4)'. Designing each question of the survey by careful examination of the statement set, provides a potentially effective systematic framework to develop order and write pertinent, useful and valid survey content within a collaborative group effort.

Conclusion

A structured conceptualization approach to survey instrument design potentially provides a more systematic repeatable approach toward question development and order of questions within the instrument. The procedures in the concept mapping exercise appear to compliment the cornerstones of best practice survey design. It enhances group collaboration when developing questions while providing a set of potential experts to help pre-test and revise the survey to minimize error. Survey instrument design has been beleaguered by ambiguous methods to devise questions and order them. The structured approach provided here will be analyzed for the strengths and weaknesses of the method in following chapters.

APPENDIX

The majority of MDS methods have two distinct processes. First an initialization routine is performed, where the data (in this case from the total square similarity matrix) is read and transformed into an initial set of coordinates in Euclidean space. The second section common to most non metric MDS programs involves a series of iterations that minimize some loss function (Kruskal's stress function). These iterations terminate when an acceptable level of 'stress' is achieved. The primary goal of the first section is to provide start values for the iterations and commonly uses Torgerson's method.

Kruskal's (1964) Stress (Standardized Residual Sum of Squares) function. Kruskal's stress is defined as (Kruskal, 1964):

$$metric\ stress = \sqrt{\frac{\sum_{i<j}(d_{ij} - t_{ij})^2}{\sum_{i<j} d_{ij}^2}}$$

Where i and j together iterate over all pairs of items, dij is the Hamming distance of i and j's bit vectors and tij is the correlation distance of i and j's initial vectors, scaled by the dimensionality of the bit vectors, D.

$$non\text{-}metric\ stress = \sqrt{\frac{\sum_{i<j}(d_{ij} - \hat{d}_{ij})^2}{\sum_{i<j} d_{ij}^2}}$$

Here the dˆij are the distances between points at any particular iteration given in terms of the N x N coordinates in the matrix of N points in N dimensional Euclidean space. Where dˆij are those values that achieve minimal stress, under the constraint that the dˆij have the same rank order as the corresponding t ij. Non-metric stress is a better measure if one is only concerned with preserving the rank-order relationship between pair wise distances.

Hierarchical clustering analysis in concept mapping employs Ward's Algorithm (Ward, 1963). Ward proposed a clustering procedure seeking to form the partitions Pn, of P n-1,....., P1 in a manner that minimizes the loss associated with each grouping, and to quantify that loss in a form that is readily interpretable. At each step in the analysis, the union of every possible cluster pair is considered and the two clusters whose fusion results in minimum increase in 'information loss' are combined. Information loss is defined by Ward in terms of an error sum-of-squares criterion, ESS:

$$ESS(X) = \sum_{i=1}^{N_X} |x_i - \frac{1}{N_X} \sum_{j=1}^{N_X} x_j|^2$$

Ward's Method seeks to choose the successive clustering steps so as to minimize the increase in ESS at each step.

The ESS of a set X of Nx values is the sum of squares of the deviations from the mean. The distance between clusters X and Y is described by the following expression:

$$D(X,Y) = ESS(XY) - [ESS(X) + ESS(Y)]$$

Where XY is the combined cluster resulting from fusion of clusters X and Y and ESS is the error sum of squares described above. A key component of the analysis is repeated calculation of distance measures between objects, and between clusters once objects begin to be grouped into clusters. On each step, the pair of clusters with smallest cluster to cluster distance is fused into a single cluster.

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CHAPTER 4

Methods of Implementing the Surveys

Introduction

Best practices for survey questionnaire development additionally focus on survey implementation: choosing an appropriate survey execution method, selecting a sample, pre-testing with a focus on avoiding the four types of error and coding the survey for analysis. This chapter provides a discussion on how each of these steps was accomplished for the Home Energy Use (HEU) and Comprehensive Plan (CP) surveys. Best practices identified in the Chapter 2 Literature Review are adhered to strictly to uphold the production of a highly reliable and valid survey instrument. In this manner any potential improvement to survey question design and order may be attributed to the structured conceptualization discussed in the previous chapter.

Survey Implementation

In primary data collection, the survey instrument is an effective tool to produce quantitative descriptions of aspects of a population of interest. The sample survey relies on asking questions (written or verbally) of a randomly chosen subset of the larger population of interest. What follows is a detailed discussion on the rationale behind the survey method chosen, sampling methods of each survey, pre testing of the surveys along with how the HEU and CP surveys were coded.

Survey Method

According to Salant and Dillman (1994) there are several different ways to administer a survey: mail, telephone, face-to-face interviews, and drop off. Each has their advantages and disadvantages and may be ineffective if applied under the incorrect circumstances. The choice of a particular survey method should be made only after careful consideration of the pertinent factors of available resources, time constraints, topic sensitivity, complexity of the survey questions and the probability of introducing error or bias. Different methods are suited to these specific concerns, where the survey designer makes every attempt to match an appropriate method given the constraints faced. Trochim (2001) provides a dichotomous ratings index (table 2) which a researcher may use to determine an effective questionnaire method facing several of these constraints and factors:

Table 2 Questions When Determining a Survey Method, Trochim 2001

Factor or Concern	**Written Questionnaire**			**Verbal Interview**	
	Group	**Mail**	**Drop-Off**	**Personal**	**Phone**
Are Visual Presentations Possible?	Yes	Yes	Yes	Yes	No
Are Long Response Categories Possible?	Yes	Yes	Yes	???	No
Is Privacy A Feature?	No	Yes	No	Yes	???
Is the Method Flexible?	No	No	No	Yes	Yes
Are Open-ended Questions Feasible?	No	No	No	Yes	Yes

Table 2 (Continued)

Is Reading and Writing Needed?	???	Yes	Yes	No	No
Can You Judge Quality of Response?	Yes	No	???	Yes	???
Are High Response Rates Likely?	Yes	No	Yes	Yes	No
Can You Explain Study in Person?	Yes	No	Yes	Yes	???
Is It Low Cost?	Yes	Yes	No	No	No
Are Staff and Facilities Needs Low?	Yes	Yes	No	No	No
Does It Give Access to Dispersed Samples?	No	Yes	No	No	No
Does Respondent Have Time to Formulate Answers?	No	Yes	Yes	No	No
Is There Personal Contact?	Yes	No	Yes	Yes	No
Is A Long Survey Feasible?	No	No	No	Yes	No
Is There Quick Turnaround?	No	Yes	No	No	Yes

The advantages and disadvantages of a chosen survey method may also be articulated as follows. If considering mail surveys as a chosen method, they are low cost, self administered and relatively benign to confidentiality concerns where the implementation does not require much labor. The

marginal cost of completing an extra survey is low which in turn minimizes sampling error. Yet, the non response of respondents is higher in mail surveys than in other methods. Telephone surveys produce results quickly, allow greater interviewer control and are moderate in cost. Measurement error however increases with vocal communication. Face to face interviews are best when surveying a population that has no defined list and when gathering complex information attempted. However, this method is the most expensive and prone to a high measurement error if a poor interviewer is employed ruining accuracy of results. The drop off survey is a hybrid of the mail and face to face methods. The questionnaire is delivered by hand from a trained survey staff to those pre-selected. They enjoy low labor costs, the possibility to sample from large populations effectively with a small staff. However, privacy is not maintained as thoroughly as in the mail survey nor will results be valid if the staff incorrectly follows pre-selected sampling units or instructions.

With respect to the HEU and CP surveys, each had different circumstances, concerns and objectives. The HEU survey desired gathering of information over a wide area, the Southern Tier region of New York State, whereas the CP survey only required a detailed look at a small village within the same local. The HEU survey desired a high response from the pre-selected sampling frames; whereas the CP survey desired a representative sample from the entire village population. Cost was more of a concern for the HEU survey. In particular there was only a small staff of three to administer the survey. Since the staff was highly trained in the HEU survey methods, with the endeavor to collect the desired information over a diverse geographic area, the method that would receive a high response rate at relative cost was a drop off survey. The HEU drop off survey was employed by the staff over a two

week period in August of 2005. As suggested in Salant and Dillman (1994), a good practice to encourage response was the use of a small incentive for completion of the survey. Compact fluorescent bulbs were distributed to each respondent upon completion of the survey which elicited a very high response.

The CP survey for the Village of Trumansburg desired an accurate assessment of citizen beliefs, attitudes and concerns for the future governance of the Village. A new comprehensive plan would be the product and future roadmap that the survey results would inform. Since the document would not only inform future policy decisions and need to be politically palatable to a large majority of the Village residents, the survey method should take into account the validity and reliability of the instrument and its results. Therefore, the cost of the survey was not as paramount as was limiting sampling and measurement error. A mail survey to all residents meets the requirements of improving response level, allowing more complex questions to be developed, along with guaranteeing a high level of confidentiality. Each household in the Village was then mailed a survey to be completed within two weeks of receipt. To elicit a the highest response rate possible, postage was provided along with easily accessible drop off boxes for completed surveys throughout the Village. This method also proved to be successful in its attempt to meet desired goals.

Sampling

Selecting a representative sample for each of the surveys is an important task that necessitates a through understanding of survey sampling methods. Only in this manner can the survey results be defended as collected with best practices guidelines where only deliberate alterations to best

practices (such as the structured conceptualization method) will yield differential results. Since the sampling method has more of a degree of variability to determine if a survey's results are valid, more detail of the history of survey sampling and the methods employed for this dissertation's surveys are discussed in full detail.

Building upon Kiaer's (1895) foundation, probability sampling was fully developed by statisticians in the next half century and incorporated into survey research. The scientifically accepted method today for survey sampling is probability sampling, which assures known probabilities of selection for every element in the frame population (Kish 1965, 2002). The frame (a census tract, block, neighborhood etc.) provides the equivalent of listings of sampling units for each stage of selection. This is then the foundation for statistical inferences from sample statistics to the corresponding population - statistics whose methods for survey research are described in detail in Hansen et al. (1953).

The desired goals of each of the surveys in this dissertation were twofold: to posit an improvement to survey design focusing on questionnaire development and to gather information on a desired population for use by constituent agencies. In order to gauge the surveys success, the path undertaken was to probability sample from the desired population so that statistics may be developed. These statistics could then be judged on their own merit by the constituent agencies requesting them for generalization to the larger population. Otherwise, developing a general sense of the population for the comprehensive plan of the Village of Trumansburg or even the home energy use survey of Southern Tier residents might not have required more than a pilot study or focus group to measure the range of ideas or opinions.

When sampling, it is first prudent to define the term. A sample is a subset of the larger population of interest. A good sample is a miniature version of the larger population that is representative of the important population characteristics under interest. A good sample also allows findings from the survey to be generalized to the larger population. In developing the appropriate sample for each of this dissertation's surveys many factors must be considered. It is imperative to initially understand the survey's purpose and objective (Fink 2005) as well as consider the importance of the sampling frame and population (Fowler 1984, 2001) at the outset. Consideration of goals and objectives when sampling is just as is important as with many of the other preparatory steps when developing the survey. Both of these surveys had different purposes, objectives and hence specific research questions. The Home Energy Use survey's purpose is to evaluate the residential energy use, practices and patterns of households in the Southern Tier region of New York State. The objective is development of practical knowledge and information where Cornell Cooperative Extension and NYSERDA may better target services aimed at home energy conservation in this region. The second survey instrument produced with the method was for the development of a new comprehensive plan for the Village of Trumansburg, New York. The Village's purpose is to obtain a 'snapshot' of attitudes and desires from residents regarding their outlook for the future of the Village. The objective is to incorporate this knowledge into a legal document which provides guidance for future governance. Since each of the objectives, purposes and populations of these two surveys is distinct they will be discussed separately.

To determine sample size, there are many resources which fully discuss the probabilistic methods in establishing an accurate and statistically

useful sample (Scheaffer et al. 2005; Weisberg et al. 1996; Desu and Raghavarao 1990; Cohen 1988; Kraemer and Thiemann 1987; Warwick and Lininger 1975; Cochran 1977; Mace 1964). For this document's purpose much of the mathematics discussing the probability theory in developing a statistically significant sample size is secondary. Of import is to trace the functional link of the method of sampling utilized here back to the foundational resources mentioned above.

There are several approaches to determine sample size for a sample survey as discussed in the cited literature. For instance, one can specify the desired width of a confidence and precision interval and determine the sample size which achieves that goal. A Bayesian approach may be used where the optimization of some utility function is completed, for example determining a sample that takes into account both precision and cost. Another popular approach involves studying the power of a test of a hypothesis. The power approach involves specifying a hypothesis test on a parameter of interest, the significance level, an effect size, a target value and gathering historical estimates to compute the power function of the test.[29]

Having established the stated purpose of the study and knowing the population size of interest (discussed for each individual survey below), three criteria are necessary to determine the appropriate sample size with the approaches listed above: the level of precision, the level of confidence or risk, and the degree of variability in the attributes being measured (Miaoulis and Michener, 1976). The level of precision, or sampling error, is the range in which the true value of the population is estimated to be expressed in

[29] For a very concise discussion of the power approach to sampling see *Some Practical Guidelines for Effective Sample-Size Determination* by Lenth (2001).

percentage points. The confidence or risk level is based on the central limit theorem. The tenet of the central limit theorem is that when a population is repeatedly sampled, the average value of the parameter of interest obtained is equal to the true population value. It also states that these values are distributed normally about the true value, with some samples having a higher value and some lower than the true population value. The degree of variability in the characteristics being measured relates to the distribution of those characteristics in the population of interest. The more heterogeneous the target population, the larger the sample size required to obtain a given level of precision. The more homogeneous a population, the smaller the sample size needed to ascertain the same level of precision.

The method used to determine sample size for this dissertation's surveys was a reliance on a table created from Cochran's formulas (1953), which provides the appropriate sample size for a given set of criteria.[30] Specifically a probabilistic sample may be determined from table 3 below if the combinations of precision, confidence levels, and variability are assumed or known.

[30] Please see the appendix for a brief discussion of the mathematics behind the sampling procedure for the creation of Table 3.

Table 3 Sample Size Calculator – Format adapted from Salant and Dillman 1994

	Sample Size for the 95% Confidence Level					
	± 3% Sampling Error		± 5% Sampling Error		± 10% Sampling Error	
Population Size	50/50 Split	80/20 Split	50/50 Split	80/20 Split	50/50 Split	80/20 Split
100	92	87	80	71	49	38
250	203	183	152	124	70	49
500	341	289	217	165	81	55
750	441	358	254	185	85	57
1,000	516	406	278	198	88	58
2,500	748	537	333	224	93	60
5,000	880	601	357	234	94	61
10,000	964	639	370	240	95	61
25,000	1,023	665	378	234	96	61
50,000	1,045	674	381	245	96	61
100,000	1,056	678	383	245	96	61

The sample sizes in the table are the number of obtained responses from sampling units and not the number of surveys mailed out, telephoned, interviewed, etc. The accepted alternative method to sample small populations is to perform a census, or a gathering of information from the entire population. Cochran (1953) in his classic text on sampling provides the following advantages of sampling over complete enumeration when sample size is large:

1. Reduced cost.
2. Greater speed. Data can be collected and summarized more quickly with a sample than with a complete count.
3. Greater scope. Surveys which rely on sampling have more scope and flexibility as to the types of information that can be obtained.

4. Greater accuracy. Personnel of higher quality can be employed and trained, creating a sample that may produce more accurate results than a census.

Therefore, if a census is not feasible and a probabilistic sample is desired for tests of inference and generalization, knowing how much sampling error can be tolerated, the population size, and how varied the population is with respect to characteristics of interest, a researcher may use the table to determine a final sample size. In many cases the alpha level used in determining sample size in most research studies is either .05 or .01 (Ary et al. 1996) with table 3 utilizing the more common 95% confidence level. In other words, this means that, if a 95% confidence level is selected, 95 out of 100 samples will have the true population value within the range of precision specified by the researcher.

Sampling Method – Home Energy Survey

Cornell Cooperative Extension and NYSERDA desired to gain a greater understanding of New York State Southern Tier household's energy use and conservation. In order to select the sample properly, specification of the population, sample unit specification and sample frame selection must be identified (Alreck and Settle 1994). In this case the population is households in the Southern Tier of New York State, the sample unit consists of an individual representing the household and the frame is a list of households in a specified area identifying all the sample units in that sub- population. More specifically the sampling frame for this study is a geographic area representing neighborhoods or a defined municipality in the communities of interest that comprise the households to be sampled in this region. Neighborhoods,

defined municipal areas and census tracts provide a distinct cluster in which to random sample from representing the larger population or geographic area. Hence a multistage sampling approach, a simple random sample from defined clusters in this case, provided the most economical approach to achieving a probability sample.

The Southern Tier of New York State in geographical terms refers to the counties of New York State west of the Catskill Mountains along the northern border of Pennsylvania. The largest city in the region is Binghamton. The region includes Tompkins, Tioga and Broome Counties, counties which Cornell Cooperative Extension and NYSERDA in Ithaca are interested in serving better. Over the last several decades the Southern Tier has experienced a net population loss. This is mostly likely due to decline in the manufacturing industries that once flourished here, its relative inaccessibility from major cosmopolitan centers, and a generally unfavorable climate compared to more flourishing regions of the country (Lichter et al. 2005)[31]. Cornell Cooperative Extension of Tompkins County and NYSERDA placed a regional threshold on the study of this in need area to comprise the counties near and adjacent to Tompkins in the Southern Tier. Considering the constraints of cost, time and the ability to mobilize resources, Cooperative Extension of Tompkins County and NYSERDA directed survey research to be undertaken on nearby and easily accessible communities in the Southern Tier: communities the agencies would effectively be specifically serving in the near

[31] Appalachian counties grew at a sluggish rate of .5% per year in the 1990's. However, the counties that comprise the Southern Tier of New York State had a population decline of roughly -.02%. Tompkins County is one of a handful of counties in the northern Appalachian region that experienced a population increase. Please see the *Emerging Patterns of Population Redistribution and Migration in Appalachia* report by the Lichter et al. and the ARC (2005) for further information.

future. The final populations to be sampled comprised the City of Binghamton in Broome County, Village of Owego in Tioga County and an economically challenged and moderate income neighborhood in the City of Ithaca (Southside and Fall Creek neighborhoods) and the Village of Trumansburg in Tompkins County.

Having determined the populations of interest to sample from, selecting an appropriate sample frame or cluster is then undertaken. Census tracts and population data on neighborhoods and villages from the United States Census 2000 provide the foundation to draw a simple random sample of households of interest.[32] Since each of these clusters is different, results from the surveying of each of these clusters is presumed to be different. However, it is reasonable to compare results across these clusters if the appropriate differences are acknowledged.

In Tompkins County the investigators wished to gather information on an economically challenged population, a suburban village and a moderate income population. It is believed the three populations chosen are representative of the larger population of Tompkins County. Given the time and financial constraints of the HEU survey process, sampling error was relaxed to ±10% margin of error deemed to be acceptable. Furthermore, the assumption that households in each of the Southern Tier clusters were similar allowed the sample to be determined from a homogenous predisposition. More specifically, attributes and characteristics of households found within a neighborhood, village or census tract are assumed to be very comparable.

[32] Appendix B Maps and Household Population Tables should be examined for further information and detail.

In Tioga County the most likely area to be served by the agencies according to their determination was the Village of Owego. Here the Village was comprised of an entire census tract facilitating the simple random sampling of households easily. Owego's potential sample was characterized similarly, assuming a ±10% margin of error and a homogenous population.

In Broome County the City of Binghamton, the largest of the sampling clusters with 21,089 households, provided more of a challenge. With the relaxed assumptions according to table 3, the maximum number of final samples gathered to be representative according to the criteria is 61. It was decided that the inner core region of the city, represented by census tracts 1, 2 and 15 was to be sampled due to its representative makeup as the vibrant core of the city. The sampling team was encouraged to over sample this area and attain several more completed surveys than the acceptable 61 required. Over sampling, in fact was done on each of the clusters to some degree to guard against the inevitable ineligible and illegible questionnaire(s).

After designating the three clusters in Tompkins County, one in Tioga County and one in Broome County, a simple random sample of the appropriate number of households was taken from each cluster (see table 3 above) and sampled by several trained personnel in a door to door drop off / pickup survey (table 4). The random sample was attained by marking on a map an arbitrary starting point (any house on a block) and moving outward in a spiral pattern skipping every other household until the outer boundary was met. The process would repeat avoiding the area already sampled. An incentive to the homeowner for completing the survey was one compact fluorescent bulb received upon pick up of the completed survey. The

appropriate number of completed questionnaires was gathered in August of 2005 without difficulty or unusual circumstance.

Table 4 Final Sample Sizes for HEU survey

	Total Households[33]	Sample Size[34] 95% CI, ±10% Error, 80/20 Split
Tompkins County, Southside	483	55
Tompkins County, Fall Creek	1,246	60
Tompkins County, Trumansburg	709	57
Tioga County, Owego	1,913	60
Broome County, Binghamton	4,987	61

Sampling Method – Comprehensive Plan Survey

The Village or Trumansburg, New York required information from households within the village in order to better inform a new comprehensive plan. As with the HEU survey, in order to select the sample properly, specification of the population, sample unit specification and sample frame selection must also be identified. The success of the comprehensive plan required the broadest community input and support. The comprehensive plan committee decided it sensible to survey every household in the Village. Hence

[33] Number of households determined from United States Census 2000, Tompkins County Planning Department, Broome County Planning Department and Tioga County Assessment Department.
[34] Final sample size is determined at the higher population size category from Table 3 for actual sample taken.

the population is all households located within the Village, the sampling frame is the list of names of each head of household, while the sampling unit an individual in the household answering the survey.

Sampling for the CP survey differed from the HEU survey in that a complete enumeration of Village residents was attempted despite the greater expense and time associated. Each of the 709 households in Trumansburg was mailed a survey on May 15, 2006 with a request to complete it by June 5, 2006. Several 'drop boxes' were made available throughout the Village where a completed questionnaire could be collected. The CP survey was also available online at the Village website for download if a Village resident required an additional copy.

Of the 709 surveys mailed out, 217 were returned complete or 31%. In order to determine if this is an adequate sample to generalize to the entire Village population, utilizing table 3 provides a useful method to provide an answer. Reading down the population column for a population size close to and above 709, the higher population category is listed at 750. Reading across the table from 750 to find a sample size less than 217 lends this sample size to fall within a region of ±5% margin of error assuming a homogenous population (80/20 split). It may be concluded this sample size or number of collected surveys is beyond adequate with a high level of precision if inferences are to be made to the entire Village population from this sample. Cochran's (1977) formulas (in Appendix A) would provide the precise margin of error; however for these purposes the above method is acceptable.

The CP survey again was a success in that there was no unforeseen circumstances or difficulties. Additionally the response rate was high, the details of which are discussed in the Results and Analysis chapter.

Avoiding the Four Types of Error

Implementation of a quality survey also requires the survey developer to be cognizant throughout the process of the four types of error prone to survey instrument design. Sample surveys yield generalizable results if there is success in avoiding these four types of error associated with sample surveys: coverage, non-response, measurement and processing error (Salant and Dillman 1994). According to Groves (1989), the four types of error are more specifically described as:

1. Coverage and sampling error, error which results from the failure to give some members of the population any chance of selection into the sample;
2. Non-response error, error which results from the failure to collect data on all members of the sample;
3. Measurement error, that which results from the failure of the recorded responses to reflect the true characteristics of the respondents;
4. Editing and processing errors, which result from the failure to convert responses accurately into an analysis file.

Both the HEU and CP surveys were designed throughout with the attempt to avoid these four potential types of survey error.

Coverage or sampling error was reduced by a sound method of sampling, described in the previous section. The population, sampling frame and sampling unit were a focus when following the total survey design method (Dillman 1978, 2006) for looking at all sources of error and attempting to keep them at a minimum. Utilizing population data from the US Census, assistance of GIS mapping services from municipal agencies and sticking to a random

sampling approach once the frame was designated allowed a systematic and strictly drawn sample.

Non-response results when data is not collected from respondents. One way to limit non-responses is to effectively explain the survey purposes and uses to the respondent. This was accomplished in a short but concise cover letter and protocol for survey staff to follow in the field.[35] Also assurances of confidentiality aid responses where many respondents are unwilling to respond due to privacy concerns if they are not assured of confidentiality. The choice of survey methods attempted to take confidentiality into account. Non-response error was also minimized with the use of incentives to elicit responses. As previously mentioned a compact fluorescent light bulb was given to all HEU survey participants who returned a completed survey. The bulbs were purchased in and provided a choice of wattages to recipients (100w, 75w, 50w and 25w). The CP survey consequently elicited the maximum response by minimizing costs to participants. Drop boxes were place throughout the Village for easy return. Postage was already provided on the form if the respondent chose to mail instead of physical return of the survey. Aligning incentives with the goal of maximum completed surveys provided response rates for the HEU upwards of 90% to those agreeing to do the survey and the CP at 32% for a mailed out survey. Both are very high response rates for surveys of their type.

Every step of a survey is a potential source of measurement error. Some examples of the causes of measurement error are non-response, badly designed questionnaires, respondent bias and processing errors. Taking into

[35] Each of the developed survey instruments can be found in the end of this dissertation's Appendix. These documents are complete with the mentioned cover letter discussed above. The protocol instruction sheet is found in Appendix C of this chapter.

account the other sources of error separately, measurement error is primarily minimized by the crafting of a good survey instrument. The content and wording of the questionnaire may be misleading and the layout of the questionnaire may make it difficult to accurately record responses. Questions should not be misleading or ambiguous, and should be directly relevant to the objectives of the survey. This involves question wording and layout appropriate to the information sought as well as a question design that minimizes any interviewer or investigator effects (i.e. unbiased). Question wording and order within the surveys are discussed in the Results and Analysis chapter given their central importance to this dissertation.

There are four stages in the processing of the collected data where errors may occur: data grooming, data capture, editing and estimation (Groves 1989). This dissertation does not focus on the actual compilation and analysis of the survey data. However, in the Results and Analysis chapter basic descriptive statistics are compiled for each of the surveys. The data was groomed for missing responses, inadequate responses and the like. If the survey had large missing or inadequate responses it was not included in the compilation of statistics.

In many ways the success of the proposed method is validated if the surveys developed avoid or display a marked reduction in the four types of error described. This supposition is further discussed in the Results and Analysis chapter.

Pre-testing and Coding for Analysis

In spite of a survey researcher's best efforts, the final draft of the survey may contain errors, omissions, questions that are confusing or poorly worded.

Additionally answer choices devised for closed ended questions may be poorly provided. A primary reason to pre-test the survey is to further refine the question development phase. According to some, the survey designer is encouraged with absolute necessity that a pre-test is completed to make sure that the questions can be clearly understood and have an adequate range of responses (Warwick and Lininger 1975). Consequently the pre-test may eliminate possible errors made by respondents incorrectly interpreting the meaning of questions as well as ensuring that there is enough variation to actually analyze the data within a group of questions (Fowler 1995). Since many sample surveys rely heavily on closed ended questions (making it easier to code and analyze the survey quantitatively) this situation requires researchers to anticipate how respondents will answer the questions. Writing a good question entails also writing good responses. These responses for closed ended questions must be both exhaustive and mutually exclusive. Exhaustive answers cover all ranges of the potential spectrum, so that all respondents can answer with one of the choices. Mutually exclusive answers allow the respondent to select only one answer, meaning that if one answer is selected then the other possible responses are eliminated. A pre-test attempts to clarify errors made in the question development and order process.

Best practices of survey design typically encourage pre-testing the survey with a small and representative sample of respondents to identify any problems respondents may have with the survey. Of several available methods to pre-test a survey, Presser and Blair (1994) find that expert panels composed of individuals familiar with the survey project and with experience in survey research consistently diagnosis the greatest number of non-trivial problems in the survey. The proposed method in this dissertation provides a

convenient assemblage of ‘experts’ to aid in the survey pre-test. The original set of brainstorming and sorting individuals who partake in the structured conceptualization process are a select group with a precise understanding of the survey project easily able to fit the role of expert panel to perform a critical pre-test. This assumption is further discussed in the results and analysis chapter.

A survey must also be considerate from the outset that its primary purpose (in most cases) is to produce data that will assist in the answer of important research questions. Once the data is collected, it must be collated and organized for typical summaries and descriptions. Calculating summary measures such as means, frequencies, standard deviations, and correlations as well as creating tables and graphs that illustrate important findings can be done only after the survey data is entered into a data matrix that may be analyzed by a computer program. It is also appropriate when beginning the data entry process to *clean* the data by eliminating erroneous responses (Salant and Dillman 1994). Obvious outliers and superfluous notes can be eliminated before data is keyed into the database for analysis.

The HEU and CP surveys were designed in such a manner as to be self coded. That means that with the master code book, (see figure 25 for a section of the HEU survey) a copy of the survey instrument with numbered questions, the data entry person is able to enter into the database the numerical responses for each respondent. Where there is a text response the survey data imputer enters the comment in the specified cells as shown. After the data is entered into the data matrix it may then have descriptive statistics computed from it or the estimation of econometric models to test hypotheses or research questions (as appropriate)

q1, q1_text Which best describes your home?

1 SINGLE FAMILY, DETACHED HOME
2 DUPLEX OR TRIPLEX
3 ROW HOME
4 APARTMENT BUILDING
5 MOBILE HOME
6 TOWN HOMECONDOMINIUM
7 OTHER, pleasespecify_____

q2 Approximately when was your home built?

1 BEFORE 1900
2 1900 TO 1945
3 1946 TO 1970
4 1971 TO 1995
5 AFTER 1995
6 DON'T KNOW

q3 In what type of community is your home located?

1 RURAL
2 VILLAGE
3 SUBURB
4 CITY

region	respondent	q1	q1_text	q2	q3
5	1			6	4
5	2	1		1	4
5	3	1		1	4
5	4	1		3	4
5	5	1		1	4
5	6	1		2	4
5	7	1		2	2
5	8	1		3	4
5	9	1		6	4
5	10	1		3	4

Figure 25 HEU Survey Coding and Analysis

Conclusion

A survey instrument designed following best practices should yield useful data that assists in answering pertinent research questions of interest. The HEU and CP surveys attempted to follow standard best practices, from defining specific goals and objectives to coding the survey in a straightforward and logical manner. It has been posited in previous sections that if there is an improvement to survey design, it is argued that it comes from the addition of the structured conceptualization approach rather than from any specific alteration of best practices undisputed here. This conjecture is analyzed and discussed in the remaining chapters.

APPENDIX A

SAMPLE SIZE CALCULATION FOR TABLE 3

In a survey, there is usually no hypothesis being tested. The sample size determines the precision with which population values can be estimated. The sample size for a survey, then, is determined by asking the question, "How accurately do you need to know something?" To calculate the necessary sample size for a different combination of levels of precision, confidence, and variability, the application of formulas based upon Cochran's work (1953, 1977) are used. Cochran's (1977) formula uses two key factors:

1. The risk the researcher is willing to accept in the study, commonly called the margin of error, or the error the researcher is willing to accept, and
2. The alpha level, the level of acceptable risk the researcher is willing to accept that the true margin of error exceeds the acceptable margin of error:

Assume a researcher has set the alpha level a priori at .05, has set the level of acceptable error at 5%, and has estimated the variation within the population as .5 (maximum variance). Cochran's sample size formula then is:

$$n_0 = \frac{(t)^2 * (p)(q)}{(d)^2}$$

$$n_0 = \frac{(1.96)^2(.5)(.5)}{(.05)^2} = 384$$

Where t = value for selected alpha level of .025 in each tail = 1.96. (the alpha level of .05 indicates the level of risk the researcher is willing to take that true margin of error may exceed the acceptable margin of error).

Where (p)(q) = estimate of variance = .25. (maximum possible proportion (.5) * 1- maximum possible proportion (.5) produces maximum possible sample size).

Where d = acceptable margin of error for proportion being estimated = .05 (error researcher is willing to except).

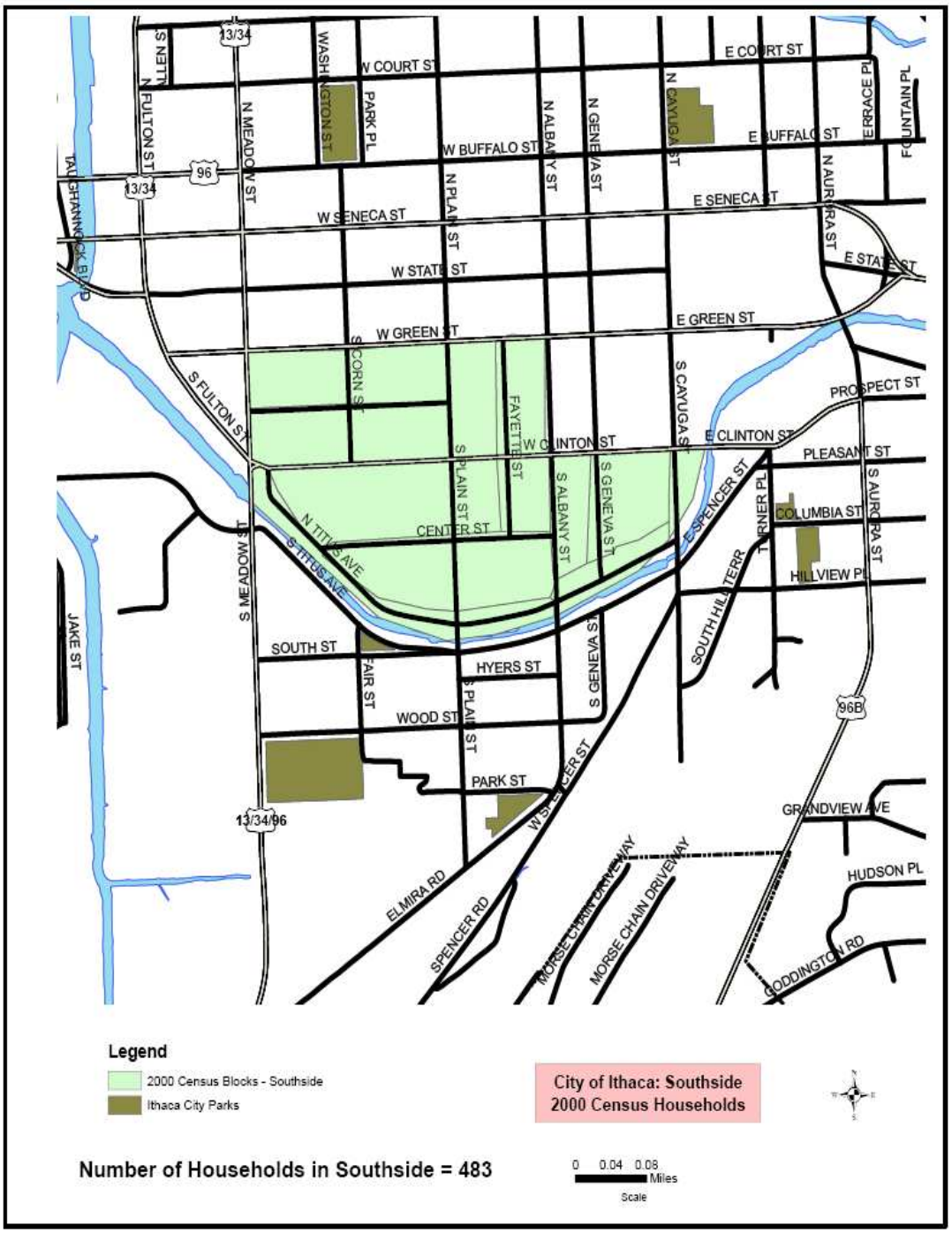
Therefore, for a large population the required sample size is 384 as indicated in table 3. However, if the sample size exceeds 5% of the population, Cochran's (1977) correction formula should be used to calculate the final sample size:

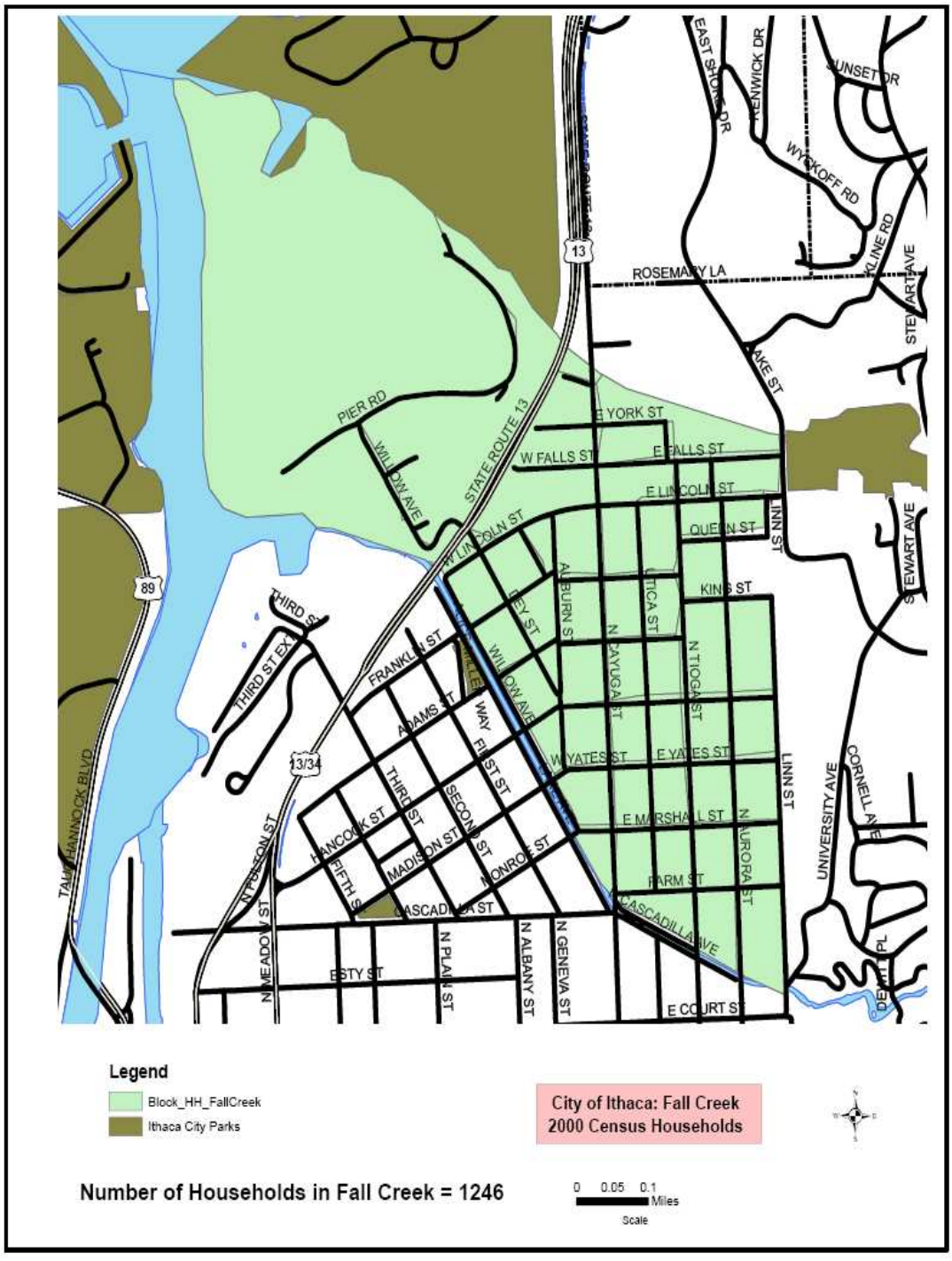
$$n_1 = \frac{n_0}{(1 + n_0 / \text{Population})}$$

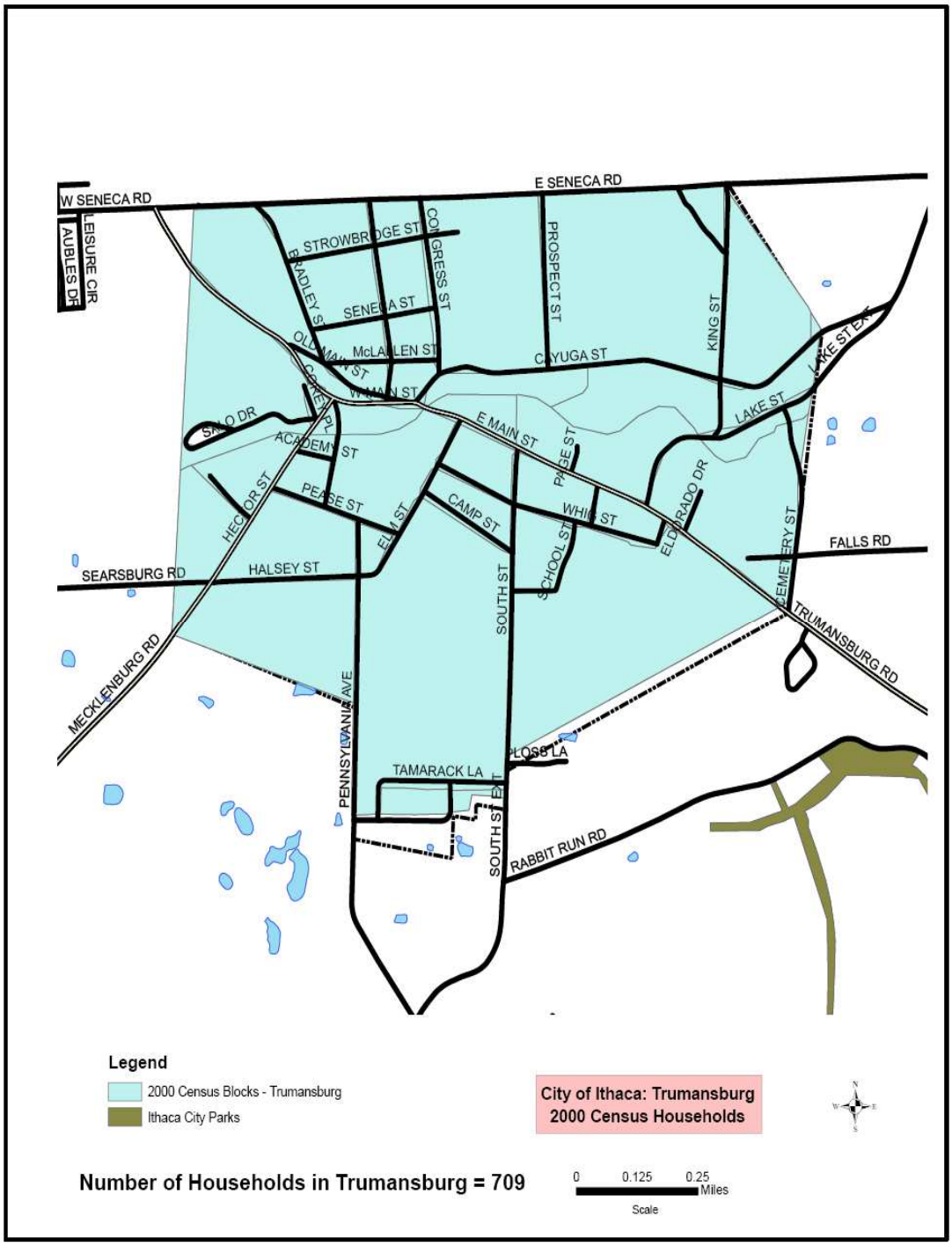
A population of 1000 would hence need only 278 units sampled to be statistically accurate as shown on table 3.

APPENDIX B

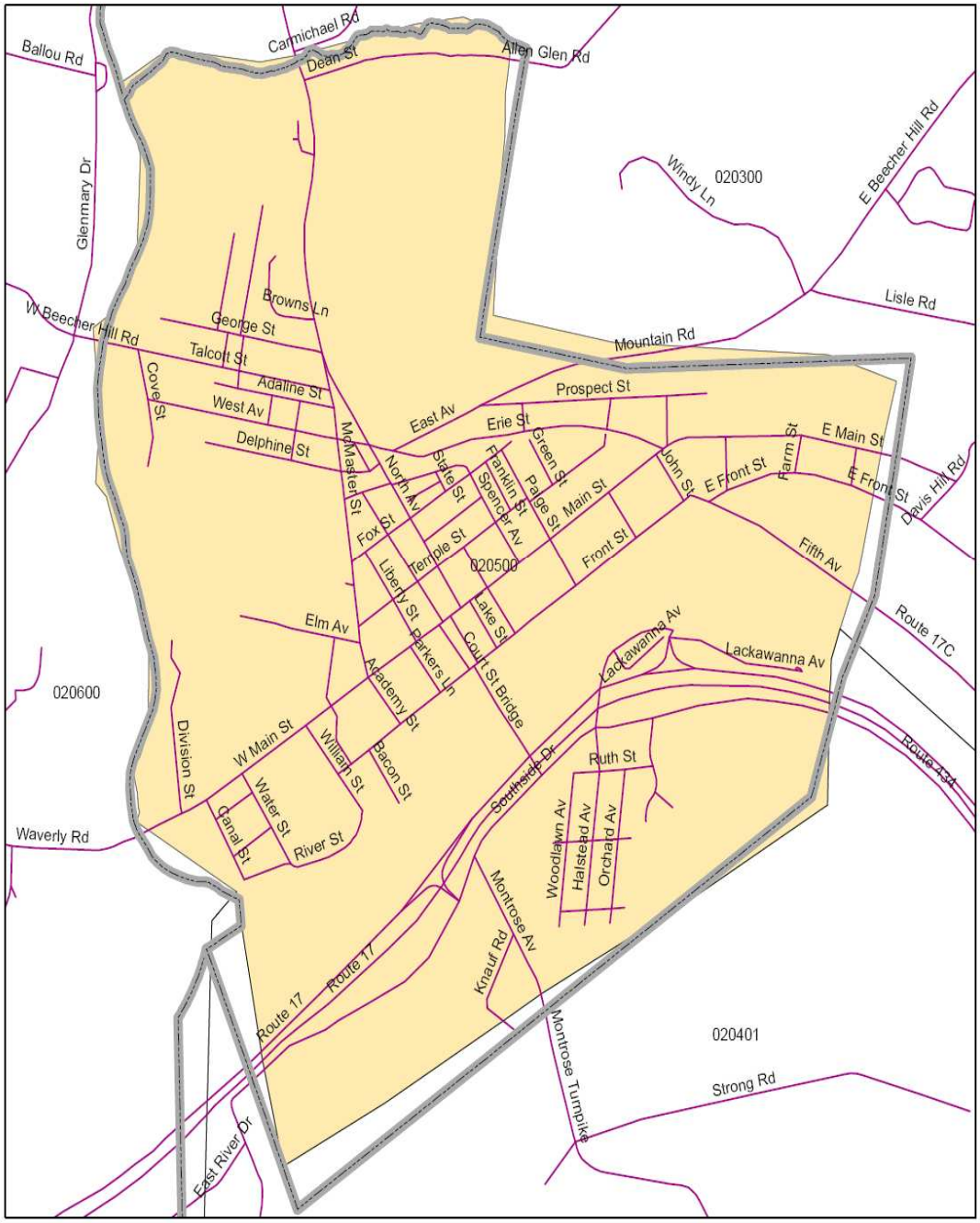
MAPS AND HOUSEHOLD POPULATION TABLES

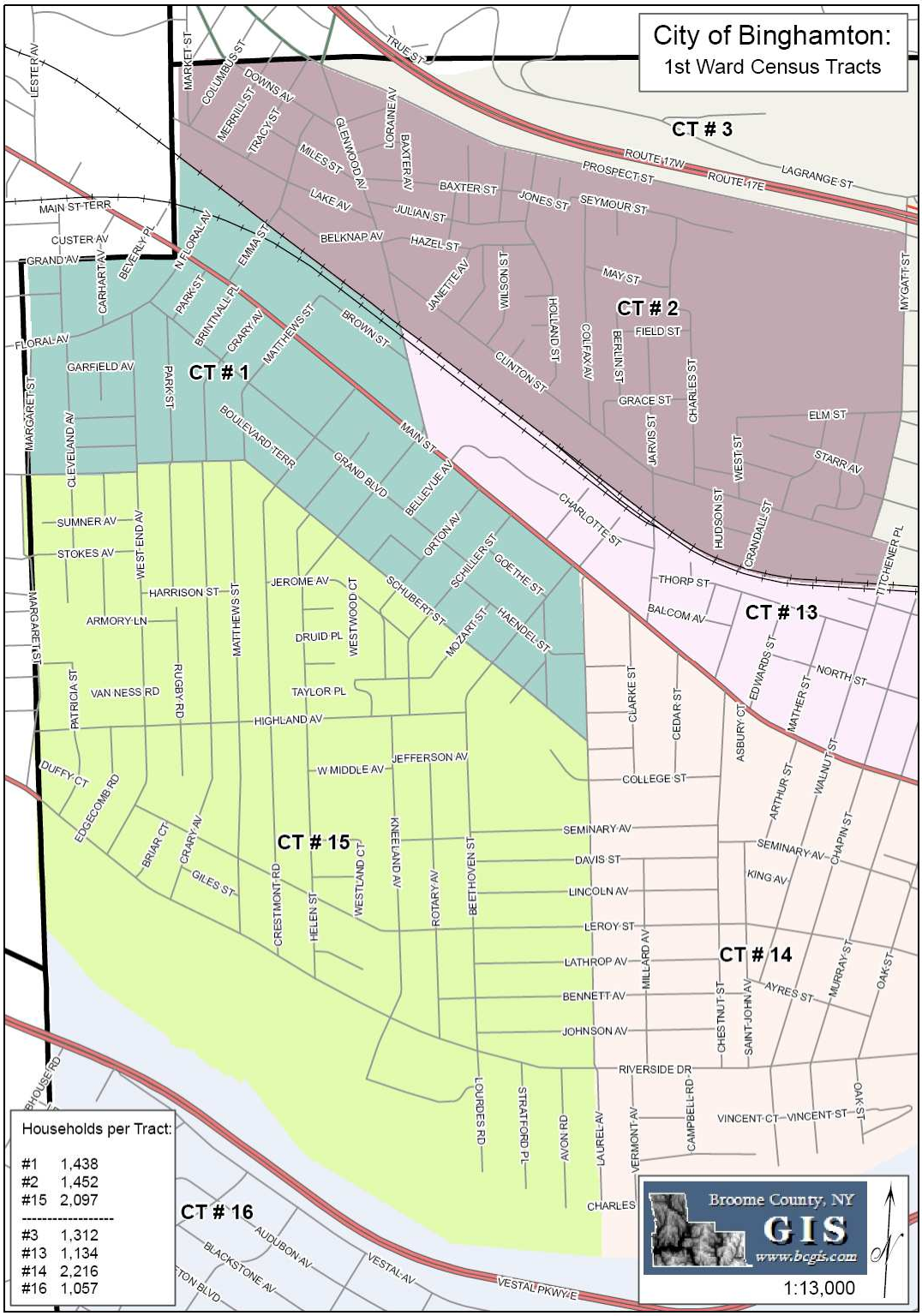



EAST SHORE DR
KENWICK DR
SUNSET DR
WYCKOFF RD
KLINE RD
STEWART AVE
ROSEMARY LA
13
PIER RD
WILLOW AVE
STATE ROUTE 13
E YORK ST
W FALLS ST
E FALLS ST
E LINCOLN ST
W LINCOLN ST
QUEEN ST
LINN ST
KING ST
ALBURN ST
UTICA ST
N CAYUGA ST
N TIOGA ST
89
THIRD ST
THIRD ST EXT
FRANKLIN ST
ADAMS ST
WILLOW AVE
FIRST ST
W YATES ST
E YATES ST
13/34
THIRD ST
SECOND ST
HANCOCK ST
FIFTH ST
MADISON ST
MONROE ST
E MARSHALL ST
AURORA ST
UNIVERSITY AVE
CORNELL AVE
TAUGHANNOCK BLVD
JEFFERSON ST
MEADOW ST
CASCADILLA ST
CASCADILLA AVE
ESTY ST
N PLAIN ST
N ALBANY ST
N GENEVA ST
E COURT ST
DEWITT PL
Legend
Block_HH_FallCreek
Ithaca City Parks
City of Ithaca: Fall Creek
2000 Census Households
Number of Households in Fall Creek = 1246
0 0.05 0.1
Miles
Scale


W SENECA RD
E SENECA RD
LEISURE CIR
AUBLES DR
E STROWBRIDGE ST
CONGRESS ST
PROSPECT ST
KING ST
BRADLEY ST
SENECA ST
McLALLEN ST
CAYUGA ST
LAKE ST EXT
OLD MILL ST
COLLEGE PL
W MAIN ST
SAGO DR
E MAIN ST
LAKE ST
ACADEMY ST
PEASE ST
HECTOR ST
ELM ST
CAMP ST
WHIG ST
ELDORADO DR
CEMETERY ST
FALLS RD
SEARSBURG RD
HALSEY ST
SCHOOL ST
SOUTH ST
TRUMANSBURG RD
MECKLENBURG RD
PENNSYLVANIA AVE
TAMARACK LA
CLOSE LA
SOUTH ST EXT
RABBIT RUN RD
Legend
2000 Census Blocks - Trumansburg
Ithaca City Parks
City of Ithaca: Trumansburg
2000 Census Households
Number of Households in Trumansburg = 709
0
0.125
0.25
Miles
Scale

Village of Owego, Tioga County
Census Tract # 020500




City of Binghamton:
1st Ward Census Tracts
CT # 1
CT # 2
CT # 3
CT # 13
CT # 14
CT # 15
CT # 16
Households per Tract:
#1 1,438
#2 1,452
#15 2,097
#3 1,312
#13 1,134
#14 2,216
#16 1,057
Broome County, NY GIS
www.bcgis.com
1:13,000

Tompkins County, New York -- Census Tract

Geographic area	Population	Housing units	Area in square miles			Density per square mile of land area	
			Total area	Water area	Land area	Population	Housing units
Tompkins County	96,501	38,625	491.63	15.57	476.05	202.7	81.1
CENSUS TRACT							
Tract 1	1,294	883	0.20	0.00	0.20	6,317.7	4,311.1
Tract 2	4,570	2,033	0.17	0.00	0.17	27,224.4	12,111.0
Tract 3	876	122	1.54	0.02	1.52	574.7	80.0
Tract 4	1,117	439	1.59	0.01	1.58	709.1	278.7
Tract 5	4,274	1,968	2.05	0.02	2.03	2,101.6	967.7

Tract 6	10,724	2,155	5.07	1.44	3.63	2,953.5	593.5
Tract 7	3,898	1,765	0.65	0.04	0.61	6,340.2	2,870.8
Tract 8	2,469	1,216	0.53	0.03	0.49	4,995.8	2,460.5
Tract 9	3,207	1,506	11.14	1.53	9.61	333.6	156.7
Tract 10	4,024	1,980	11.97	0.04	11.93	337.2	165.9
Tract 11	4,782	2,210	7.41	0.09	7.32	653.7	302.1
Tract 12	3,575	61	0.51	0.00	0.51	6,980.9	119.1
Tract 13	5,918	2,851	7.45	0.04	7.42	797.8	384.4
Tract 14	3,482	1,677	20.70	0.03	20.68	168.4	81.1
Tract 15	5,214	2,309	18.45	1.27	17.18	303.5	134.4
Tract 16	4,136	1,883	29.20	3.23	25.97	159.2	72.5
Tract 17	4,340	1,830	46.35	0.04	46.32	93.7	39.5
Tract 18	4,935	2,131	63.95	0.15	63.80	77.4	33.4
Tract 19	5,418	2,340	103.60	0.17	103.43	52.4	22.6
Tract 20	4,013	1,639	21.45	0.17	21.28	188.6	77.0
Tract 21	4,334	1,705	33.91	0.07	33.84	128.1	50.4
Tract 22	4,511	1,798	30.68	0.01	30.67	147.1	58.6

Tract 23	5,390	2,124	73.04	7.18	65.85	81.8	32.3

Source: U.S. Census Bureau, Census 2000 Summary File 1

Broome County, New York -- Census Tract

Geographic area	Population	Housing units	Area in square miles			Density per square mile of land area	
			Total area	Water area	Land area	Population	Housing units
Broome County	200,536	88,817	715.46	8.64	706.82	283.7	125.7
CENSUS TRACT							
Tract 1	2,989	1,636	0.35	0.00	0.35	8,604.9	4,709.8
Tract 2	3,005	1,720	0.53	0.00	0.53	5,706.6	3,266.3
Tract 3	3,333	1,474	1.27	0.03	1.24	2,682.0	1,186.1
Tract 4	2,389	1,141	0.49	0.07	0.42	5,704.1	2,724.3
Tract 5	1,957	1,130	0.51	0.04	0.47	4,144.3	2,393.0
Tract 6	2,422	1,101	0.62	0.01	0.61	3,990.5	1,814.0

Tract 7	3,667	1,548	1.32	0.05	1.27	2,887.2	1,218.8
Tract 9	1,660	832	0.54	0.10	0.44	3,774.5	1,891.8
Tract 11	1,745	1,148	0.42	0.07	0.35	4,944.6	3,252.9
Tract 12	1,005	923	0.24	0.01	0.22	4,475.1	4,110.0
Tract 13	2,696	1,463	0.28	0.01	0.27	9,920.7	5,383.5
Tract 14	4,855	2,478	0.55	0.04	0.51	9,487.8	4,842.6
Tract 15	4,727	2,212	0.88	0.06	0.82	5,740.7	2,686.4
Tract 16	2,387	1,125	1.21	0.10	1.11	2,158.0	1,017.0
Tract 17	4,302	2,121	0.94	0.01	0.93	4,614.1	2,274.9
Tract 18	4,241	1,919	0.89	0.00	0.89	4,761.9	2,154.7
Tract 102	5,459	2,181	45.77	0.03	45.74	119.4	47.7
Tract 119.01	3,032	1,245	39.78	1.69	38.09	79.6	32.7
Tract 119.02	2,738	1,067	41.79	0.41	41.38	66.2	25.8
Tract 119.03	2,707	1,083	46.98	0.05	46.93	57.7	23.1
Tract 120	1,790	717	24.35	0.04	24.31	73.6	29.5
Tract 121.01	3,982	1,616	12.97	0.10	12.86	309.5	125.6
Tract 121.02	3,981	1,620	4.10	0.18	3.91	1,017.2	413.9

Tract 121.03	3,491	1,498	17.19	0.05	17.14	203.6	87.4
Tract 122.01	2,680	1,147	4.11	0.15	3.96	676.0	289.3
Tract 122.02	4,229	1,794	29.26	0.34	28.92	146.2	62.0
Tract 123	5,441	2,189	79.21	0.69	78.52	69.3	27.9
Tract 124	2,477	1,545	91.00	0.93	90.07	27.5	17.2
Tract 125	6,421	2,793	92.76	1.26	91.50	70.2	30.5
Tract 126	5,651	2,469	31.39	0.43	30.96	182.5	79.7
Tract 127.01	5,940	2,435	24.93	0.42	24.51	242.3	99.3
Tract 127.02	4,969	1,911	25.47	0.04	25.43	195.4	75.2
Tract 128	5,335	2,131	4.86	0.07	4.79	1,114.8	445.3
Tract 129	1,000	405	5.68	0.01	5.67	176.3	71.4
Tract 130	4,478	1,894	3.93	0.17	3.76	1,192.1	504.2
Tract 131	2,709	1,419	0.86	0.06	0.80	3,371.3	1,765.9
Tract 132.01	2,364	1,039	0.39	0.00	0.39	6,119.6	2,689.6
Tract 132.02	3,219	1,550	0.94	0.00	0.94	3,431.6	1,652.4
Tract 133.01	5,127	2,438	4.03	0.02	4.01	1,277.0	607.2
Tract 133.03	2,858	1,128	8.31	0.00	8.31	343.7	135.7

Tract 133.04	5,975	2,302	3.70	0.01	3.69	1,619.0	623.8
Tract 134	4,249	2,014	0.88	0.00	0.88	4,808.8	2,279.3
Tract 135	1,835	1,068	0.37	0.00	0.37	4,986.4	2,902.2
Tract 136	3,678	1,975	0.59	0.00	0.59	6,285.5	3,375.2
Tract 137	3,276	1,629	1.58	0.26	1.31	2,492.3	1,239.3
Tract 138	3,322	1,664	0.64	0.00	0.64	5,168.1	2,588.7
Tract 139	2,406	1,335	0.38	0.00	0.38	6,260.2	3,473.5
Tract 140	2,880	1,501	0.26	0.00	0.26	11,256.1	5,866.5
Tract 141	3,643	1,596	0.77	0.13	0.64	5,662.1	2,480.6
Tract 142	3,279	1,550	2.52	0.01	2.51	1,304.2	616.5
Tract 143.01	5,219	2,170	7.65	0.24	7.41	704.3	292.8
Tract 143.02	7,306	1,069	2.71	0.00	2.71	2,699.8	395.0
Tract 144	5,126	2,144	4.40	0.12	4.28	1,196.8	500.6
Tract 145	3,617	1,528	6.41	0.14	6.27	576.6	243.6
Tract 146	5,267	1,987	31.51	0.00	31.51	167.2	63.1

Source: U.S. Census Bureau, Census 2000 Summary File 1

Tioga County, New York -- Census Tract

Geographic area	Population	Housing units	Area in square miles			Density per square mile of land area	
			Total area	Water area	Land area	Population	Housing units
Tioga County	51,784	21,410	522.91	4.21	518.69	99.8	41.3
CENSUS TRACT							
Tract 201	6,633	2,678	118.82	0.11	118.71	55.9	22.6
Tract 202	5,317	2,234	94.59	0.06	94.53	56.2	23.6
Tract 203	7,173	2,847	50.87	0.70	50.17	143.0	56.7
Tract 204.01	5,024	1,940	48.16	0.55	47.61	105.5	40.8
Tract 204.02	4,257	1,526	4.03	0.13	3.90	1,092.3	391.6
Tract 205	3,911	1,913	2.71	0.22	2.50	1,566.7	766.3
Tract 206	7,424	3,074	94.11	1.73	92.38	80.4	33.3

Tract 207.01	2,979	1,271	49.88	0.34	49.55	60.1	25.7
Tract 207.02	4,541	1,907	58.11	0.37	57.74	78.6	33.0
Tract 207.03	4,525	2,020	1.62	0.00	1.62	2,796.2	1,248.3

Source: U.S. Census Bureau, Census 2000 Summary File 1

APPENDIX C

HEU SURVEY PROTOCAL

Survey Introduction:

- Hello my name is_____
- I work for Cornell Cooperative Extension's Energy $mart Communities program.
- We are surveying residents in your neighborhood in order to better understand what the energy needs of this community are.
- We are giving each person who fills out a survey a free energy-saving compact fluorescent light bulb. [Have light bulb in hand to show them]
- This bulb is sold for about $5, but it could save you as much as $75 on your electric bill over the life of the bulb.
- We would very much appreciate your help. Would you be willing to fill out our survey? It takes about 15 minutes to complete.
- If they say yes, say "Thank you" and hand them the survey and light bulb and tell them "I'll be back to pick up the survey within the hour and if you have any questions circle the numbers and I will answer them upon my return". If the person will be leaving shortly, tell them to "leave the survey in the door and I will pick it up on my way back".
- If they say no, give them the educational packet and say: "here are some handout showing what energy program you could qualify for the dates of our free energy and financial workshops. Thank you."

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CHAPTER 5

Results and Analysis

Introduction

The method proposed in this dissertation is an attempt to improve upon the standard techniques of developing a survey instrument. The indefinite set of maxims and rules that direct the creation of successful survey instruments from the best practices literature falls short of a systematic group developed survey instrument. More importantly a systematic method, founded upon cognitive processes, where questions are logically generated and ordered appropriately is currently lacking. This dissertation's purpose is then to answer the research question *can a structured conceptualization process improve survey content development, design and framework from standard best practices within a group format?* The author speculates that a survey developed from a structured conceptualization is an improved approach to survey design. It is a method which specifically improves survey question composition and structure, while reducing negative group interactions. Verifying an improvement to standard best practices however is a vexing task. Survey success has several interpretations. Disproving the research questions might mean the proposed method may indeed hinder the survey development process rather than advance instrument design progress. An approach to determine if the dissertation surveys are successful is to examine them with standard measures of quality. In this chapter survey success is first identified and defined, followed by a brief discussion of each survey's results finishing with an analysis of the success or failure of the proposed method's ability to produce a quality survey.

What Constitutes a 'Successful' Survey? Analysis of the research question: measuring success

Usually when judging an improvement of a method over previous best practices in quantitative terms, a controlled or natural experiment is most desirable when proposing and verifying hypotheses. Given the constraints and biases that might be interjected from developing a treatment and control set of surveys, one developed with standard best practices and the other with the proposed alternative structured conceptualization method, this type of controlled experiment proved to be infeasible. Several of the constraints and sources of bias included the time, cost, and control over the sample population of concept mapping participants and the sample population of survey takers. Experimental groups for testing of the method, the treated and non treated surveys, therefore were impracticable to consider provided the situation. A further thought on future research where experimentation might be pursued is suggested in the next chapter.

In proposing criteria to measure the success of a survey developed from the structured conceptualization approach, logically criteria that deem a survey successfully developed from standard methods should also apply to the proposed method. However, the survey quality literature is fragmented with considerable variation in the community regarding the perceptions of quality. Upon review, several important criteria stand out as benchmarks to determine survey quality. First of all, the questionnaire must be written in a way so the questions produce valid, reliable and unbiased results. According to many researchers, much of any survey's success rests in the design of its questions (Fowler 1995). Along with designing good questions the quality of the data from a survey depends on the size and representativeness of the

sample, the technique used to collect data and the quality of the interviewing (if undertaken) (Dillman 1978). Some describe this as the *Total Design Method (TDM).* The TDM emphasizes the application of social exchange theory and a comprehensive approach to encouraging respondent trust, while creating perceptions of increased rewards and reduced costs as a means of increasing survey response rates (Dillman 1978). This increased trust is then parlayed into higher response rates. Dillman with his colleague Priscilla Salant (1994) further describe that the cornerstones of a quality survey rest on avoiding the four types of error they identify: coverage, sampling, measurement, and non response. The four kinds of error are then directly related to a survey's quality and accuracy.

Accuracy in this context means the results are a close approximation to the true population value(s) of interest. Accuracy is often measured by total survey error or mean squared error (MSE). MSE is quantified by the squared sum of the variance and measured biases around each question in the instrument. However, computation of the bias(s) which surround the questions and the process to produce them requires knowledge of the true parameter values of the population. Lyberg (2003) is critical of utilizing MSE as the primary benchmark for survey quality. He states that it is not sufficient to rely on MSE for accuracy because the variance and bias components usually do not reflect contributions from all the different sources of error (Lyberg and Elvers 2003). He suggests designing surveys so that MSE is as small as possible given a specified research budget. The MSE, although impractical to compute then, provides error components to be aware of when producing the survey in order that they are minimized: non-response, measurement, frame,

specification, data processing and sampling.[36] Then there is the concept of survey quality to contend with.

The most widely cited example of survey quality is Juran and Gyrna's definition, a 'quality survey is one judged by its "fitness for use"' (Juran and Gyrna 1980). Biemer and Lyberg (2003) further expound on the fitness concept that the data that surveys produce are *accurate* as necessary to achieve their intended purposes and objectives, available at the time needed (*timely*) and be *accessible* to those for whom the survey was constructed. Finally Blankenship (1943) adds that questions should avoid bias at all costs. To simply state, the quality of the information from a survey instrument is directly comparative to the quality of the questionnaire and in turn directly comparative to the quality of the question construction process.

In the absence of a controlled experiment between a standard best practices survey and the proposed method, there is no satisfactory standard against which to assess the validity of the proposed structured measurement technique. For one, examining the proposed method's repeatability is worthwhile. If the techniques can replicate a valid and reliable survey, the method is a potentially defensible improvement. Hence the reason behind constructing two instruments from the proposed method. The following measures of survey success then will substitute as the gauge in which to measure the overall success of the surveys developed from the proposed method. Since it is out forward that the structured conceptualization method *improves survey content development, design and framework from standard best practices within a group format*, an instrument developed from the method may be judged by,

[36] List of error components provided by Biemer and Lyberg (2003).

1. An instrument that elicits high respondent trust resulting in an acceptable response rate, minimizing non-response error;
2. Well written questions that overall avoid or minimize the four types of error most notably measurement error;
3. And one which produces accurate, timely and accessible data or "fitness for use"; one whose results meet the objectives of the survey for the constituent agency.

This list is certainly not complete when considering the scope of ideas which determine survey quality. However, it is acceptable provided the latitude of what ideally determines quality as well as the specific constraints of this particular research project (time, cost and personnel primarily). If standard best practices are considered and accounted for throughout the survey design process, then the alternative method may be scrutinized to provide a similar or improved response rate, low measurement error and most importantly rich data (accurate, timely, accessible). A high response rate, low coverage and sampling error (errors of non-observation) are easily observed. However determining whether measurement error is indeed low and the data from the surveys is of high quality is again more subjective. The best understanding of the survey's quality is if the information it provides is useful in determining estimates of population characteristics while garnering information of interest to the investigator. In the results section of this dissertation a brief review of selected descriptive figures and tables produced from the survey data are provided to make the argument that the surveys do in fact provide useful information to the investigative purposes the surveys were originally commissioned for. In accounting for the three considerations of a successful

survey above, it may then be argued (more fully in Chapter 6 Discussion) that the proposed method not only produces successful quality surveys, but improves question design and order while facilitating an improved group design process.

Results of the Surveys[37]

Each dissertation survey had its data carefully coded into a Microsoft Excel spreadsheet, providing a database where descriptive figures could be generated. The HEU survey had a total of 293 responses and the CP survey 217. At 47 questions for the HEU survey there are 13,771 data points while the CP survey is composed of 4,123. Utilizing the statistical software packages of SPSS and STATA, single variable statistics, percent distributions and associated histograms, were completed and provided in full on the accompanying CD at the back of this document. These specific results, although necessary in a broad sense to support the success of the survey and underlying method, are rather insignificant regarding the potential inference calculations to populations of interest for this document's purpose. Illustrating that the data has provided accurate, timely, accessible data/results is the goal of this section. In retrospect, the data has proven useful to the constituencies that commissioned the research, guiding energy policy decisions (HEU) and assisting in a completed comprehensive plan document (CP). A summarized sampling of important findings from the surveys is described below with

[37] Both the CP and HEU survey questions are summarized in the format of a percentage distributions, bar chart and/or histogram for each individual question. The results of these tabulations along with the underlying datasets are included at the end of this document on a compact disk for the purpose of brevity.

emphasis placed on the data's capacity to produce accurate, timely and accessible information or "fitness for use".

HEU Survey

The Home Energy Survey was commissioned by Cornell Cooperative Extension and NYSERDA in order to gain a greater understanding of New York State Southern Tier household's energy use and conservation practices. In this cross sectional survey of Southern Tier households, attitudes beliefs and behavior changes were sought from the survey data so as to better inform public outreach services that may be provided by the agencies. The questionnaire data then was to provide a snapshot of areas of concern from the perspective of the focus prompt in the conceptualization process, *specific factors and concerns that influence my energy consumption and energy conservation are.* The underlying data of the HEU survey allow many group and inter group comparisons if desired, given the five regions sampled.

In August of 2005 research personnel administered the HEU drop off questionnaire to 315 households. Of these households 293 returned acceptable completed surveys, those free of a large number of missing questions or sections. This provides a response rate of 93%. Utilizing the social exchange theory concept presented by Dillman (2006), the survey interviewers were instructed to be pleasant and provide an incentive (one compact fluorescent bulb) all the while speaking of the benefits the survey and incentive would provide. It is hypothesized that a combination of not only a well written questionnaire but also a pleasant and mutually beneficial social exchange accounts for the very high response rate experience with this survey.

The survey is divided into seven distinct sections or conceptual domains as produced form the structured conceptualization process: fear and anxiety, influence / control, time and knowledge considerations, social and environmental awareness, financial considerations, hassle factors, and program and subsidy issues. Each of these sections is easily referred to when performing any analysis. The results that follow offer a succinct example of how the survey data potentially provides accessible, timely and accurate results. A global perspective analysis, one where computing of percentage distributions and frequencies of the combined five regions, offers respectable evidence of the HEU survey's fitness for use.

With the purpose of the survey to assess energy use and conservation practices, a series of home energy improvement items is first queried to prime and frame the respondent to the surveys purpose. The energy improvement item series was born out of a group discussion to quickly ascertain and educate (best practice procedure for initial questions) the energy use behaviors of the respondents. Table 5 is a summary of questions 4a to 4q in the Home Energy Survey priming questions. As expected, 96.2% turn off lights and water when not in use and turn down the thermostat when not at home (79.5%). When it comes to possible energy improvements, 30.5% say they would consider installing fluorescent lights, 34.9% installing a programmable thermostat and 48.4% thermal blinds on windows. However, more importantly the respondent is now thinking of energy conservation and efficiency where the next set of cognitive cues developed (in the form of section questions) from the conceptualization process will further gauge attitudes, beliefs and knowledge of the items of interest.

Table 5 HEU Survey Results

HEU Survey q4a-q4q

	In place	Don't do	Would consider	Does not apply
	Row N %	Row N %	Row N %	Row N %
a Turn off lights and water when not in use	96.2%	1.7%	1.4%	.7%
b Turn down thermostat when leaving home	79.5%	11.7%	6.7%	2.1%
d Raising the temperature setting a few degrees on the air conditioner	33.0%	17.6%	11.1%	38.4%
e Installing fluorescent light bulbs	42.5%	22.1%	30.5%	4.9%
f nstalling water saver shower heads	50.5%	21.2%	25.4%	2.8%
g Purchasing and installing a programmable thermostat	39.9%	19.2%	34.9%	6.0%
h Installing thermal blinds on windows	14.5%	30.7%	48.4%	6.4%
i Weather-stripping doors	70.5%	8.5%	19.6%	1.4%
j Caulking Windows	60.4%	11.5%	22.3%	5.8%
k Insulated water heater	48.0%	17.2%	30.8%	3.9%
l Using storm windows in the winter	81.3%	5.2%	6.3%	7.3%
m Insulated the attic or crawl space	68.6%	5.0%	20.0%	6.4%
n Replacing old windows with double or triple pane glass	45.6%	16.6%	32.5%	5.3%
o Adding insulation throughout the home	55.1%	9.2%	31.4%	4.2%
p Buying one or more high efficiency appliance(s)	63.2%	3.9%	30.9%	2.1%
q Hiring a qualified contractor to do an	13.3%	35.5%	43.7%	7.5%

From this point forward until the ending demographic questions, the HEU survey follows the topic order developed from the conceptual domain as discussed in the first methods section. That is the framework illustrated in figure 20 (the HEU final cluster solution) from Chapter 3, provides a cognitive sequence, cognizant of direction as well as order of sections within the questionnaire. Questionnaire section order arranged in this way provides respondents with a cognitive framework, further surmised to be unnoticed by the respondent, yet valuable in providing cognitive harmony encouraging the completion of the survey. The proposed method of ordering sections may additionally prime the memories of a respondent on questions that are topically related to one another providing further reinforcement to complete the questionnaire.

In the HEU Survey questions 5 through 8 are focused on the fear and anxiety a respondent may have regarding energy efficiency and conservation, or more likely the lack thereof in their own household. There was strong agreement regarding the ability to find a trustworthy contractor to perform improvements on the home. Many respondents also felt comfortable allowing an unknown contractor in their home to undertake the improvements as shown in table 6. Another counterargument question, number 6, shows that energy efficiency measures will in fact increase or have no effect on the comfort, convenience and safety respondents currently enjoy. From these simple distribution calculations, respondent attitudes regarding fear over instituting efficiency changes by allowing strangers into ones home may already be discerned.

Table 6 HEU Survey Results

HEU Survey q5-q8

		Column N %
5 'It is easy to find a trustworthy contractor to make energy efficiency improvements in my home.'	STRONGLY AGREE	13.1%
	SOMEWHAT AGREE	23.8%
	NEITHER DISAGREE NOR AGREE	15.6%
	SOMEWHAT DISAGREE	15.2%
	STRONGLY DISAGREE	5.3%
	DOES NOT APPLY	3.9%
	DON'T KNOW	23.0%
6 'I am concerned that energy efficiency measures will reduce the comfort....'	STRONGLY AGREE	6.7%
	SOMEWHAT AGREE	9.5%
	NEITHER DISAGREE NOR AGREE	14.1%
	SOMEWHAT DISAGREE	15.2%
	STRONGLY DISAGREE	44.5%
	DOES NOT APPLY	1.8%
	DON'T KNOW	8.1%
7 'Staying comfortable in my home is more important to me than saving money on money on my bills.'	STRONGLY AGREE	8.8%
	SOMEWHAT AGREE	24.2%
	NEITHER DISAGREE NOR AGREE	15.4%
	SOMEWHAT DISAGREE	26.0%
	STRONGLY DISAGREE	23.9%
	DOES NOT APPLY	.7%
	DON'T KNOW	1.1%
8 'One barrier to having energy efficiency improvements done by contractor is that I am uncomfortable....'	STRONGLY AGREE	6.0%
	SOMEWHAT AGREE	13.4%
	NEITHER DISAGREE NOR AGREE	17.0%
	SOMEWHAT DISAGREE	13.4%
	STRONGLY DISAGREE	35.7%
	DOES NOT APPLY	12.0%
	DON'T KNOW	2.5%

Control and influence as the next discrete topic attempts to measure where respondents feel most comfortable gathering information and who or what they trust the most to best deliver this information. When it came to where respondents felt most comfortable attending discussions on community issues, 53.2% stated at community groups and 47.1% in town or village halls. Question 12 probed familiarity with the Energy Star Label on appliances as well as its importance when making consumer decisions. 61.4% indicated the label was important when deciding which appliance to buy. Question 13 asked respondents if they felt their daily habits and decisions regarding energy use impacted themselves and others not only at the personal level but also at the global level. 89.1% of total respondents answered in the affirmative that their monthly energy bill was impacted by daily their own daily habits and decisions. From a broader perspective, respondent's beliefs that their habits and decisions impacted the larger community was remarkably unaccounted for; only 49.8% felt what they did impacted their local community, 42.7% the national environment and the 44.4% global environment.

Touching on the time and knowledge cluster, question 18 depicted in figure 26 gauged respondent's beliefs as to the one most important reason they were unable to pursue energy efficiency in their home. The overwhelming response choice selected was a lack of money to implement the change at 56.8%. A distant second at 12.6% was a lack of time to implement energy efficiency changes. When asked if willing to attend a two hour workshop on ways to avoid high energy costs, almost 40% said they would while 27.7% responded no and 32.6% couldn't decide.

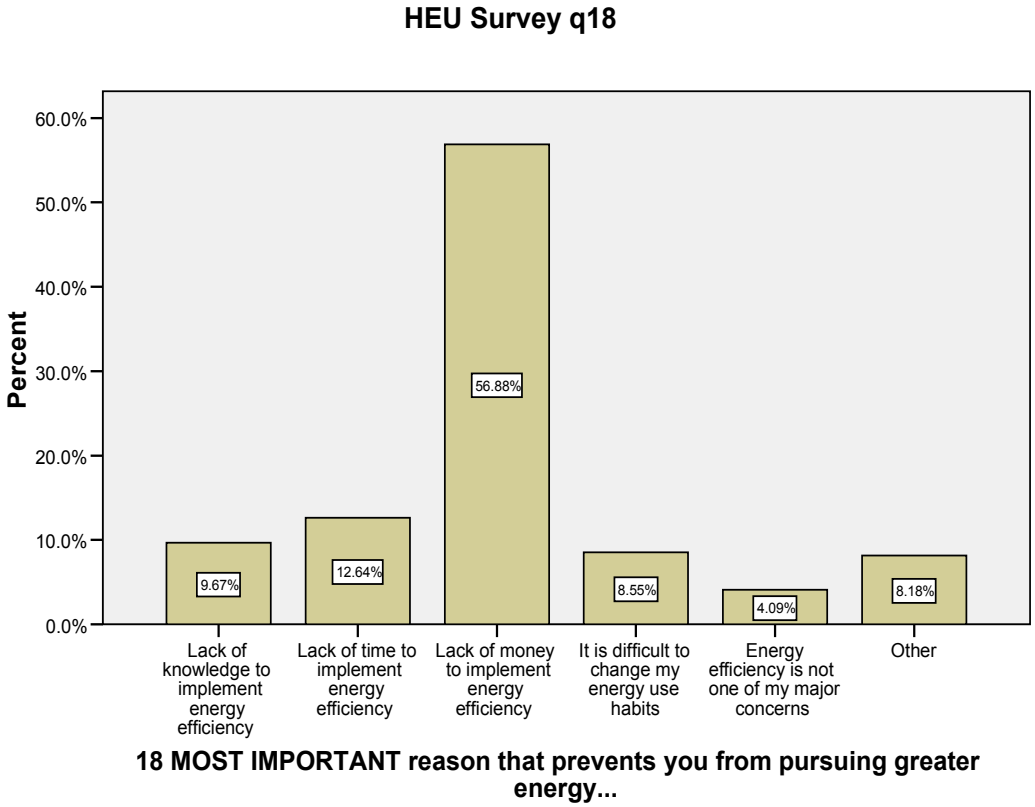

Figure 26 HEU Survey Results

Concerning the beliefs of respondents about their concern for the environment, 42.8% are willing to pay more for environmentally friendly sources of energy. Also of note was that 22.7% of total respondents rated their concern for the environment as very high. Touching on the cost section, as inferred from previous questions, cost is a determining factor when deciding to undertake energy efficiency improvements. This is verified in table 7 q26 where 47.4% stated they believe investing in energy efficiency improvements cost too much and in q28 where another 49.2% believe they cannot afford the upfront cost of making upgrades. .

Table 7 HEU Survey Results

HEU Survey q25-26, 28

	25 'I believe that energy prices are going to continue to increase and could remain a significant monthly expense.'		26 'Investing in energy-efficiency improvements in my home would cost me too much financially.'		28 'Even though I know I would save money on my utility bills, I can't afford the upfront costs of having my home insulated or the heating system upgraded.'	
	Count	%	Count	%	Count	%
STRONGLY AGREE	225	78.4%	59	20.7%	76	26.7%
SOMEWHAT AGREE	44	15.3%	76	26.7%	64	22.5%
NEITHER DISAGREE NOR AGREE	8	2.8%	49	17.2%	34	11.9%
SOMEWHAT DISAGREE	3	1.0%	49	17.2%	18	6.3%
STRONGLY DISAGREE			23	8.1%	24	8.4%
DOES NOT APPLY	2	.7%	4	1.4%	57	20.0%
DON'T KNOW	5	1.7%	25	8.8%	12	4.2%

Another barrier to energy efficiency improvement beside cost is the perceived or real 'hassle' of making the improvements. This next section attempts to gauge the perceived or real barriers to a homeowner's reluctance to making energy efficiency improvements beyond cost. Somewhat surprising is that time does not create as much of a barrier as might be expected when isolated in q32. A somewhat normally distributed set of answers illustrates that almost as many disagree that time is a constraining factor for making improvements as agree, with 20.57% remaining neutral on the subject (figure 27).

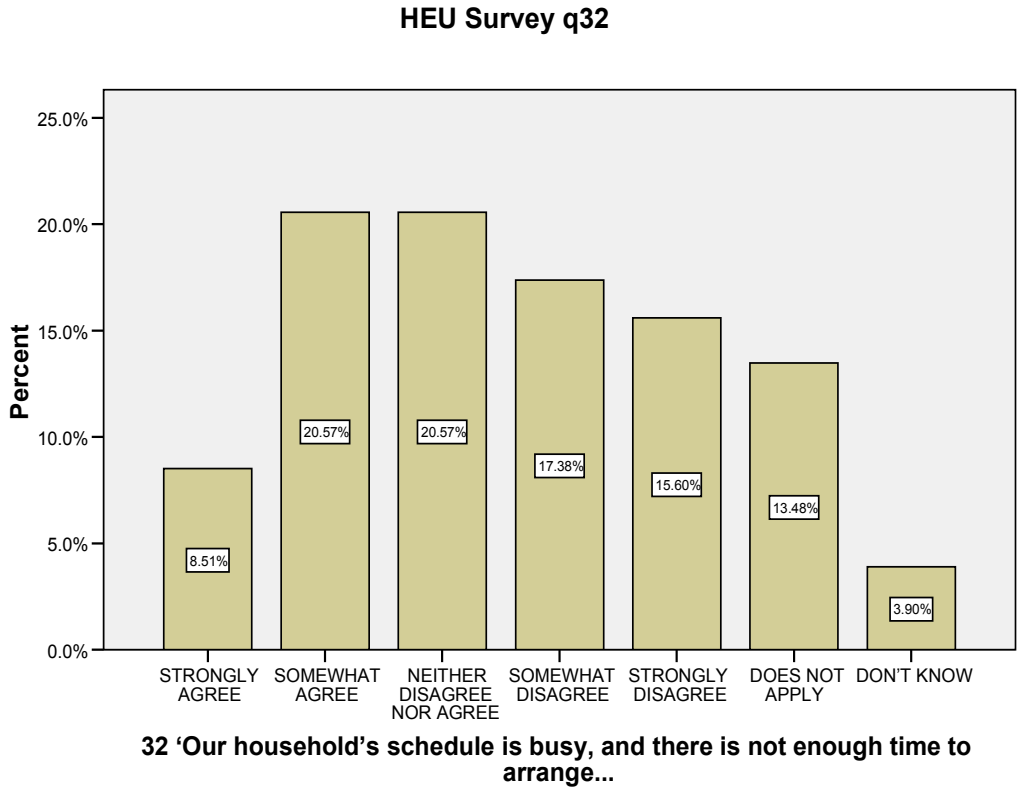

Figure 27 HEU Survey Results

The last topic section queries respondents on knowledge of NYSERDA and assistance programs that may be offered by the agency. It is very apparent that the population surveyed has little familiarity with NYSERDA. 68.6% never heard of the agency and 80.4% are unfamiliar with programs offered. However, 35.7% of respondents are likely to take advantage of an energy efficiency loan program administered by the agency (table 8).

Table 8 HEU Survey Results

HEU Survey q36-q39

		Count	Column N %
36 How FAMILIAR or UNFAMILIAR are you with NYSERDA?	VERY FAMILIAR	19	6.7%
	SOMEWHAT FAMILIAR	70	24.7%
	NEVER HEARD OF 'NYSERDA'	194	68.6%
37 How FAMILIAR or UNFAMILIAR are you with NYSERDA's programs for lower income	VERY FAMILIAR	13	4.6%
	SOMEWHAT FAMILIAR	42	14.9%
	NOT FAMILIAR	226	80.4%
38 NYSERDA has a New York Energy Loan Fund Program that offers an interest rate reduction of 4%...How LIKELY or UNLIKELY would you be to use this program?	VERY LIKELY	36	12.7%
	SOMEWHAT LIKELY	65	23.0%
	NEITHER LIKELY NOR UNLIKELY	41	14.5%
	SOMEWHAT UNLIKELY	35	12.4%
	VERY UNLIKELY	58	20.5%
	NEED MORE INFORMATION	48	17.0%
39 Have you ever discussed any of NYSERDA's programs with an energy	YES	27	9.6%
	NO	254	90.1%
	4	1	.4%

The demographic characteristics of HEU respondents were somewhat atypical. 65% who responded to the survey were female, while 45.5% of total respondents held a 4 year degree or higher and were overwhelmingly Caucasian (83.7%).

CP Survey

The Comprehensive Plan survey's primary objective was to provide an accurate assessment of citizen beliefs, attitudes and concerns relating to the future governance of the Village of Trumansburg. The survey results would

inform a new comprehensive plan becoming the future roadmap and community guiding document utilized by Village municipal officials. The survey results were compiled in the same manner as the HEU survey; percentage distributions, bar charts and/or histograms for each question with SPSS and STATA. Looking back to the conceptualization process, the CP survey has four distinct cluster solutions or in this case survey topics that emerged. The method produced a survey that would meet the purpose and objective stated above by probing respondent responses to the topics of living in Trumansburg, what is Trumansburg, economic development and zoning/land use. In 2006 the Village of Trumansburg mailed out the Comprehensive Plan survey to all residents. Each of the 709 households in Trumansburg received a survey on May 15, 2006 with a request to complete it by June 5, 2006. Several 'drop boxes' were made available throughout the Village where completed questionnaires were collected. The survey was also available online at the Village website for download. Keeping in mind the positive social exchange practices of incentives for high response rate, surveys had postage supplied. Of the 709 surveys mailed out, 217 were returned complete or a 31% response rate. The following discussion aims to illustrate that underlying data producing these results provides accurate, timely and accessible information having a high degree of fitness for use.

The first question (figure 28) of the survey provided a list of Village services and asked whether levels of service should be increased or decreased. More than 15% of respondents felt that the amount of police protection should be decreased. This was the only category in which more than 9% of those surveyed indicated that they would like to see allocations decreased. In contrast, only 6% of respondents thought that less should be

spent on village sidewalk construction while 58% felt that the level of service should increase. This was the only category wherein a majority of respondents indicated that the level of service should rise. No distinction was made in the survey between sidewalks in commercial areas and those in residential neighborhoods.

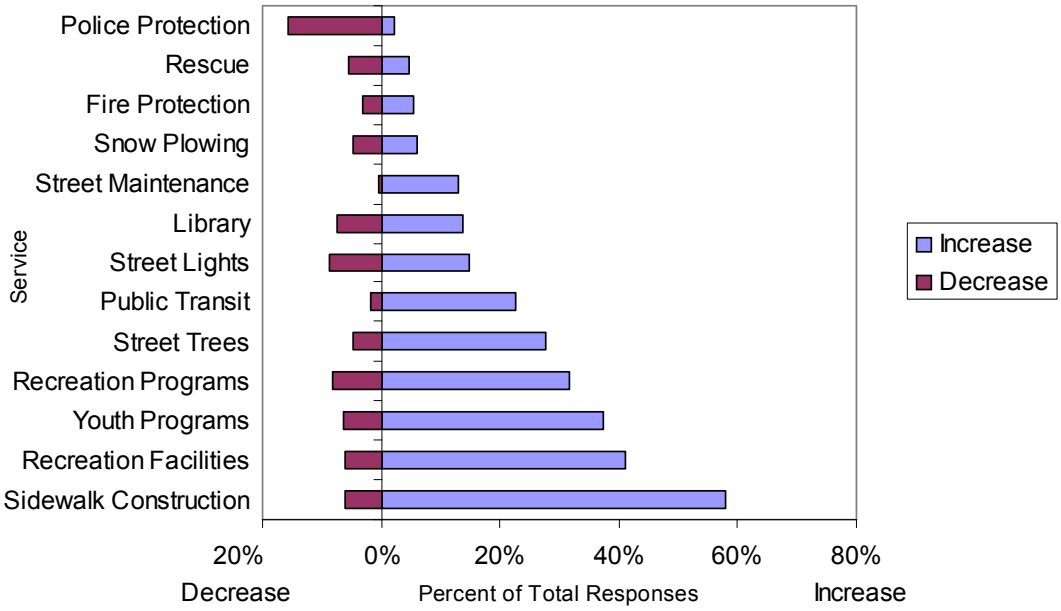

Figure 28 CP Survey q1

The second question provided a list of land-use issues and asked respondents to rate their importance. Only “Green space" was rated as "very important" by a majority (53.9 %) of those residents polled. "Historic preservation" came in second with 46.5 % rating as "very important". The issue, "aesthetic entrances" to the Village generated the least interest by the sample of residents; 19.4 % rated it as "very important".

When residents were asked what activity they would like to see the community develop for young people, a skateboard park with 12.4%

expressing interest was, along with an “other" option the least popular. More people (16.6%) favored doing "nothing" additional for young people in the community. The largest number of people 6.3% looked favorably on the generalized category of "after school activities".

The sample's response to the question "Do you believe that Trumansburg is changing for the better or worse?" was rather evenly divided. The combined total for the categories "better" and "somewhat better" is 38.2%, and the total percentage under "worse" and "somewhat worse" was 43.3%. Only 12.4% felt that the community was not changing.

Questions 6 and 8 asked respectively whether the village should spend money on preservation of natural and architectural features and how important tourism was to the local economy. A clear majority of those polled (68.2%) agreed that preservation was important and 74.2% believed that tourism was either "very important" or "somewhat important."

When it came to the topic of commercial development and the various opportunities that may be available, Village residents overwhelmingly rejected fast food establishments and chain stores locating in Trumansburg. Each option at earned a 78.8% avoid response rate. The farmers market 89.4%, neighborhood retail establishments 73.7% and tourism 71.4% all scored high in the type of commercial development to include (figure 29).

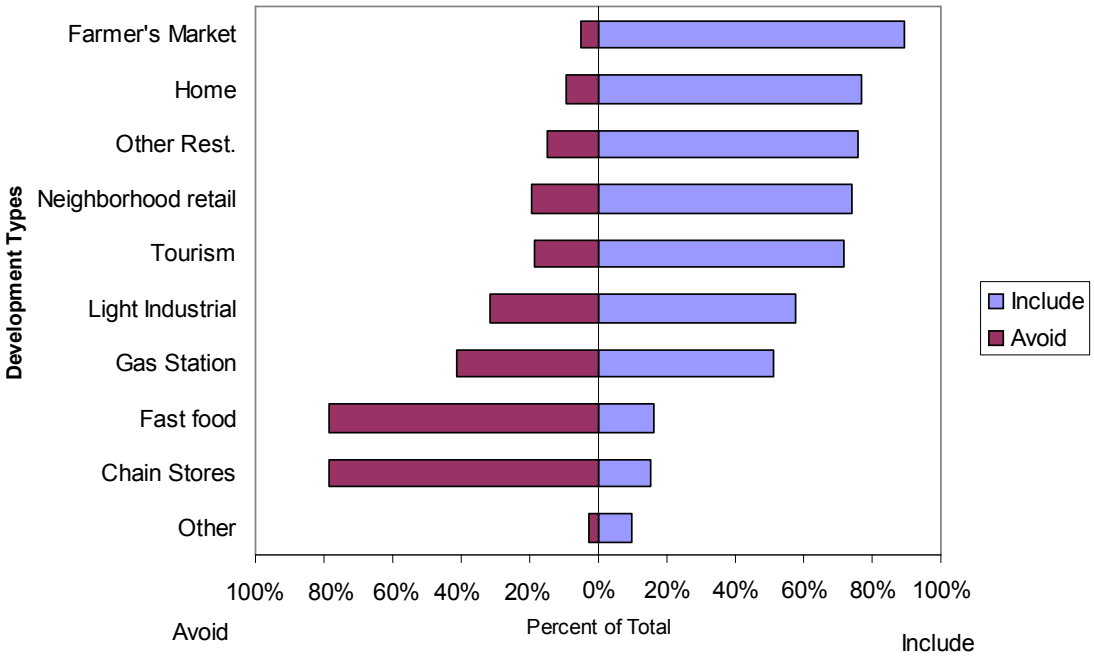

Figure 29 CP Survey q10

The most frequently cited reason for living in Trumansburg was the answer choice "quiet"; 90.3% of respondents considered it either "somewhat important" or "very important." Also ranking high were "community" (86.6%), "rural" (85.7%) and "aesthetic" (81.1%). Rated somewhat lower were "schools" (77.8%) and "Main Street" (64.1%) . Distinctly less important to those who responded to the survey were "agriculture land" (41.1%) and "family" (26.7%) (figure 30).

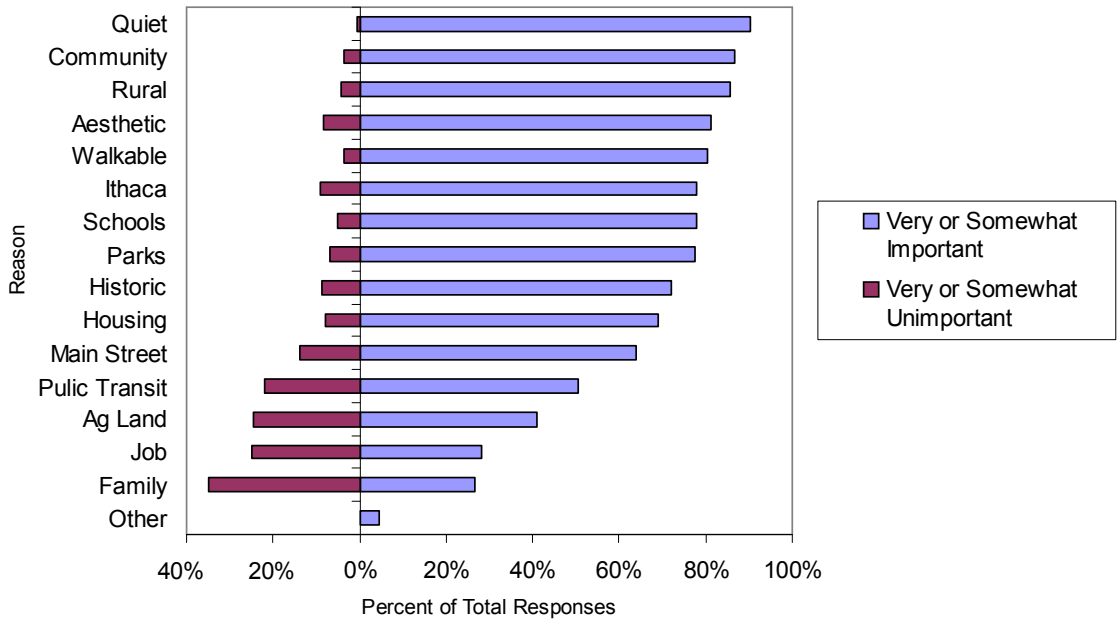

Figure 30 CP Survey q9

There were some clear opinions expressed regarding the nature of commercial development that should be included in the future Village landscape. Chain stores and fast food establishments were unpopular; 78.8% indicated that they should be avoided. Favorable reactions were given to the existing farmers' market (89.4%), home occupations (77%), restaurants (76%), tourism (71.4%), and neighborhood retail (73.7 %). A surprising majority percentage (57.6%) favored more light industrial development.

Opinions were generally more evenly divided regarding favoring more or less of several land-uses. More "green space" was the most solidly preferred (60.4%) choice. 53% of those responding wished to see less land for agriculture. The final question asked residents how often they engaged in seventeen different economic activities in Trumansburg. The post office and

the grocery store were the most frequented places with 40.1% and 43.8% respectively of responding residents stopping in more than three times per week. Local restaurants were patronized three times per month or more by 46.5% of respondents. Fewer responding residents (22.5%) sought out entertainment in Trumansburg more than three times per month. This was fewer than the 23% who indicated that they never sought out entertainment in the village where they live.

The demographic characteristics of the respondents were typical of those who inhabit the Village compared to U.S. Census Figures. Almost 50% of the respondents were aged 45-64 years, with a household income of $50,000 to $99,999 of 39.6% of those responding. Many were long time residents, 41.9% living there more than twenty years and an average household size of two residents (44.7%). Of surprise was the education level of those whom responded; 72.8% hold college or higher advanced degrees.

Analysis of the Method

Evaluating the outcomes of the two surveys completed with the proposed structured conceptualization method requires a comparison with the list of successful survey measures selected at the beginning of this chapter. If each survey compares favorably with these selected measures of quality, it may be argued that the method develops a successful survey where the question development and ordering process is improved upon within a group framework. For the moment it may be ignored that the method offers a systematic repeatable framework that simplifies group instrument design processes and produces ordered survey question material. First it must be established that the method generates a valid and reliable instrument against

the identified measures of success: avoids or minimizes the four types of error most notably non-response and measurement error, while eliciting high respondent trust resulting in a high response rate, and produces accurate, timely and accessible data or “fitness for use” for intended constituents.

Avoiding the four types of error from Salant and Dillman’s (1994) list are the self imposed prerequisite measures that begin to define a successful survey, one of high quality and accuracy. Avoiding and attempting to minimize these errors with standard best practices should result in a successful survey. If these steps are taken yet there is strong evidence of measurement and non-response error particularly, then it may be possible the likely introduction of error is derived from the proposed method in this dissertation. Measurement error is when the respondent’s answer to a given question is inaccurate or imprecise due to poorly defined and structured questions (primarily among other factors). In this dissertation measurement error has the greatest threat of being introduced by an unreliable and poorly worded questionnaire due likely to dynamics introduced by the proposed structured method.

Non-Response Error

Non-response error, when a significant number of sampling units or households in this case do not respond to the questionnaire, would naturally follow from a poorly devised instrument, resulting in respondents abandoning the survey soon after agreeing to take it or not agreeing at all. Non-response bias happens when the population who do not respond display characteristics that are different to the population who do respond. With a very low response rate the researcher is likely to have found that people who do respond are unusual in some way resulting in non-response bias.

A high response rate is one of the primary means to legitimizing a survey's results and therefore success (Biemer and Lyberg 2003). When a survey elicits responses from a large percentage of the sample population, the findings are more accurate approaching the results of the whole population. However, large response rates invariably cost more where the minimum number of responses should be sought to achieve the desired level of accuracy and generalizability given the budget. Some pertinent reasons for non-response include respondents have trouble understanding the questions (poor questions), the format is ambiguous and inconsistent (poor order), and a questionnaire which looks unprofessional or is haphazardly constructed.

Both dissertation surveys attempted to achieve a high response rate within the time and budget constraints. The aim was to achieve the necessary minimum sample size desired for inference by setting desired survey responses equal to or greater than this number. Chapter 4 provides the minimum sample size for different levels of acceptable error (see table 3 Sample Size Calculator, Chapter 4). Frequently response rates in survey research are calculated simply by dividing the number of completed interviews by the number of units in the sample. However, this method is too simplistic according to the standards sought by several professional survey research organizations. The Council of American Survey Research Organizations (CASRO) proposed a method to better consider the various situations encountered in survey research. This method in turn formed the basis for the development of a standard for the calculation of response rates and disposition reports by the American Association for Public Opinion Research (AAPOR 2006). This method is now the standard to judge response rate dispositions of surveys for scholarly literature.

Following the rules for reporting response rates, each dissertation survey's interviews were divided into two groups: complete and partial. Adopting AAPOR standards, any survey with less than 80% complete was considered partially complete and not counted. Eligible respondents are those in the sampling frame, while refusals resulted in no interview from eligible respondents. The contact rates measure the proportion of all cases in which some responsible member of the sampling unit was reached by the survey. Contact rate for the HEU survey was the amount of respondents deemed necessary to achieve a desired number of completed surveys for the appropriate sample size. The CP survey contact rate included all units within the sampling frame or all households within the Village of Trumansburg i.e. an attempted census. The refusal rate gives the proportion of eligible respondents or those contacted who refused to give an interview.

As illustrated in table 9 response rates, the completed number of surveys divided by the contact rate ranges from 98.45% (Binghamton, HEU Survey) to 30.61% (Trumansburg, CP Survey). The HEU survey was more costly and time consuming to administer. Yet, of 315 total households sampled within the eligible survey clusters, 304 responded with complete surveys.

Table 9 Survey Response Rates

	Total Eligible Households	Sample Size 95% CI, ±10% Error, 80/20 Split	Contact Rate	Completed Surveys	Response Rate	Refusal Rate
HEU Survey						
Tompkins County, Southside	483	55	62	61	98.39%	1.61%
Tompkins County, Fall Creek	1,246	60	63	60	95.24%	4.76%
Tompkins County, Trumansburg	709	57	60	57	95.00%	5.00%
Tioga County, Owego	1,913	60	64	63	98.44%	1.56%
Broome County, Binghamton	4,987	61	66	63	95.45%	4.55%
		Sample Size 95% CI, ±5% Error, 80/20 Split				
CP Survey						
Village of Trumansburg	709	185	709	217	30.61%	69.40%

As with many of the rules and procedures for conducting survey research, there is no agreed upon norm as to what is or what may be received as an acceptable and reasonable response rate (and subsequently, what is unacceptable) in survey research. It is now understood that survey response rates have been declining for at least several decades (de Leeuw and de Heer 2002; Baruch 1999) and that high levels of response may actually be suspect if not accounted for how they were achieved. Concerns with privacy, confidentiality, the exploitation of personal information, general cynicism, and declining civic participation have led to these declining response rates. Some of what has been published and reported on response rates has a very wide dispersion on what is acceptable.

Baruch (1999) performed a comparative analysis to explore what could and should be a reasonable response rate in academic studies. By examining 141 papers from the behavioral sciences that reported response rates from questionnaires in the years 1975, 1985, and 1995 the average response rate

was 55.6% with a standard deviation of 19.7. Salant and Dillman (1994) report that one can reasonably expect response rates of 60% for a mail survey of the general population. The Robert Wood Johnson Foundation in a guide for potential grantees gives a range of acceptable survey response rates as follows: rigorous surveys conducted in the private and non-profit sectors generally achieve response rates in the range of 60 to 70%, quick turn-around surveys to gauge public response to current events usually have response rates of about 30% and response rates between 40 and 50% are common for surveys that form the basis of much of what we know about public attitudes and behavior (Colasanto 2007). Finally, the Pennsylvania State Survey Research Center advises that acceptable response ranges for telephone surveys is 35 to 60%, mail of the general population 35 to 75%, special population mailing is 20 to 80% and personal interview surveys approximately 60 to 80% (Penn State 2007). With this small review, it can possibly be concluded that a response rate as low as 30% for surveys of general public attitudes is acceptable while a mail response rate typically sees anywhere between 20 and 60%.

The HEU and CP surveys fall within the ranges of reported acceptable levels of survey response. There is however a clear distinction to the different response rates of each survey. The HEU elicited response rates above 95% while the mailed out CP survey achieved only a roughly 30% rate. Dillman's (1978) Total Design Method, which is basically a prescription on how to achieve decent response rates in mail and telephone surveys based on social exchange theory, provided good advice followed with the HEU survey more so than the CP effort. The compact fluorescent light bulb incentive more than likely boosted response rates of those contacted to the desirable level

illustrated here. Resources were not available to provide incentives for the CP survey other than ensuring the return of a completed survey was as easy as possible. The CP survey however did yield a very high level of response for sample size thresholds of a small margin of error and confidence level. If a complete census was not attempted resources might better have been spent only contacting a suitable number of respondents to yield the desired sample size as was done in the HEU survey. Repeated targeted mailings as recommended by Dillman (1978) and others to achieve high response might have subsequently proved the instrument was indeed capable of 60% plus rates of response. As importantly it is to gauge survey success by evaluating response rates it is as important to ascertain whether the instrument measures accurately that which intended.

Measurement Error

The second source of non-sampling / coverage error that may be caused by a poor quality questionnaire (among other factors) is measurement error. Sampling and coverage error were minimized by adhering to the strict conventions of sampling design discussed in Chapter 4. As such, measurement error is related to the observation of the variable through the survey data-collection process and consequently it is sometimes referred to as an "observation error" (Groves 1989). Measurement error is more narrowly defined and focused on for this dissertation's purpose so defined as when a respondent's answer to a given question is imprecise, most likely due to a poor choice of survey method, interviewer fault or the actual questionnaire construction (Dillman 2006). The sources of observational errors according to

Groves (1989) are categorized then into four principal sources which are accounted for:

1. The interviewer.
2. The respondent.
3. The mode of data collection, that is, whether telephone, personal interview, self administered drop off.
4. The questionnaire.

These sources of error which comprise total measurement error on the whole may be attributed to the questionnaire i.e. the wording, ordering and design of the questionnaire as is further illustrated.

The interviewer plays a critical role in many sample surveys. As a fundamental part of the data collection process, his/her performance can influence the quality of the survey data. The interviewer staff and personnel is one component of the collection process whose performance the survey researcher/survey manager can attempt to control. The most useful strategies that have evolved are through the careful selection, hiring, training, and monitoring of job performance to minimize the error associated with the role of the interviewer (Fowler, 1991). Survey interviewer staff and personnel for the dissertation surveys were composed of the author, a State University of New York at Binghamton graduate student, Cornell University undergraduate student, and the staff of the Village of Trumansburg, New York. Each was trained, supervised and evaluated periodically by the author to ensure a minimum of interviewer error.

Respondents may contribute to error in measurement by failing to provide accurate responses. Hastie and Carlston (1980) identify several

stages in the formation and provision of answers by survey respondents: encoding of information, comprehension of the survey question, retrieval of information from memory, judgment of appropriate answer, and communicating the response. Hence it is likely that the wording and ordering of the question and the design of the questionnaire may influence how and whether the respondent understands the question. This potentially proves to be very informative on the marriage between a cognitively structured conceptualization and questionnaire design, a discussion saved for the last chapter of this document. The respondent's willingness to provide correct answers may also be affected by the types of question asked, by the difficulty of the task in determining the answers, and by the respondent's view of the social desirability of the responses. Well constructed questionnaire material seems to address this sort of error as well.

In the dissertation surveys with respect to the component of measurement error relating to the mode of data collection (in person drop off and mail respectively), there is the possibility that the mode chosen was a poor vehicle for delivery of the instrument. Cost often plays a significant role in the decision for a chosen method. However, the proposed content of the questionnaire, the target population, the anticipated response rates, and the length of the data collection period are all important considerations in the process of deciding on the most appropriate instrument delivery method. Researchers have found that the same question asked by mail, telephone, and face to face interviews sometime yield different results (Tarnai and Dillman 1992). Accounting for the necessities to consider the above, most notably cost and length of time for data collection, the judgment was made to undertake the particular survey methods. It is conjectured that each mode of

survey delivery had little effect on measurement error, although without performing the same survey with different methods, this assumption may not be entirely accurate. Yet a potential “method effect” as Dillman refers to, this particular error is minimized if questions are written and ordered well and placed in a well designed questionnaire (Salant and Dillman 1994). This ultimately again leads to a well worded, ordered and designed questionnaire.

Total measurement error is then tied overwhelmingly to the construction of the questionnaire. It cannot usually be said with certainty how large the total measurement error is in a given survey. However, it may be minimized with careful question wording, question ordering, questionnaire design, pre-testing, and interviewer training. Staffing and pre-testing of the survey was undertaken with diligence and according to best practices (documented in Chapter 4) which should not contribute significantly to measurement error. Isolating the questionnaire design as the variable of interest requires a further look at the proposed method’s contribution to quality as indicated by the “fitness for use” concept. If the data and results are accurate, timely, and accessible to the constituents who commissioned the research, failure at this threshold is possibly the most likely indicator of any untold measurement error.

Overall Survey Quality or "fitness for use"

Biemer and Lyberg (2003), Provost (2003) and Statistics Canada (2002) assess survey quality according to the fitness for use concept. Of the many assessment routines survey methodologists attempt to judge survey quality this appears to be the most straightforward and one gathering widespread acceptance. To determine whether information gathered from survey data is fit for use, the concept of quality has been broken down into six

dimensions. According to the Statistics Canada's Quality Assurance Framework, those dimensions are: relevance, accuracy, timeliness, accessibility, interpretability, and coherence (Statistics Canada 2002). Of most significance to this study is a positive determination of relevance, which reflects the degree to which the survey data meets the real needs of clients, and accuracy, the degree to which the information correctly describes the phenomena it was designed to measure.

Regarding relevance, there is currently documented evidence that both constituent parties received valuable information from the data to meet their needs.[38] As of this date the Village of Trumansburg has utilized the information gleaned from the survey to draft a new comprehensive plan, maintain a high degree of community confidence in the project and predictably will have the current draft adopted by the municipal government in the near future. The Village of Trumansburg directly organized the six elements of interest for the new comprehensive plan (community, housing, economic development, environment, recreation, and land use) directly from the CP survey data.[39] The HEU survey has preformed similarly to achieve the goals and objectives it was commissioned for. Cornell Cooperative Extension of Tompkins County partnered with NYSEDA has employed several of the key findings from the HEU survey data when devising energy conservation workshops and programs. The data has been instrumental by informing the New York Energy $mart^{SM} Program coordinators on where to place time and

[38] The Village of Trumansburg's Comprehensive Plan success is reported in the weekly newspaper Tompkins Weekly, "Village's Future Comes into Focus," Volume 2, No. 8 • December 3-9, 2007. The article is included in the CD ROM with this document and also may be accessed online here: http://tompkinsweekly.com/

[39] The most current information on the Village of Trumansburg's plan may be found on their website accessed here: http://www.trumansburg-ny.gov/comp_plan.htm.

resources for assisting New York State residents with energy efficient home improvements, education and training services. The details of these programs and services may be found on the respective websites. [40]

The accuracy of the survey information is also further supported by the confidence these constituent agencies displayed when interpreting the results as fundamental truths to bolster a municipal master plan, energy efficiency and conservation workshops and assistance programs. The content validity or accuracy in this exercise is more formally established then by having experts (constituents) evaluate the relevance of the surveys' data and finding it worthwhile to act upon.

All of these dimensions of quality are overlapping and interrelated (figure 31). There is no general method which gathers these six dimensions to optimize or to prescribe a minimum level of quality. Attaining an acceptable level of quality is the result of addressing, managing and balancing these elements of quality while at the same time paying attention to survey goals and objectives, costs, respondent burden and other factors that may ultimately affect survey quality. Both dissertation surveys when evaluated in retrospect made a conscious and sometimes subconscious effort to address each of these quality dimensions.

[40] For further detail on the programs and workshops informed through data from the HEU survey please see the following websites:
http://counties.cce.cornell.edu/tompkins/consumer/Energy/SaveEnergy.htm#Workshops
http://www.getenergysmart.org/WhereYouLive/HomePerformance/overview.asp

Relevance The *relevance* of information reflects the degree to which it meets the real needs of clients. It is concerned with whether the available information sheds light on the issues of most importance to users.

Accuracy The *accuracy* of information is the degree to which the information correctly describes the phenomena it was designed to measure. It is usually characterized in terms of error in statistical estimates and is traditionally decomposed into bias (systematic error) and variance (random error) components. It may also be described in terms of the major sources of error that potentially cause inaccuracy (*e.g.*, coverage, sampling, non response, response).

Timeliness The *timeliness* of information refers to the delay between the reference point (or the end of the reference period) to which the information pertains, and the date on which the information becomes available. It is typically involved in a trade-off against *accuracy*. The *timeliness* of information will influence its *relevance*.

Accessibility The *accessibility* of information refers to the ease with which it can be obtained from the research agency. This includes the ease with which the existence of information can be ascertained, as well as the suitability of the form or medium through which the information can be accessed. The cost of the information may also be an aspect of *accessibility* for some users.

Interpretability The *interpretability* of information reflects the availability of the supplementary information and metadata necessary to interpret and utilize it appropriately. This information normally covers the underlying concepts, variables and classifications used, the methodology of data collection and processing, and indications of the accuracy of the statistical information.

Coherence The *coherence* of information reflects the degree to which it can be successfully brought together with other information within a broad analytic framework and over time. The use of standard concepts, classifications and target populations promotes coherence, as does the use of common methodology across surveys. *Coherence* does not necessarily imply full numerical consistency.

Figure 31 Dimensions of Survey Quality
Source: Statistics Canada 2002

Admittedly the estimation of quality for the two dissertation surveys is difficult to ascertain quantitatively. Any variable error that may be quantified, which would be measured by the variance of a statistic computed from the survey data and arising if values differ over the units (e.g., sampled persons, interviewers used, questions asked) when compared with the results from repeating the survey is not possible in this situation. Replicating the same survey with the proposed method proved beyond the available time and monetary constraints of this exercise. A re-interview study, where the new interview (survey) repeats a subset of questions from the original survey might have been possible. In this manner a response variance and bias may be measured regarding the chosen subset of questions. If there are significant differences this might lead to a concern for the instrument's validity and reliability. Suggestions for further study are explored in the next chapter.

Conclusion

The Home Energy Use and Comprehensive Plan surveys may be argued to be of high quality provided the evidence presented is sufficient. A quality survey consequently provides evidence that the structured conceptualization method offers an alternative method for constructing a survey instrument while sticking to a fundamental maxim of proposed improvements by 'doing no harm'. The surveys developed here are at least no worse off in valid and reliable information than ones designed from standard practices. Objectively the surveys meet many of the requirements for being fit for use. More subjectively they provide useful information that fulfills the goals and objectives of the constituents which required them. Statistics calculated

from the survey data from a face valid perspective appear to be what was is expected e.g. HEU question 18, the most important reason that prevents you from pursuing greater energy efficiency is overwhelmingly answered as 'cost'. Numerous similar examples of the face validity of the data are found in both survey's results.

Each instrument did display differences in non-response. This dichotomy however is explained by the attempt to perform a census of the CP survey population while being constrained from repeating mailings to augment final survey response. Examined from a pre-determined outlook of adequate sample size, the CP survey's solitary mailing did in fact achieve a very desirable response to formally generalize findings to the entire population of interest. 217 complete and adequate Comprehensive Plan surveys from a population of 709 is more than sufficient to achieve a ±5% margin of error at the 95% confidence level of results for a homogeneous population. Evidence of a low non-response error is not only achieved by examining the respective response rates but also the positive social exchange that aims to minimize non-response. Each instrument was implemented to elicit high respondent trust by providing incentives so that respondents felt like the benefit of completing the survey outweighed the perceived costs. According to Dillman (2000) following this basic social exchange principle will garner higher response and more importantly higher quality data.

Measurement error, not easily quantified in any study, is examined and illustrates that by isolating the questionnaire as the common source of this error, very little perceived error is witnessed. Consequently if measurement error is small then there is the positive likelihood that the survey's fitness for

use is high. After examining the results from the survey data, they were deemed fit for use by the agencies which commissioned them. These findings are incorporated into achieving many of the goals and objectives these organizations sought.

Since the HEU and CP surveys devised from the proposed structured conceptualization method display acceptable levels of error and have been deemed fit for use, there is a likely conclusion which may be made at this time. If the method offers a comparable or even better systematic method over alternative best practices to develop survey content and order within a group format, it is potentially a valuable addition to furthering the scholarship on the organization and design of survey instruments. Chapter 6 Discussion will further expound on the potential benefits, uses and further study the method exhibits and requires.

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CHAPTER 6

Discussion

Introduction

Survey questionnaire designers aim to develop standardized questions and response options that are understood as intended by respondents and that produce comparable and meaningful responses. In the past the extent to which these goals were met in practice was rarely assessed. In recent decades better tools for assessing how well survey instruments and questions perform have been introduced or refined. Another advance in survey research, where this dissertation aims to contribute, is new theoretical perspectives that help make sense of the effects of question wording, context and order. One perspective examines the cognitive tasks in which a respondent must engage to answer a survey question. Another examines the practical aspect of communication in a survey interview or questionnaire. Both have shed light on the response process, although utilizing cognitive schema to craft a survey instrument is relatively unexplored. Providing a scientific basis for decisions about construction of survey questionnaires and their order is the aim of this work which potentially has many uses in the ever evolving field of survey research.

Cognitive Link

Much of what is known comes from asking questions. The collection of attitudes beliefs and self concept of perceived knowledge is often ascertained from questions posed by researchers in surveys attempting to discern the truth of the subject matter of interest. Much of how the survey researcher approaches gathering this information comes from a common understanding of language usage between the researcher and survey respondent. However, it is not important what the researcher attempts to mean but rather what the respondent thinks the researcher means and in essence believes is being asked. It is the researcher's intention translated to the respondent in the survey instrument that is ultimately the arbiter of rich and valid data. Translating a researcher's intentions has as its underpinnings a cognitive link between the aspiration of the survey designer for untapped respondent knowledge and the organization of that knowledge within a respondent's psyche. A structured conceptualization aims to be the mode of transmission for better translations mediated with a more valid and reliable instrument created in the process.

Detailed models of the mental steps respondents go through in answering survey questions have just begun to be developed, with much of the work accomplished since the 1980's. Answers to survey questions are prone to a variety of response effects, or differences in survey outcomes that reflect a difference in question order, understanding, or other mental processes. Tourangeau et al. (2000) devote an entire text to the components of the response process in surveys and the underlying cognitive response effects. The model they put forward to explain the cognitive processes that people may use to respond to a survey question entails first comprehending

the question, retrieving the memories related to it, judging what information to integrate into the answer and finally responding to a response category (Tourangeau et al. 2000). This model of the response process exhibits many of the components of the structured conceptualization process and in this case those elements in concept mapping.

Concept mapping initially requires generation of ideas from a prompt of interest. Analogous to the response process of a survey respondent, the mapping participants must comprehend the item of interest (the prompt), retrieve memories related to it and make unconscious judgments as to what information would form a statement, and respond to the prompt by articulating a brainstormed statement. This process is then iterated internally until each respondent feels they have exhausted ideas related to the prompt. Liking the proposed structured process of survey design to a sort of reverse engineering, a procedure of taking something apart and revealing the way in which it works, the survey instrument is developed from the conceptual domain of the prompted mapping participants forming the entire locus of relevant ideas *before* the instrument is designed. If the concept mapping group resembles a subset of future respondents, the probability that a questionnaire developed with the method represents the language and conceptual framework of future respondents is high. These brainstormed statements will form the content of questions for a survey instrument allowing the survey designer(s) to gather the potential universe or conceptual domain of ideas related to the survey topic in the language of respondents prior to making judgments on what and how each question might be asked.

Use of the sorting procedure in the concept mapping process allows the survey designer to assess the cognitive structure of the mapping participants

and in turn provide an effective cognitive structure for the survey instrument. The free sorting of statements by mapping participants, grouping ideas that "go together" into distinct piles or clusters, generates a measure of psychological proximity between pairs of objects within that domain. Analyzing the structure of the proximity data with the concept mapping software provides information on how mapping participants represent and organize their knowledge regarding subjectively meaningful groupings relating back to the original prompt. The analysis includes a multidimensional scaling (MDS) of the sort data and a hierarchical cluster analysis of the MDS coordinates in the cluster analysis stage. The resulting maps represent a structured conceptualization or pictorial representation of the mapping group's set of ideas. Each idea represented as a point in two dimensional space, with ideas that are more similarly located more proximally, represents the psychological similarity between statements. Brewer and Liu (1996), Tversky and Hutchinson (1986) and Rosenberg (1982) reiterate this concept of psychological similarity by explaining that the primary purpose of the sorting procedure is to provide co-occurrence data from which estimates of psychological distance between the objects can be calculated with a routine like MDS.

Psychological similarity, represented by the distance between points or statements and then further aggregated into similar concepts with the hierarchical cluster analysis routine, provides a basis to systematically order question sections within the instrument. Clusters proximally located are also cognitively similar if the points that comprise them are taken to be as well. It is suggested here that comprehension of the shared cluster representations in any domain from mapping participants can inform the decisions about the

structure and ordering of questions to facilitate an efficient and reliable retrieval of relevant information from questionnaire respondents. This finding is potentially a valuable addition to current practices of ordering question sections within a questionnaire.

The proposed method offers a systematic repeatable framework that simplifies a group instrument design process and produces ordered survey question material with a strong cognitive link to the consciousness of potential respondents. The process also reveals the benefits of group participatory instrument design, a function that is exploited to potentially produce a better survey instrument. Developing survey instruments in a group format is often burdened with negative group interactions. The proposed method subsequently addresses many of these difficulties by taking advantage if the inherent benefits of the Concept Mapping procedure.

Group Dynamic

Concept mapping is a group collaborative process. It helps to organize the ideas of a diverse collection of stakeholders. This conceptualization method has been utilized with groups of any size, ranging from small single site meetings to hundreds of geographically diverse stakeholders (Kane and Trochim 2007). When two or more people aggregate they interact and influence each other; groups develop a number of dynamic processes that separate them from a random collection of individuals. It is beyond the scope of this dissertation to discuss the field of group dynamics, however it has been demonstrated in the literature that cooperative groups perform better than independent individuals on a wide range of problems (Laughlin et. al 2006; Kerr and Tindale 2004; Levine and Moreland 1998; Hastie 1986; Hill 1982). It

should be no different that a competent cooperative group would potentially develop a better survey instrument than an individual charged with the task. With the aid of the inherent participatory group advantages in the concept mapping process, survey design is further improved with the proposed method.

In a group collaborative process, often a dominant or handful of dominant participants engulf the process with a narrow viewpoint. The concept mapping process seeks to provide an equal voice to participants thereby disengaging the threat of an individual(s) overwhelming the process of survey development with a singular viewpoint. A survey instrument is often designed by a small group of investigators. This format is often absent of any organizational method, fraught with difficulties from potentially negative group interactions. Transparency potentially suffers where the finished product is potentially a narrow extension of a minority of principal investigator's ideas. According to Pagliari et al. (2001), group collaboration often leads to a consensus surrounding a minority of voices due to various psychosocial processes at play. A solution to this problem is to have a mechanism that enables the support of sensible groups.

Group interaction may also coalesce into what researchers have termed "groupthink". Irving Janis (1972), who did extensive work on the topic, describes the phenomenon as "a mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members' strivings for unanimity override their motivation to realistically appraise alternative courses of action". A group's ability to measure a situation or task objectively declines if the group is too like minded, acting in essence as a herd would. Subsequently if a group's leader is too dominant in suppressing alternative

opinions, the group will only reinforce the leader's positions or ideas. This phenomenon may lead to poor decisions. It is ideally avoided in group collaboration where collective wisdom (having many potential beneficial attributes) dominates group think tendencies. The concept mapping process undermines many of the processes that may lead to group think with equal collaboration and anonymous representation of ideas.

One popular author has written on how collective wisdom better informs decisions than ones made by individuals. *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations*, written by James Surowiecki (2004) provides evidence that the aggregation of information in groups results in better decisions than ones that could have been made by any single member of the group. Its central thesis, that a diverse collection of independently deciding individuals is likely to make certain types of decisions and predictions better than individuals or even experts, draws many parallels with the concept mapping process. Surowiecki believes that groups can be wise in solving problems if they fulfill four conditions: diversity of opinion, independence, decentralization and aggregation. If adhered to, these conditions should undermine potential groupthink situations. In concept mapping the participant group becomes a 'wise crowd' by undertaking the brainstorming and sorting steps where each individual contributes equally to the conceptual domain of ideas. Each participant is able to maintain their opinion despite status differences or social comparison factors between group members that usually bias decision making to the few vocal experts in attendance. Participants are able to decentralize, ensuring that no one at the top is dictating the group's answer to the problem or prompt in this case;

participants are able to specialize and draw on personal local knowledge to incorporate into the final statement set for sorting. Finally and most importantly the mapping process facilitates a method for aggregating opinions. The MDS and hierarchical cluster analysis solutions provide a mechanism for turning private judgments and ideas into a collective decision and solution. The concept map is a way of summarizing the group's ideas and opinions into one collective verdict: the cluster map. Not only does the mapping process ensure a 'wise crowd' capable of solving problems better than experts according to Surowiecki, but short-circuits many of the negative influences inherent when a collection of disparate individuals attempt to solve a problem.

In the dissertation surveys there were several observed instances when one or two individuals attempted to design the survey instrument from their strongly vocalized personal viewpoint. The mapping process coupled with the task of writing a good survey instrument allowed the incorporation of these singular viewpoints when it was time to discuss the cluster labels as well as the crafting of individual questions from the statement set. At the point of actual instrument development mapping participant ideas and opinions are built into the final cluster solution allowing dominant personalities to engage without terminally altering the final instrument from the original group collaboration.

The process of writing a collaborative survey instrument is successful in large part due to the brainstorming session that occurs early in the mapping exercise. Brainstorming provides the unsullied list of ideas where much of the survey questionnaire content is derived. Having a process where individual group members lend a unique voice without fear of reprisal in a group setting, provides viewpoints and thoughts that otherwise might not be represented.

This proved valuable when it came time to develop individual questions from the statement set. Statements that in essence are represented anonymously were allowed to be deliberated and decided upon for inclusion in a corresponding survey section within the instrument. The final survey instrument appears to be a richer and more representative document then otherwise might have been developed with standard practices alone.

Implications and Limitations of the Structured Conceptualization Method for Survey Instrument Design

Potential Uses of the Method

The proposed method has many uses in any endeavor that requires an instrument to ascertain the attitudes, beliefs and knowledge of a population of interest. The structured conceptualization approach to survey design is potentially a useful method for any group of individuals desiring to construct a survey instrument. Two to as many as can be accommodated in the concept mapping process may hypothetically engage in the process successfully. If the instrument is employed to a larger population sampled appropriately, statistical analysis and inference may be calculated from the responses. However, this is not necessary for the method to be of use. It is anticipated that the proposed method is of greatest use to:

1. Groups new to survey design or have never constructed a survey instrument;
2. Researchers unfamiliar with the subject matter of interest; consultants, primary investigators;
3. Market Researchers in need to establish a focus group or select group of interest along with an instrument;

4. Pollsters able to select constituency of interest along with development of the polling instrument.

Those in need of survey instruments who do not have a background in the topic they are charged with gathering information on may benefit most from the strengths of the method. Consultants, market researchers and researchers who potentially may only investigate the topic for the first and last time now have a method to generate relevant questionnaire material with this structured method. Rather than relying on pre conceived notions of what material is important for inclusion a well chosen set of participants will harness the power of 'wise groups' to create a more meaningful relevant instrument. However, it is necessary to assemble a survey design group as similar to the eventual sample of those to be surveyed if knowledge of the subject is low by the principal investigator(s).

The method is also predicted to be useful when a researcher might desire the co-creation of a focus group, an interactive group setting where participants are asked questions and free to talk with other group members on the subject of interest. Market researchers conduct formal surveys as other researchers do. However, many times informal polls to determine consumer demand for new products and services, future demand for existing products and services, consumer satisfaction and the impact of advertising campaigns are desired in the same study that requires the formal survey. The proposed method pre assembles individuals that may also partake in these informal polls and focus groups. The limitation of the benefits of this preassembled group of survey designers is only restricted by the imagination of the principal investigators.

Formulating a "Theory of Surveys" (Groves 1987)

According to survey researcher Robert Groves (1987), ingredients for a theory of surveys must come from cognitive psychology, which concentrates on the processing of questions by the respondent, from the study of social interaction, and from sociological perspectives on inter group relations all of which provide insights into the role of social measurement. The structured conceptualization approach to survey design provides a potential repeatable systematic framework for survey development rooted in the fields of cognitive psychology and sociology while complimenting the established cornerstones of a quality survey. As a theory of survey development emerges any method intended to add to this foundation must be judged by the success of its output. Survey questionnaire success is gauged by how well the questionnaire minimizes the major sources of error among other considerations, but in many cases whether it is fit for use. In both survey development exercises with the described method, a successful instrument was obtained yielding valuable information incorporated into use by constituent agencies. The several objectives of creating a process where questionnaire material is created more systematically and ordered within a group framework were achieved.

However, the structured conceptualization process of survey design exhibits certain limitations. For one, the very strength the conceptualization process provides adds a level of sophistication and necessary adaptability by the group to a new process that standard practices are lacking. It is anticipated that for many there will be no prior experience with concept mapping or formal survey design before embarking upon the process. Before a single word of the survey is even drafted, a somewhat lengthy preparatory process (the structured conceptualization) must occur. This proved to be difficult to endure

for one or two group members in the dissertation surveys that would rather have done away with the process and just got on with writing a survey instrument. Systematic processes require a level of patience and adherence to a set framework which laypersons may not be inclined to follow.

Time, cost and desired level of complexity also constrain the process. A survey instrument anticipated providing a very general set of questions or one where time is limited, should look to more traditional methods of design. The concept mapping process is suitable for groups that have several weeks at their disposal for not only the mapping exercise but the careful deliberation of the results and the subsequent improvement of the questionnaire given the output form the mapping process.

Further Research

As with any recently proposed method in an established field there is ample opportunity to continue research with the merging of the structured conceptualization process and survey development. There are several questions which arose during the development of the method and potentially different courses of action which might be undertaken if the process was repeated. Further refinement of the method with subsequent iterations should occur with survey groups of increased size. Increasing the size of the survey development participant group might have an upper bound that proves infeasible when developing a quality instrument. The proposed method should also take the opposite approach; perform the exercise with only two researchers and see if there is a noticeable influence on final survey quality. Further streamlining of the question development process from the statement sets might also be accomplished if only a subset of the statement set is

utilized for question development e.g. the top ten cluster labels the concept mapping software creates would be the only statements considered for questions within that section. Manipulation of the order of the clusters in different arrangements for the final survey should also be attempted and the effect recorded. Quite possibly the ordering of sections by the strict approach illustrated in this study might prove to have little or no effect if the particular order is modified from the cognitive flow provided by the final cluster maps. Attempting the method with the rating step from the concept mapping process might also prove a valuable exercise. Although the rating of statements is not required for the generation of point and cluster maps it allows the creation of pattern matches and go-zones potentially useful for the question development step. However, significant insight is potentially gained if the process is undertaken with some sort of scientific control.

An experiment between two similar surveys, one developed from the proposed method and the other from standard practices, is the typical method to isolate any variable(s) which eliminate alternative explanations as to the perceived success of the proposed method. It would prove difficult to gather a similar group of participants randomly assign them to a treatment (proposed method) and non treatment group and undertake the survey development process. Differences in group composition potentially might sully the outcome of this particular experiment despite rigorous efforts to reduce bias. However, a solution to this difficulty might be to engage the same group of participants up until the question writing and ordering steps of the survey design process. Randomly assigning the group into two, one undertakes creating the instrument from standard best practice procedures and the other utilizing the

proposed methods. The argument may be made that inter and outer group biases are minimized with this simple procedure.

When evaluating the overall validity and therefore success of the proposed method it might be a prudent exercise to complete several post survey evaluations not undertaken here. Most notably injecting two or more similarly worded questions in the final survey that are strongly correlated would allow internal consistency studies. This type of consistency analysis would further bolster any reported success (or failure) of the instrument created from the proposed method. An intercorrelational study between adjacent clusters is also recommended. Determination of the construct validity of the cluster organization may be examined in this way. Correlations between theoretically similar questions in adjacent clusters (sections) should be highly correlated. Convergent validity is potentially established now by showing that measures that should be related are in reality related and discriminant validity by illustrating that measures that should not be related are in reality not related. This analysis might provide a suitable level of construct validity thereby providing evidence that clusters aligned in the manner suggested are in fact organized more effectively.

External validation of the instrument could also be undertaken if there already existed external estimates of the characteristics being measured by the survey. Census estimates or results from a survey considered to be a gold standard may well be compared to the results of an instrument created with the method. To the extent that the external estimates are accurate, the bias and error in the survey estimates being compared can be measured.

Conclusion

A structured conceptualization approach toward survey design attempts to add to the evolving theory of surveys. Survey research being a relatively new field, one where contributions come from several disciplines, is currently in need of defining cross disciplinary methods that standardize development of survey instruments. Questionnaire development should continue to follow best practice formatting, typeface choices, clear interviewer instructions, question numbering, pre coding provisions and any other foundations of best practice already demonstrated to ensure greater survey success. Question wording and question order within surveys currently have more esoteric and ambiguous sets of rules. Many of the maxims set forth in the literature are anecdotal at best and untested common sense at worst. Inappropriate questions, incorrect ordering of questions and bad questionnaire format can make a survey development effort valueless

The order in which questions on a similar topic are asked oftentimes makes important differences in the outcome. Asking one set of questions before a second can yield different results from asking the second set first. The proposed method provides a cognitive framework which informs researchers on a potentially reliable method to order question sections within the instrument.

Since, group interactions can be fraught with difficulties and liabilities brought about by interpersonal influences, such as differences in the social status of group members, individual domination, the variety of individual ideas, and winning of an argument by specific members, a method which assists in eliminating these harmful processes is advantageous. A method that also concurrently provides a more systematic method of question writing and

ordering within a survey is potentially more valuable than solving just one of these problems. The structured conceptualization approach toward survey design presented in this dissertation attempts to do just that. This researcher endeavors the method to be added to the lexicon of successful survey design methods in the near future.

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