TRADE-OFF BETWEEN INNOVATION AND SUSTAINABILITY: PERCEPTIONS FROM STUDENTS FROM DEVELOPED AND DEVELOPING COUNTRIES

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

This study investigated the human perception of certain social values to improve national well-being. It focused on the relative importance of two values, innovation and sustainability. Finally, it examined the possibility of a perceived trade-off between these two values by identifying whether a value change occurred among people from developed and developing countries under both constrained (forced-choice) and unconstrained (free-choice) rating conditions.

The perceived importance of social values was measured in a survey using an eleven point rating scale. The perceived trade-off and the value change were identified by analyzing rating responses of the survey from test to retest. The analysis found that participants experienced a significant value change from test to retest and participants had different value preference depending on their country type, either developed or developing.

This study consisted of two parts. The exploratory pilot study was conducted based on the Management Sciences Student Survey. This survey gathered information about the importance of selected social values from sixteen graduate students in the Department of Management Sciences at the University of Waterloo. The confirmatory main study was conducted using a web-based survey, Global Representative Value Change Survey. It collected information about the importance of the social values from close to three hundred students at the university at both test (Time One) and retest (Time Two). In this way, it enabled the researcher to identify a value change over time that was primarily attributed to a salience manipulation of innovation and sustainability trade-off.

With a focus on the trade-off, the results revealed that all participants from developed and developing countries experienced a significant value change under the unconstrained condition, while very few significant value changes took place under the constrained condition.

This study implies that people tend to maintain their value consistency and are not inclined to trade-off innovation for sustainability. If these values can co-exist in harmony and without compromise, people are prepared to give due consideration to sustainability, but not at the compromise to innovation. Implications are highlighted for educators, policy makers, and managers of technological innovation and change.

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Dedication

谨以此硕士论文献给我的父母，张乃全，李亚利，感谢您对儿子多年的养育和支持！

Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

Today, national systems of innovation are underpinned by the diffusion of technology and knowledge among persons, firms and institutions which is key to the innovative capacity of nations. Innovation drives economies and it depends upon the successful introduction of something novel, useful and valuable, such as introducing new products, services or processes (Freeman 1995, Patel and Pavitt 1994). Sustainability is often characterized as the ability to satisfy the basic needs of today without compromising the ability of future generations to satisfy their needs (WCED 1987). Increasingly, innovation and sustainability appear to be in conflict, requiring a delicate balance in the management of technological innovation and change.

In spite of the recent economic slowdown in major developed economies, soaring energy and raw material prices, the global economy growth has followed an upward trend. According to the United Nation's release, the global economy will grow at an expected rate of 3.4 percent in 2008, where developed economies grow at 2.2 percent, developing economies grow at 6.5 percent, and the least developed countries are expected to grow at 6.9 percent (*World Economic Situation and Prospects 2008)*.

On one hand, such upward economic growth trend seems to be generally regarded as positive. On the other hand, this global trend in addition to the fast-growing economies such as China and India has dramatically stimulated energy consumption. For example, world oil consumption was 85.7 million barrel per day in 2007 (Monfort 2008). While the energy and material input are transformed into economic benefit, it has created significant environmental problems, such as climate change, resource depletion, air and water pollution, and the human impact on natural environment.

1.1 Research Motivation

Although the human society has transformed from a Coal Age, an Oil Age to what is now known as an Information Age (Hart and Milstein, 1999), the dependence on non-renewable energy has been always required to maintain such a society, which will only worsen the future development of our human society in a long term perspective. What is the future ahead for our globe? How are we as human beings going to survive when non-renewable energies are depleted? These are the questions that should be thought about by all nations. To solve these questions, it may require tremendous

efforts concerning the trade-off between rapid economic growth, abundant material supply and a healthy natural environment.

In order to preserve and advance the human civilization, a long-term sustainable solution has to be found and implemented. A variety of factors has been studied by researchers to transform the economic system towards sustainability, such as strong leadership (Thompson, Green 2005), radical architectural innovation (Mulder and van den Bergh 2001, Huesemann 2003), technological eco-innovation (Hellström 2006), and institutional change and social arrangement in various social systems (Freeman 1996, Mulder and van den Bergh 2001).

Although more attention has been paid to the technological aspects, the social power of the general public has been rather neglected. This study focuses on the human perceptions of the trade-off between innovation and sustainability in the context of economic prosperity and long-term economic growth in developed and developing countries.

1.2 Research Statement

This study modified and used the social values that have been used by The Conference Board of Canada when evaluating Canada's performance in different areas such as education, health, innovation, environment, sustainability and society. The study intends to explore the perceived importance levels of these social values by people from developed and developing countries. Furthermore, it focuses on the two values, innovation and sustainability and identifying whether a trade-off between innovation and sustainability would occur, in other words, if the perceived importance levels of the two values change and how the change takes place.

The study anticipates that, in countries where economic development is more advanced, people tend to appreciate non-material needs and values over needs and values that are material related; and in countries where economic prosperity is less developed, people tend to appreciate material related values over non-material needs and values such as environmental sustainability. This study also predicts a value change in which the importance levels of sustainability increase from test to retest and the increase will be greater than that of innovation.

Survey instruments are used in this study. To identify how people perceive the social values, an 11-point rating scale is used to indicate the importance levels; and to identify a value change, participants are asked to re-rate the values after reading certain information that may create a self-dissatisfaction.

1.3 Research Question

This research involves the studies of two survey instruments. The first pilot survey study is considered an exploratory step. It concerns the question of what social values are the most important to develop national well-being, including innovation and sustainability. This question is explored by examining the rating responses of the survey instrument. The pilot study is also used as a portion of the main study to introduce a self-dissatisfaction.

The main study expands on the basis of the pilot study and investigates whether a trade-off between innovation and sustainability takes place. It is examined by analyzing the rating responses of the Global Representative Value Change Survey from test to retest. This survey is a partial replication of the Rokeach (1973) Value Change Instrument, where a key manipulation concerned trade-offs between freedom and equality.

1.4 Research Contribution

The study relates to management sciences, especially the areas of management of technology, in the aspects of better understanding of the human perceptions of how technological innovation interacts with environmental sustainability. It does this by probing certain public opinions and preferences which may help corporations and government policy makers increase the level of consensus and conformability when dealing with technological innovation and related sustainability issues.

This study also intends to provide some practical essentials of the social values, and guidance of value change, so that improvements can be made concerning issues such as societal and environmental policy making. Moreover, the value change trends found in this study have significance in the educational aspect in terms of influencing public attitude towards innovative and sustainable development.

Chapter 2
Literature Review

2.1 Social Values: Innovation and Sustainability

2.1.1 Social Values

The concept of value has attracted attention from many social scientists, and the value theory occupies an increasingly important position in social sciences (O'Donnell 1951). Researchers have defined value in terms of virtuous living and morality (Perry 1926), conception of the desirable and preferable (Kluckhohn 1951, Smith 1969), and criteria or standards of preference (Allport 1961, Williams, 1968). Well known and widely accepted research on value theories has been presented in Rokeach's study and his analysis on the Rokeach Value Survey (Rokeach 1967). Rokeach (1979) conceptualized human values as consisting of a relatively small number of core ideas or cognitions present in every society about desirable end-states of existence and desirable modes of behaviour instrumental to their attainment that are capable of being organized to form different priorities. Moreover, Rokeach (1973) studied and classified social values in two categories, terminal values that are concerned with "end states of existence", and instrumental values that are concerned with "modes of conduct."

Value theory has been one of the important tools to understand human attitudes and behaviour. It was argued by Alwin and Krosnick (1985) that the concept of values is crucial to the understanding of human behaviour. Rokeach (1973) also believed that values are more fundamental components within a person's makeup than attitudes and, moreover, that values are determinants of attitudes as well as of behaviour. Williams (1979) further elaborated that values serve as criteria for selection in action and they become criteria for judgement, preference and choice.

Incorporating with the current world-wide economic development, understanding how the general public perceives the relationship between the world's capacity of innovation for future economic growth and the sustainability in the areas of environment, technology and bio-diversity is becoming increasingly important in social sciences, management sciences and many other disciplines.

2.1.2 Innovation

Previous studies have focused on the topic of innovation and sustainability and there is a variety of definitions for both terms. The classic definition of economic innovation from Joseph Schumpeter emphasizes aspects of introduction and adoption of a new good, a new method of production, a new market, a new source of supply of raw materials and the new organization of an industry (Schumpeter 1934).

Recent researchers have tended to define innovation with a point of view leaning towards environmental and sustainable basis rather than simply economic productivity. For example, Hellström (2006) studied the general structure of environmentally sustainable innovation, Larson (2000) focused on sustainable innovation in an entrepreneurial perspective, and emphasized that corporations are facing the challenge to define their relationship to natural environment. Smits (2002) defined innovation as a successful combination of hardware, software and orgware, viewed from a societal and/or economic point of view. Hardware is related to the material equipment, software concerns the knowledge in terms of manuals, software, digital content, and orgware refers to the organizational and institutional conditions.

In this study, the definition of innovation is adopted from The Conference Board of Canada (CBC) (2007) that defined innovation as a process through which economic or social value is extracted from knowledge - through the creation, diffusion and transformation of knowledge to produce new or significantly improved products or processes that are put to use by society. Such a perspective covers both economic and social sides of innovation in terms of knowledge generation and the benefit created from it. CBC (2007) also provided a robust and empirical measure of innovation which is to identify the share of revenue from new or significantly improved goods or services.

2.1.3 Sustainability

In the study of interactions between the economy and the biophysical environment, sustainable development has been a dominant concept (Mulder and van den Bergh 2001). Agenda 21 revealed at the United Nations World Conference on the Environment and Development in Rio de Janeiro (1992) set the milestone for the global interests in sustainable development. It has been widely recognized that, in the modern era, the pursuit of development could no longer be justified in economic terms without consideration of the broader environmental impacts (Wilson, Tyedmers and Pelot 2006).

5

Furthermore, sustainable development has often been related to not only limited natural resource and its fast consumption, but also intergenerational justice (Klepper and Stähler 1998). A broadly acknowledged definition of sustainable development created in the Brundtland Commission Report in 1983 stated that sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Pearce and Atkinson (1993) have introduced the concept of Strong Sustainability which states that the resource consumption must not surpass its regeneration to ensure an intergenerational equity. However, such definition does not cover non-renewable resources since it would require zero consumption of the resource. Thus, Pearce and Atkinson (1993) introduced Weak Sustainability that requires not a constant amount of resource but the constant value of all resource over different generations. It then allows taking non-renewable resources and also the substitutability of different resources into account.

The applications related to sustainability have been studied in many fields including the performance measurement of sustainability (Beloff, Tanzil and Lines 2004, Pope, Annandale and Morrison-Saunders 2004, Moran et al 2008), the economic and cultural impact of sustainability (Fischer-Kowalski and Haberl 1998, Mulder and Van Den Bergh 2001) and the government initiatives and programs to improve sustainable development (Chifos 2007). Moreover, researchers have applied the concept of sustainability in urban planning (Campbell 1996, Haughton 1999).

2.2 The Trends in Value Change

Influential research work accomplished by Milton Rokeach (1973) has comprehensively studied subjects of value, value systems and value change in various segments within the American society classified by such factors as race, age, religion, occupation, political orientation, and income level. Rokeach (1973) has suggested that a person's value system may undergo change as a result of socialization, therapy, cultural upheaval, or as a result of experimental procedures designed to change values. Such value change has been measured by using the correlations between value rankings from test to retest, where the smaller the correlation, the greater the value system change. His survey analysis revealed that terminal values are generally more stable than instrumental values, and the stability of ranked values and the importance level follow a U-shaped relationship in which those initially ranked as most and least important change the least, those ranked in the middle change the most.

Other researchers have also focused studies on value change in a range of aspects. A general trend found by Inglehart (1971) in the post-industrial countries indicated a shift away from materialist concerns about economic and physical security toward greater emphasis on freedom, self-expression, and the quality of life, or post-materialist values.

In spite of criticism raised by a number of researchers (van Deth 1983, Clarke and Dutt 1991, Clarke, Dutt and Rapkin 1997, Clarke et al 1999), subsequent analyses conducted by Ronald Inglehart and his colleagues have shown that the prediction of the trend toward post-materialism can be re-confirmed (Abramson and Inglehart 1994, Abramson, Ellis and Inglehart 1997).

This phenomenon of new value priorities was explained, according to Inglehart, by generational population replacement (Inglehart 1971). Inglehart and Abramson (1994) have found that such value shift occurs in any society that has experienced sufficient economic growth which allows the younger birth cohorts to have more economic security than those of older cohorts and that large value change tends to be found in societies that have experienced rapid growth in gross national product per capita, and are negligible in societies that have had little or no growth.

Inglehart's theory of value change largely agreed with Maslow's hierarchical theory of motivation (1943) in that they both identified a trend of value change from the basic material needs to higher levels of non-material needs when basic needs, described as "physiological" and "safety" needs by Maslow, are being met consistently. Such trends predict that persons who have been satisfied in their basic needs next address higher levels of needs such as Maslow's self-esteem, self-actualization; Inglehart's freedom, quality of life, and importance of preserving nature.

A key value studied in this research, Environmental Sustainability, might be classified among non-material values but may be perceived differently by people from countries of different phases of economic development. This study considered specific economic characteristics of different types of countries in studying how two different levels of values may be interchanged from test to retest, using a prompt of personal preference over economic prosperity in their home country.

2.3 Interrelationship Between Innovation and Sustainability

Rokeach (1973) highlighted that a value change effect can be triggered by a contradiction between self-conceptions and terminal values, which can be induced by a state of self-dissatisfaction. Through experiments, Rokeach and Cochrane (1972) found that the feedback of information about own and others' values, attitudes, and behaviour made many of the experimental subjects consciously aware of

the fact that their values, attitudes, or behaviour were incompatible with self-conceptions, thus giving rise to an affective state of self-dissatisfaction. Such arousal of an affective state of self-dissatisfaction has been shown to be crucial in generating long-term changes in values, attitudes, and behaviour (Rokeach 1971, 1973). A related line of research was conducted by Festinger (1957), the study introduced the theory of Cognitive Dissonance which holds that a tendency emerges to change one's beliefs and attitudes when a person is induced to act or say in a way that is contrary to one's beliefs.

Rokeach's study found long-term increases in the importance attached to two values, Equality and Freedom, though the increase in freedom ranking in all groups was smaller than the equality increase due to the fact that freedom was typically ranked higher than equality to begin with. This study anticipates a similar value change pattern in which the importance of Capacity for Innovation is expected to be initially greater than that of Environmental Sustainability and the survey which ideally provides a process of value change that coordinates subjects' opinion on the dependence of environmental quality and resource availability on the one hand and economic development on the other hand (Mulder and van den Bergh 2001). Finally, by sharing with participants the value preference of Management Sciences students and reinforcing the participants' attitude towards economic prosperity in their home country, we hope to create a state of self-dissatisfaction by contradicting economic-oriented innovation with sustainable employment of the natural environment.

We predict that increases of perceived importance of both social values, Capacity for Innovation and Environmental Sustainability, will take place; in addition, Environmental Sustainability increases are expected to be greater than the Capacity for Innovation increases depending on the types of country the subjects are from, those from developed versus developing economies.

2.4 Conclusion

Despite the variety of research areas covered by previously mentioned studies, the human perceptions of social values, specifically related to innovation and sustainability, have rather been neglected, especially in the developing countries. This study, therefore, is aimed at studying how people from both developed and developing countries perceive these values, finding the perceived relationship between these two values, and also trying to identify any patterns that may occur within the perceived interrelationship between innovation and sustainability related to economic prosperity.

Furthermore, the previous studies have raised the following important points of view that influence the current study:

- Human behaviour can be predicted or influenced through better understanding of social values.
- The more people have constant satisfaction of basic material needs, the lower the importance level they tend to apply on these needs, and the higher importance level they tend to apply on higher levels of needs such as quality of life.
- A value change process can be induced by reinforcement that generates a contradiction between persons' conception and terminal values.
- Innovation and sustainability are inter-related; the human perceptions of these two values may be manipulated in terms of their importance levels as such a contradiction mentioned above is present.

Chapter 3
Research Objectives

The research objectives considered in this thesis include:

Firstly, this research is primarily focused in finding out how important certain social values related to national well-being are perceived by citizens from developed and developing countries. These social values are mainly elicited and tailored from the six social values used by The Conference Board of Canada (2007) to evaluate the national well-being of Canadian society.

Secondly, it is to investigate whether a change of the importance levels of these social values would take place from test (Time One) to retest (Time Two) using the Global Representative Value Change Survey, which was partially replicated from Rokeach (1967)'s Value Survey.

Finally, this study is also dedicated to discover to what extent the perceived importance of innovation and sustainability can change or trade off among the participants from the different country categories, and possible interaction effects among these.

3.1 Research Hypotheses

This study anticipates finding:

1. Among participants from developed countries, the values that will be rated more important are those that are related to higher level needs described in Maslow (1943), such as Environmental Sustainability. A change in the ratings of Innovation and Sustainability will be anticipated, such that the importance level of Sustainability is expected to be kept higher than Innovation, and the rating difference of Sustainability is expected to be greater than that of Innovation.

2. Among students from developing countries, the values that will be rated more important are those that are related to the basic needs in Maslow (1943), such as economic growth. Innovation is expected to be rated higher than Sustainability as Innovation is perceived to be directly related to economic growth. A value change is expected, in which the importance level of Sustainability becomes higher than that of Innovation from test to retest, and the increase in Sustainability will not be as significant as that in the developed country group.

10

3. The study also anticipates that participants who value economic prosperity are more concerned about values that are associated with economic growth, such as Innovation and Economy, and participants who do not believe economic prosperity is the priority are more concerned about values that are associated with Environment and Sustainability.

4. Lastly, this study is also to explore the effects of the rating methods used in this study including the constrained (forced choice and no tie rating) and the unconstrained (free choice and tie rating); it is predicted that the unconstrained condition is more effective in terms of creating value change, because this method offers more freedom to participants to change their value ratings.

Chapter 4
Research Method

This study was conducted in two parts including the exploratory pilot study one, in which Management Sciences Graduate Student Survey distributed in the Department of Management Sciences at the University of Waterloo, and the confirmatory study two on Value Change Survey was distributed across the university campus. Both surveys were approved with full clearance by the Office of Research Ethics at the University of Waterloo.

The two survey instruments used in this study were derived from Rokeach (1967, 1973) and The Conference Board of Canada (2007). The study adopted and modified the six tested areas used by The Conference Board of Canada to evaluate the competitiveness of the Canadian society, and the survey methodology was adopted from Rokeach (1967, 1973) to measure value and value change. The derivation of the two surveys is described below.

4.1 Values Used

Rokeach (1967) initially measured personal as well as social values using the Value Survey. A total of 18 instrumental and 18 terminal values were presented along with a brief definition. Respondents were asked to arrange them in the order of importance to themselves. The 18 terminal values were selected from a review of the literature, various values found in the American society and in other societies, as well as the values obtained from selected graduate students and metropolitan Lansing residents. The 18 instrumental values were selected from Anderson's (1968) list of 555 personality-trait words according to several criteria such as retaining only one from a group of synonyms, retaining those judged to be maximally different from one another and retaining those deemed to be maximally discriminating across such factors as social status, sex, race, age, religion, and politics (Rokeach 1973).

In this study, the social values used were derived from The Conference Board of Canada, which is a not-for-profit organization that specializes in conducting and publishing research in the areas of economic trends, organizational performance and public policy issues. The Conference Board of Canada (2007) benchmarks Canada's performance in six major domains: Economy, Innovation, Environment, Education and Skills, Health and Society. In the report, Canada's performance was

compared with the performance of sixteen peer countries in these domains to assess how well Canada is achieving its goal of creating a high and sustainable quality of life for Canadian citizens.

We believe that the performance scores of these six social values could well characterize the overall performance of a nation in terms of developing its national well-being. These social values were slightly modified in order to fit our survey instruments. For example, sustainability was added in the pilot study, and environment and sustainability were combined as environmental sustainability in the main study.

Miller (1956) suggested that a clear and definite limit to the accuracy with which a uni-dimensional stimulus variable can be identified to be seven, plus or minus two. This study complies with Miller (1956) by using similar number of values in total. The Rokeach Value survey and RVCI, however, stretched the limits of human attention with 36 and 18 social and personal values.

4.2 Value Change Measurement

To investigate long-term changes in value, attitudes, and behaviour, Rokeach (1973) implemented three experiments. His subjects ranked 12 or 18 terminal values and indicated the extent of their value commitment on an 11-point scale. They then ranked the same values the way they thought "Michigan State University students on the average would rank them." More emphasis was placed on two target values, Equality and Freedom, by showing the subjects the previously collected rankings from student participants in Michigan State University and by offering an interpretation of the findings. The purpose was to arouse a state of self-dissatisfaction, thereafter, to induce value changes. The survey then asked subjects to record their position with respect to civil rights demonstrations proposing an additional state of self-dissatisfaction concerning possible contradictions between self-conceptions and values or attitudes. Following that, participants were shown the findings from Michigan State University students regarding civil rights demonstration and again a brief interpretation to arouse further self-dissatisfaction. In addition, subjects were asked to either agree or disagree with the interpretation using an 11-point scale. Finally, subjects' new sets of rankings after the experimental procedure were elicited. These procedures used in Value Change Instrument (RVCI) by Rokeach (1973) were adopted in this study.

4.3 Study One: Management Sciences Graduate Student Survey

To identify the importance of the social values related to national well-being and their ratings from students in the Management Sciences Department, the pilot study was conducted using the survey

"Management Sciences Graduate Student Survey" (Appendix A). In this study, students were given the option to select whether their home country is a developed, developing or under-developed country and they were asked to rate the importance of the six social values related to the national well-being in their home country. The six values have been used in evaluating the national well-being in Canada by The Conference Board of Canada including Innovation, Economy, Environment, Education and Skills, Health, Society. Sustainability was added to these six values.

4.4 Study Two: Global Representative Value Change Survey

To identify perceptions of the importance of the social values, and to identify a value change, the results of Study One were presented to the participants of Study Two and a question concerning economic prosperity was asked in the Global Representative Value Change Survey (Appendix B) which was distributed to 2500 International Students at the University of Waterloo. In this survey, participants were asked to rate six social values from test (Time One) to retest (Time Two); these values include Capacity for Innovation, Robust Economy, Environmental Sustainability, Education and Skills Training, Health and Wellness and Civil Society. A state of self-dissatisfaction manipulation was created by presenting the outcome of Study One and reminding the economic prosperity in participants' home country. This method was used in Rokeach (1973) to achieve a contradiction between self-conception and terminal values.

The constraint setting was used at the retest (Time Two). The survey instrument was designed such that it captured both forced-choice and free-choice conditions. In other words, some participants were forced to assign a rating point to one and only one value; other participants were allowed to assign a rating point to more than one value. The purpose of this manipulation was to intervene with the rating options that were offered by the survey instrument and to investigate what values participants were willing to trade off among the relative importance of all six social values.

4.5 Sample Information

The target participants of this study were the citizens from developed and developing countries around the world. Due to the limited resources, this research was constrained in terms of reaching the actual participants located in homelands. Alternatively, international students at the University of Waterloo were chosen to be the proxy participants for his study. International Students were students who study in the university, have a foreign nationality, and were expected to possess the values of their home country.

Survey participants were expected to meet the following criteria:

1. Must be familiar with the value systems of their home country

2. Must be able to recognize the development of national well-being in their home country

4.5.1 Study One Sample

Sixteen graduate students participated in the pilot study which was conducted within the Department of Management Sciences. Participants included six students from developed countries, nine from developing countries and one from under-developed countries.

The survey response may not be generalized due to a narrowed number of participants. Nevertheless, it was sufficient to perform the exploratory study.

4.5.2 Study Two Sample

A recruitment email was sent out to 2500 international students, and 312 international students responded, of which 272 completed the survey. The subject pool can be broken down into categories described in the following sections.

4.6 Sample by Country Categories

The following pie chart shows the components of the total sample participants in terms of country types.

Figure 1 Sample Categorized by Country Type

5.15%

25.74%

69.11%

▤ Developing Country
▥ Developed Country
◼ Under-Developed Country
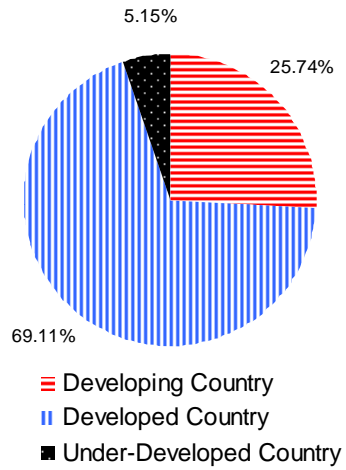
Among the 272 completed respondents, 70 were from developed countries, which accounted for 25.7%; 188 were from developing countries, accounted for 69.1%; and 14 identified themselves as from under-developed countries, accounted for 5.1% of the total respondents.

4.7 Sample by Constraint Setting

The following pie chart shows the components of the total sample participants in terms of the constraint setting.

Figure 2 Sample Categorized by Constraint Setting

38.76%

61.24%

▤ Unconstrainted Setting(Free Choice)
▥ Constrained Setting(Forced Choice)
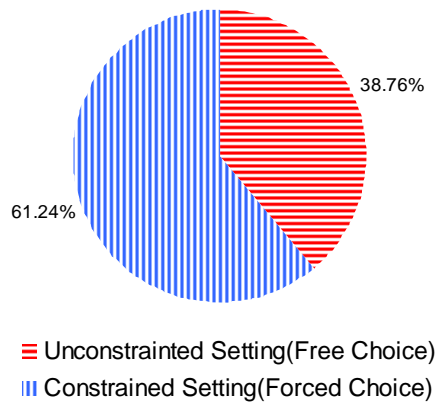
As the pie chart shows, among the 272 participants, 169 took this survey with the forced ranking feature accounting for 62.1%; 103 participants took this survey with the free choice feature, which accounted for 37.9% of the total participants.

Because Study Two was conducted excluding the students who participated in Study One and the 272 participants had never been in any contact with the researcher, it can be concluded that the survey responses were random samples of the international student population. Consequently, the findings can be confidently generalized.

4.8 Research Assumptions

This study used the following assumptions:

1. This study assumed that participants from developed and developing and under-developed countries tended to evaluate the national well-being in their home country and were able to realize what social values are important to the national well-being.

2. This study assumed that foreign students at the University of Waterloo could represent the generalized beliefs of people in their home country who received higher education and who were influential in the decision making process towards improving the national well-being in their home country.

3. This study assumed that every participant interpreted the social values in a similar way using the provided definitions of the social values; this may be a limitation and will be discussed later.

Chapter 5
Survey Instrument

This study adopted and modified the social values used by The Conference Board of Canada (2007) and the research methodology of Rokeach (1967, 1973).

5.1 Survey Design

Following Rokeach's (1973) approach, the Global Representative Value Change Survey (GRVCS) was created to study the importance of six social values to people from developed and developing countries. These values included Capacity for Innovation, Robust Economy, Environmental Sustainability, Health and Wellness, Education and Skills Training and Civil Society. The GRVCS focused on two values, Capacity for Innovation and Environmental Sustainability.

Researchers have found that the inter-correlations among ranked items tend to be zero or negative, and the correlations among the rating scales were positive and showed considerable inter-correlation in many cases (Jackson and Alwin 1980, Alwin and Krosnick 1985). A rating scale was used in this study, because it is our intention to allow an overall positive value change in all rated values. Survey participants were asked to rate the six values on an 11 point scale, in which "10" was defined to be "Very Important", "0" was defined as "Very Unimportant" and "5" was "Neutral". To keep the survey uniform, all rating questions in this survey were designed in such a way that the right end selection was positive; the left end selection was negative.

After rating the six values, participants were asked to indicate how much they care about their ratings. Furthermore, participants were asked a question regarding economic prosperity and were given the findings from Study One. This was intended to create a self-contradiction in order to generate possible value changes. Finally, the survey asked participants to indicate if they were satisfied with their original ratings; unsatisfactory ratings could be adjusted and recorded by the end of the survey. The RVCS required 40 to 50 minutes to complete (Rokeach 1973), whereas GRVCS required approximately 30 minutes.

5.2 Web-Based Survey Design

The survey instrument was designed and implemented online and was technically supported by a credible third party internet survey service provider. The online survey tool permitted the researcher to accurately collect and record participants' responses.

5.3 Process to Ensure Confidentiality

No identifying information was recorded by the survey tool unless the participants were willing to do so. In such cases, participants were eligible to enter a random draw of an iPod Shuffle as a reward for participating in the survey. Furthermore, following steps were used to ensure anonymity and confidentiality.

First of all, the procedures described in the previous section recorded only the opinions from each participant and did not require the participants to disclose their identification information or contact information unless they were willing to disclose such information. Therefore, anonymity was ensured to those who cared about it.

Secondly, the original database was divided into two separate parts to ensure confidentiality. A unique numerical code was assigned to each participant; the corresponding identifiers associated with the codes were then collected and removed onto a separate file, which was stored on the Engineering server at the University of Waterloo under a restrictive account that belongs to a third party researcher.

The third party researcher was not in any way involved in the research and was the only person who had the identifiers associated with the corresponding codes; however, the person did not have access to the actual database of survey responses. The researcher was also responsible for randomly selecting a winner for the reward.

Thus, this study managed and analyzed the database without the ability to relate the unique codes with the participants.

Chapter 6
Survey Data Analysis

6.1 Analysis of Pilot Study One

The pilot Study One was conducted among the graduate students in the Department of Management Sciences at University of Waterloo. The participants were grouped by their country types, developed or developing countries. They were also grouped by their attitude towards economic prosperity, whether economic prosperity was a priority to national well-being. The average ratings of importance of each value were calculated and summarized.

Table 1 shows the summary of the averaged ratings. Comparisons were primarily focused on the ratings of Innovation and Sustainability.

6.1.1 Grouping by Country Types

Table 1 shows the averaged ratings of the importance of each value categorized by the country types, developed or developing country.

Table 1 Summary of Average Ratings Categorized by Country Type

Social Values	Average Rating (Developed)	Average Rating (Developing)	Difference Score
Innovation	2.50	3.44	-0.94
Economy	3.83	3.89	-0.06
Environment	3.50	3.00	0.5
Education and Skills	4.00	3.78	0.22
Health	3.50	3.33	0.17
Society	2.50	3.67	-1.17
Sustainability	3.17	3.11	0.06

In the 11-point rating scale from -5 to 5, "5" was the most important rating point. Graduate students who identified their home country as developed country, on average, believed that Education and Skills was the most important value for national well-being and they rated 2.5 on Innovation and 3.17 on Sustainability. Participants who identified their home country as developing country, on average,

believed that Economy was the most important to improve national well-being and they rated Innovation 3.44 and Sustainability 3.11.

An independent samples t-test was used in testing the mean ratings. It did not reject the mean hypothesis indicating that there was no significant difference in the average ratings between participants from developed and developing countries. A difference score of -0.94 for Innovation and 0.06 for Sustainability indicating that Innovation was perceived more important by participants from developing countries than those from developed countries, and Sustainability was more important as viewed by participants from developed countries.

The highest difference score occurred in the ratings of Society, showing that developing country participants placed more concerns on the nation's society. The definition of Society provided with the survey focuses on reducing child poverty and poverty among the working age population, poverty among elders, crime, rate of homicides, assaults and burglaries, while also increasing social cohesion, voter turnout and trust in political institutions, and social spending as a percentage of GDP. Therefore, it can be reasonably concluded that the participants from developing countries had higher concerns on these issues than the participants from developed countries.

Moreover, both groups rated certain values with similar levels of importance, such as Economy. Note the average rating of Environment is rated 0.5 point (4.5%) higher by the participants from developed countries, in the direction predicted.

It was also shown that participants from developed countries rated Innovation and Society with the lowest importance level, and Environment was rated the least important by participants from developing countries. As anticipated, Sustainability was rated higher than Innovation by students from developed countries, and developing country students rated Sustainability with a lower score than Innovation, the same trend is also applicable on the ratings of Environment and Innovation.

These ratings indicated that participants from developing countries were more concerned about values such as Economy, Innovation than these from developed countries, but less concerned about other values such as Sustainability and Environment. However, no significant difference was found between the two tested groups.

6.1.2 Grouping by the Responses to Economic Prosperity

The following Table 2 shows the averaged ratings categorized by the responses to the question of economic prosperity.

Table 2 Summary of Average Ratings Categorized by Responses to Economic Prosperity

Social Values	Average Rating (Not Priority)	Average Rating (Priority)	Difference Score
Innovation	2.25	3.50	-1.25
Economy	3.50	3.83	-0.33
Environment	3.75	3.00	0.75
Education and Skills	3.00	4.25	-1.25
Health	2.50	3.25	-0.75
Society	2.75	3.08	-0.33
Sustainability	3.25	2.83	0.42

Shown by Table 2, participants who believed that economic prosperity was a priority for national well-being, on average, rated Innovation 3.5 and Sustainability 2.83, and on average, participants who believed that economic prosperity was NOT a priority rated 2.55 and 3.25 for Innovation and Sustainability.

An independent t-test did not support rejection of the null hypothesis; in other words, no significant difference in the average ratings was identified between participants who prioritized economic prosperity and these who did not. However, the rating trend associated with economic prosperity acted in accordance with the hypothesis 3.

The difference score of the ratings of Innovation and Sustainability was -1.25 and 0.42. The largest difference scores occurred in the ratings of Innovation and Education and Skills, which were rated more important by participants who believed that economic prosperity was a priority. Moreover, this group rated Environment and Sustainability with lower levels of importance.

The highest rated value was Education and Skills for students who preferred economic prosperity, Environment and Sustainability were the least important values, which may highlight the concern that people may choose to sacrifice environment for economic prosperity. For the group who did not prioritize economic priority, Innovation was perceived the least important, whereas Environment was the most important. The above rating trends may suggest that the perception of economic prosperity can be an effective factor that distinguishes how people perceive the importance of Innovation and Sustainability.

In summary from the pilot study, what was found from the mean analysis makes sense. Innovation and Economy were rated on average more important by participants who value economic prosperity. Environment, Education and Skills and Sustainability were rated on average more important by students who did not prioritize economic prosperity. This suggests that Innovation was perceived as a contributing factor for economic development and for improving national well-being. However, Sustainability and Environment may be sacrificed in order to achieve such a goal. On the other hand, in order to develop long term and sustainable national well-being, the quality of Environment, Education and Skills and Sustainability has to be ensured.

6.1.3 Care Level Analysis

The pilot study participants were required to indicate their care level that indicated how much they cared about their ratings of each value. The average care level of participants from developed countries was 4.67, and the average care level of participants from developing countries was 2. A two sample t-test rejected the null hypothesis (p=0.005) and indicated that participants from developed countries cared less about their ratings than these from developing countries.

Two sample t-tests were used in testing the mean ratings for each value based on the variables of country type and the responses to economic prosperity. No significant difference was found between any two tested groups. This may be due to the small sample size.

6.2 Analysis of the Global Representative Value Change Survey

6.2.1 Analysis Between Participants from Developed and Developing Country

This section focused on the analysis of the survey responses of participants who identified their home country as developed and developing country. Due to the small sample size and incomplete information, analysis on the under-developed country group was very limited and it was not the focus of this study.

6.2.2 Introduction to Experimental Design

Survey responses were extracted from the third party survey provider. The data were categorized according to the requirements of this analysis based on the country type and participants' responses to economic prosperity. SPSS was used to conduct the statistical experiments; in addition, Excel was used as a supplemental tool.

There were four different variables in this study. These variables were the country types, the constraint conditions, the test-retest data collection points, and the social values. Since categorized participants were required to rate the importance of six social values at test (Time One) and retest (Time Two) under the constrained and the unconstrained conditions. Consequently, the value ratings were analyzed repeatedly between more than two sets of data. Therefore, Repeated Measures ANOVA was chosen to test the equality of mean ratings.

Two Between-Subject variables and two Within-subject variables were identified in this experiment. Between-Subject variables were the country types, which were the developed and developing countries, and the constraint conditions, including constrained and unconstrained conditions. Within-Subject variables were the test-retest times; time one and time two, as well as the two social values, Capacity for Innovation and Environmental Sustainability.

Participants were divided into two groups according to their country type, developed and developing countries. Each group was then divided into two sub-groups, constrained (forced choice) and unconstrained (free choice).

6.3 Repeated Measures ANOVA Using SPSS

6.3.1 Four-Way (2x2x2x2) Mixed Design

The four-factor analysis of variance (2x2x2x2) with repeated measures on two factors, values and times, was utilized to evaluate the main and interaction effects (Tuzlak and Moore 1984).

A 2 (Country types) x 2 (Constraint conditions) x 2 (Social values) x 2 (Test-retest times) mixed design with two between-subjects factors and two within-subjects factors was implemented using statistical software, SPSS. The factor levels that form the eight basic conditions of the experimental design were as follows: two levels of country types (Developed and Developing country); two levels of constraint conditions (Constrained and Unconstrained); two levels of social values (Capacity for Innovation and Environmental Sustainability); and two levels of times (Time One and Time Two).

In SPSS 15.0, survey data were formulated to compatible and logical variables. Each social value had two sets of rating data from time one and time two, the variable of country types was represented by 0 and 1 which denoted developed and developing, and the variable of constraint conditions was represented by 0 and 1 which denoted constrained and unconstrained.

Under Analyze and General Linear Model option, Repeated Measures ANOVA test was selected. Then, the Within-subject factors, Time and Value, were defined with two levels. In the next window, ratings of Capacity for Innovation at test (Time One) were selected as _?_ (1, 1), ratings of Capacity for Innovation at retest (time two) became _?_ (1, 2); and ratings of Environmental Sustainability were defined to _?_ (2, 1) and _?_ (2, 2). The Between-Subject variables, country types and constraint conditions, were transferred to the Between-Subjects factors box.

Repeated Measures ANOVA outputs were summarized in Table 3. The output shows that the main effect of CountryType (F=0.437, p=0.509) was not significant, although there were two main effects of Times (F=37.62, p=0) and Values (F=3.868, p=0.05), a significant four-way interaction effect between all variables (F= 4.657, p=0.032) and a significant three-way interaction effect between Times, Values and Constraint conditions (F=4.255, p=0.04), as well as two significant two-way interaction effect, Times and Constraint (F=19.99, p=0); Times and Values (F=11.225, p=0.01).

The significant four-way interaction between Times, Values, CountryType and Constraint was identified. This interaction suggests that the Times and Values factors had a significant impact on the contributions across CountryType and Constraint conditions. Due to the complex interactions result in statistical significance, this repeated measures ANOVA test offered no clear interpretation (Perry 2005). Therefore, an attempt was made to reduce one of the variables, Times, by calculating the rating difference score between Time One and Time Two; it also helped reducing the deviation on the residual plot where it was tilted.

Table 3 Repeated Measures ANOVA Output 1

Source	F	Sig.
Times	37.62	0.000
Values	3.868	0.05
CountryType	0.437	0.509
Constraint	2.981	0.085
Times*CountryType	0.023	0.88
Times*Constraint	19.99	0.000
Times*CountryType*Constraint	0.007	0.931
Values*CountryType	0.13	0.719
Values*Constraint	0.099	0.753
Values*CountryType*Constraint	0.008	0.929
Times*Values	11.225	0.01
Times*Values*CountryType	2.091	0.149
Times*Values*Constraint	4.255	0.04
Times*Values*CountryType*Constraint	4.657	0.032

6.3.2 Three-Way (2x2x2) Mixed Design

A three way mixed design was implemented by eliminating the Time factor, this was done by subtracting the Time One ratings from Time Two to produce change scores.

The standard procedures were followed using SPSS; only the number of variables was reduced to three. Table 4 summarizes the Repeated Measures ANOVA:

Table 4 Repeated Measures ANOVA Output 2

Source	F	Sig.
Values	11.225	0.001
Values*CountryType	2.091	0.149
CountryType	0.023	0.88
Constraint	19.994	0.000
CountryType*Constraint	0.07	0.931
Values*Constraint	4.255	0.04
Values*CountryType*Constraint	4.657	0.032

As shown in the tables, a two-way interaction effects was found between Values and Constraint conditions (F=4.255, p=0.04), and a three-way interaction effect between Values, CountryType and Constraint conditions (F=4.657, p=0.032) was significant meaning that the Country Types and the Constraint conditions together significantly affected the ratings of the two social values. Moreover, two main effects were identified; both Values (F=11.225, p=0.001) and Constraint conditions (F=19.994, p=0) had a significant main effect on the value ratings, therefore, it is suggested that participants' ratings were rather dependent on the social values and what rating systems available to them. More analysis of group means can be found in the following chapter.

6.4 Statistical Test Assumptions

The major assumptions for this test are: Normality, Independent observations and Variance homogeneity. Researchers have argued that, without meeting the assumptions, tests of mean differences can not be validly interpreted and the resulting significance probabilities are, at best, somewhat different from what they should be and, at worst, worthless (Keselman et al 1998). Studies concerning violations of test assumptions showed that the F statistic is remarkably robust against violations of test assumptions such as normality and homogeneity of variance (Lindman 1974). As a result, the test was confidently performed.

6.4.1 Assumption of Normality

ANOVA assumes that the data for each variable are normally distributed. To verify this assumption, Montgomery (2005) suggested using the plot of the standardized residuals which is usually more effective to check normality.

SPSS's normal plots of standardized residuals (Appendix C) demonstrated a strong normal distribution in the ratings of Capability for Innovation and Environmental Sustainability at Time One, suggested by the straight line resembled in the plot of the underlying error distribution. The Time Two ratings were somewhat less convincingly normal, as the lower end slightly deviated from the plot. However, given this minor deviation, previous investigations of violations of normality showed that the accuracy of analysis of variance would not depart significantly (Collier and Baker 1963, Lunney 1970). Sample standardized residual plots are listed in Appendix C.

6.4.2 Homogeneity of Variance

Another important assumption required to use ANOVA test is that of equal variance. To verify this assumption, the built-in Levene's Test for equality of variances was used. The test output showed that the only significant F statistics, which indicates an unequal variance, occurs in the ratings of Capacity for Innovation ($F=2.736$, $p=0.044$). All other eleven groups have insignificant F statistics indicating that the homogeneity of variance assumption was largely met.

Repeated Measures ANOVA is still robust over moderate violations of this assumption, argued by various researchers and academic consulting services. Despite the minor violation of the homogeneity of variance assumption, the test output was considered to be acceptable (Steckler and Oleson 2005).

6.4.3 The Sphericity Assumption

The sphericity assumption states that the variance of the population difference scores for any two conditions should be the same as the variance of the population difference scores for any other two conditions. SPSS's Multivariate Test does not require this assumption, which is often used as an alternative in cases where the violation of sphericity occurs. Neill (2008) suggested that it is not a major concern if results from Repeated Measures ANOVA and Multivariate Test are consistent, but a different approach should be taken if the results are discrepant. In this study, the results of Repeated Measures ANOVA and Multivariate Test were consistent. Therefore, no corrections were required for the two Within-Group subjects.

6.4.4 Robustness of the Analysis of Variance

Although analysis of variance works as a very flexible and powerful technique that can be applied to very complex research issues (Hill and Lewicki 2007), statisticians have criticized the robustness of the technique that ANOVA are poorly reported with inadequate statistics to compare groups and that the results for repeated measurement are hard to understand and easily misinterpreted (Vickers 2005). On the other hand, other researchers have considered the robustness of ANOVA for the assumptions underlying complex experimental designs and the assumptions of normality and homogeneity of variance (Lunney 1970).

Given the debates between the two schools of thoughts about violations of these assumptions, many researchers have concluded that ANOVA would still be effective with certain degree of assumptions violation (Collier and Baker 1963, Steckler and Oleson 2005, Hill and Lewicki 2007, Neill 2008).

In this study, the test assumptions were met and more than two repeatedly measured variables were identified, we conclude that Repeated Measures ANOVA was appropriate and valid to use and the interaction and main effects found by the outputs were statistically valid.

Chapter 7

Mean Analysis by the Between-Subject Variables

Repeated Measures ANOVA has shown a significant four-way interaction effect between country types, constraint conditions, times and values; and a significant three-way interaction effect between country type, constraint conditions and values. These significant interaction effects posed major difficulties to reasonably interpret the relationship between these tested groups.

To further understand the tested groups, researchers have used statistical t-test to identify where the difference was after a repeated measures analysis (Marsh, Elfenbein and Ambady 2003). In this study, t-tests have been used to compare group means and have shown several statistically significant mean differences between tested groups.

7.1 Unconstrained Groups

7.1.1 Test-Retest Comparison for the Developed Country Group

A t-test was conducted on the value ratings over time for developed country participants. Mean differences in the value ratings were identified to be significant across five of the six values. With the free choice option, participants from developed countries showed a different preference of values over time. As shown in Table 5, Robust Economy ($t=-2.437$, $p=0.021$), Environmental Sustainability ($t=-4.692$, $p=0.00$), Education Skills and Training ($t=-2.978$, $p=0.006$), Health and Wellness ($t=-2.082$, $p=0.046$), and Civil Society ($t=-3.633$, $p=0.001$) were rated significantly more important at the rest (Time Two). The average rating increase across values was 0.96 indicating that value change effectively took place with the presence of the related information in the survey. Shown by Figure 3, ratings shifted upward from Time One to Time Two except for Capacity for Innovation.

Figure 3 Mean Plot of Unconstrained Ratings of the Developed Country Group
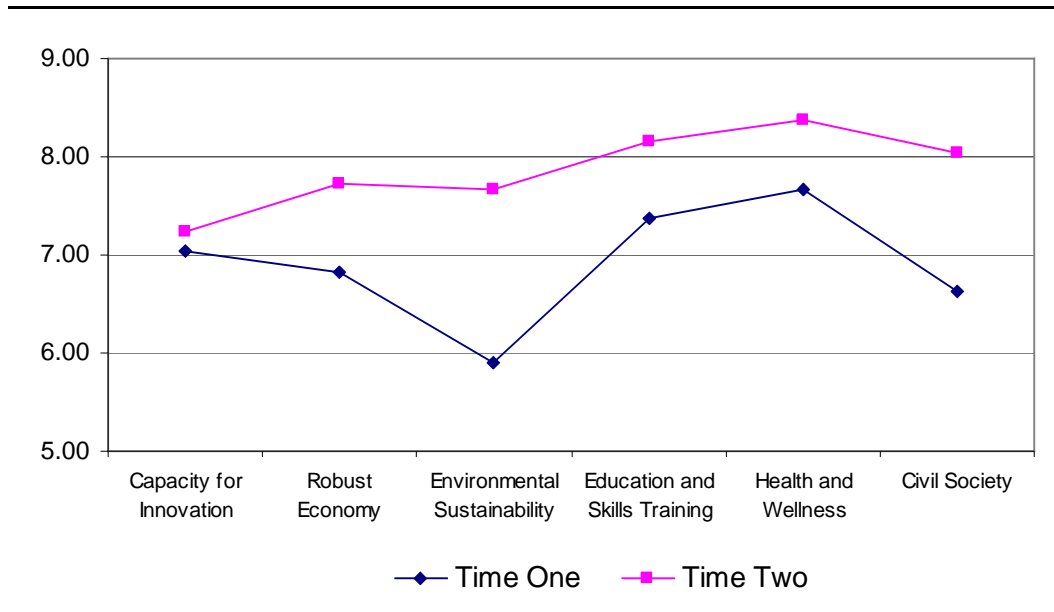
With the unconstrained condition, participants from developed countries rated Environmental Sustainability significantly higher at Time Two after a reinforcement of Economic Prosperity, and the rating of Capacity for Innovation only slightly increased over time (Figure 4). The mean increases were 1.77 and 0.2 for Environmental Sustainability and Capacity for Innovation respectively. Such a trend largely accorded with what our hypothesis 1 predicted that, realizing the impact of economic prosperity on the development of national well-being, a value change occurred among citizens from economically developed countries, in which the importance of Environmental Sustainability became more important than Capacity for Innovation, even in the situation where increasing the importance of Capacity for Innovation was permitted.

Figure 4 Capacity for Innovation & Environmental Sustainability - Developed Country Group
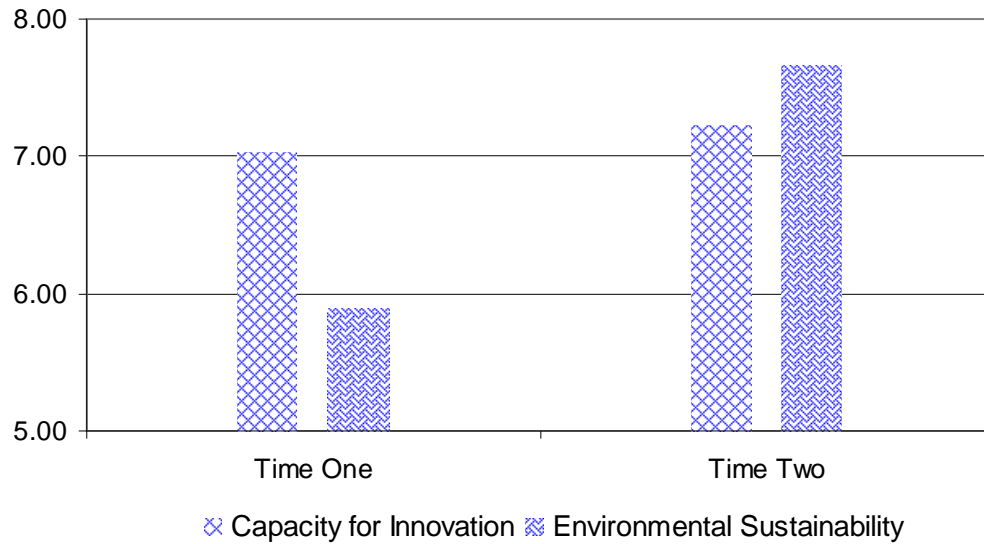
Table 5 clearly shows that even though overall ratings of all values increased and the rank order had strong similarity over time, values such as Capacity for Innovation, Civil Society, and Environmental Sustainability changed ranking positions over time. The ranking position of Capacity for Innovation was downgraded, while that of Civil Society and Environmental Sustainability moved upward. On average, the ratings of Capacity for Innovation and Environmental Sustainability increased by 0.2 and 1.77 respectively.

Table 5 Unconstrained Mean Ratings by the Developed Country Group

Rankings	Time One		Time Two	
1	Health and Wellness	7.67	Health and Wellness	8.37
2	Education and Skills Training	7.37	Education and Skills Training	8.17
3	Capacity for Innovation	7.03	Civil Society	8.03
4	Robust Economy	6.83	Robust Economy	7.73
5	Civil Society	6.63	Environmental Sustainability	7.67
6	Environmental Sustainability	5.90	Capacity for Innovation	7.23

7.1.2 Test-Retest Comparison for Developing Country Group

Under the unconstrained condition, significant mean differences have been identified over time in all rated values in the developing country group; Summary statistics are shown in the following Table 6.

Table 6 Unconstrained Mean Ratings by the Developing Country Group

Rankings	Time One		Time Two		t	Sig.
1	Education and Skills Training	7.81	Education and Skills Training	8.36	-2.34	0.022
2	Robust Economy	7.24	Health and Wellness	7.80	-2.11	0.039
3	Health and Wellness	6.90	Robust Economy	7.74	-3.72	0.000
4	Capacity for Innovation	6.62	Civil Society	7.47	-3.33	0.001
5	Environmental Sustainability	6.27	Capacity for Innovation	7.44	-4.92	0.000
6	Civil Society	6.11	Environmental Sustainability	7.40	-4.25	0.000

The Time Two ratings were, on average, higher than Time One ratings by 0.88, which indicated that the study was an effective tool that raised the levels of consciousness and understanding of the these social values associated with national well-being. Figure 5 shows an upward shift of the value ratings from test to retest with a consistent shape. It was also noticed that the ratings of Capacity for Innovation and Environmental Sustainability increased, on average, 0.82 and 1.13 respectively.

Figure 5 Mean Plot of Unconstrained Rating of the Developing Country Group
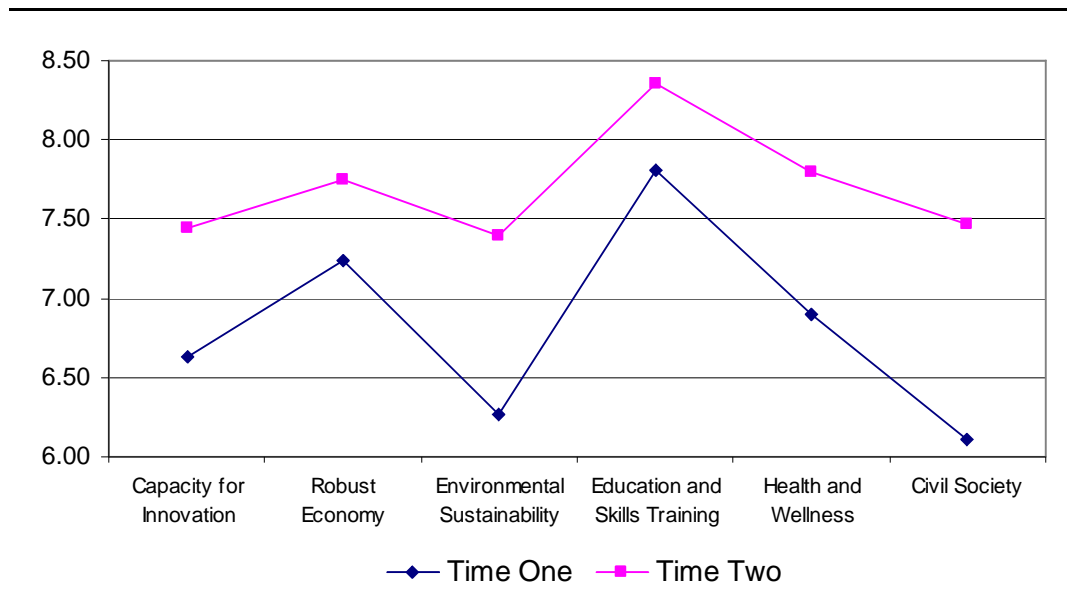
Figure 6 shows that the ratings of Capacity for Innovation (M=7.44) and Environmental Sustainability (M=7.4) notably increased at Time Two with mean increases of 0.92 and 1.13 respectively. Statistical test showed that the ratings of Capacity for Innovation and of Environmental Sustainability were not significantly different indicating that participants in the developing countries have already had high awareness of sustainability issues related to environment.

The following figure shows that this group increased the importance level of Environmental Sustainability over time, yet the value change of Capacity for Innovation may imply that the participants did not tend to balance Environmental Sustainability by lowering the other value. This suggested, given a choice, the developing country group would maintain the importance level of Capacity for Innovation and raise the importance level of Environmental Sustainability.

Figure 6 Capacity for Innovation & Environmental Sustainability - Developing Country Group
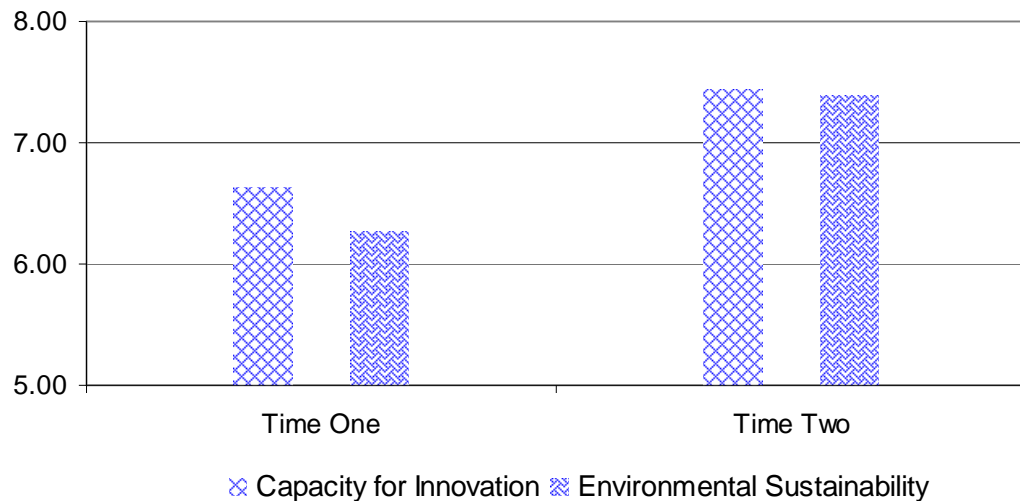
The change of Environmental Sustainability was compared between the participants from developed and developing countries. Hypothesis 2 predicted that the increase is significantly greater for the developed country group than the developing country group; the statistics showed that this relationship was not significant and the increases of importance of both groups were not significantly different.

7.1.3 Time One Comparison Between Developed and Developing Country Groups

With unconstrained condition, no significant difference occurred in the mean ratings between the two groups at Time One. As shown in Table 7, participants from developed countries rated, on average, Health and Wellness (M=7.67) the highest; participants from developing countries rated, on average, Education Skills and Training (M=7.81) the most important. Note, on average, Environmental Sustainability was rated the least important by both groups, it indicated that Environmental Sustainability was not perceived to be as important relative to other values.

Table 7 Unconstrained Mean Ratings at Time One

Rankings	Values	Ratings Developed	Values	Ratings Developing
1	Health and Wellness	7.67	Education and Skills Training	7.81
2	Education and Skills Training	7.37	Robust Economy	7.24
3	Capacity for Innovation	7.03	Health and Wellness	6.90
4	Robust Economy	6.83	Capacity for Innovation	6.62
5	Civil Society	6.63	Civil Society	6.27
6	Environmental Sustainability	5.90	Environmental Sustainability	6.11

7.1.4 Time Two Comparison Between Developed and Developing Country Groups

Mean differences of value ratings between the two groups were not significant at Time Two. Table 8 shows that Health and Wellness was viewed the most important by participants from developed countries, Education and Skills Training was the most important for participants from developing countries. However, several values were rated differently from Time One, for example, participants from developed countries did not rate the importance of Capacity for Innovation at the same pace as the other values and, instead it dropped to the last in rankings; the rating of Environmental Sustainability on the other hand increased to 7.67 from 5.9; for participants from developing countries, Robust Economy (M=7.74) and Capacity for Innovation (M=7.44) both dropped on the rankings at Time Two, while the importance levels of Health and Wellness (M=7.8), Civil Society (M=7.47) improved compared to Time One.

Table 8 Unconstrained Mean Ratings at Time Two

Rankings	Values	Ratings Developed	Values	Ratings Developing
1	Health and Wellness	8.37	Education and Skills Training	8.36
2	Education and Skills Training	8.17	Health and Wellness	7.80
3	Civil Society	8.03	Robust Economy	7.74
4	Robust Economy	7.73	Civil Society	7.47
5	Environmental Sustainability	7.67	Capacity for Innovation	7.44
6	Capacity for Innovation	7.23	Environmental Sustainability	7.40

As shown in the table above, rating scores generally increased over time. The ratings of the developed country group increased on average by 0.96 from test to retest, and the group from developing countries increased ratings on average by 0.88. The changes of the orders of certain values described above showed that the introduction of Economic Prosperity and the Unconstrained Condition was effective in terms of creating the value rating trend.

7.2 Constrained Groups

7.2.1 Test-Retest Comparison for the Developed Country Group

Mean test did not find significant mean differences between the tested groups. It indicated that, with the constrained condition, participants from developed countries tend to rate the importance of social values with reasonable consistency; no social values were significantly devalued at Time Two in order for others to become more important, though it should be noted that the ratings of Robust Economy decreased while the ratings of other values increased.

Figure 7 Mean Plot of Constrained Ratings of the Developed Country Group
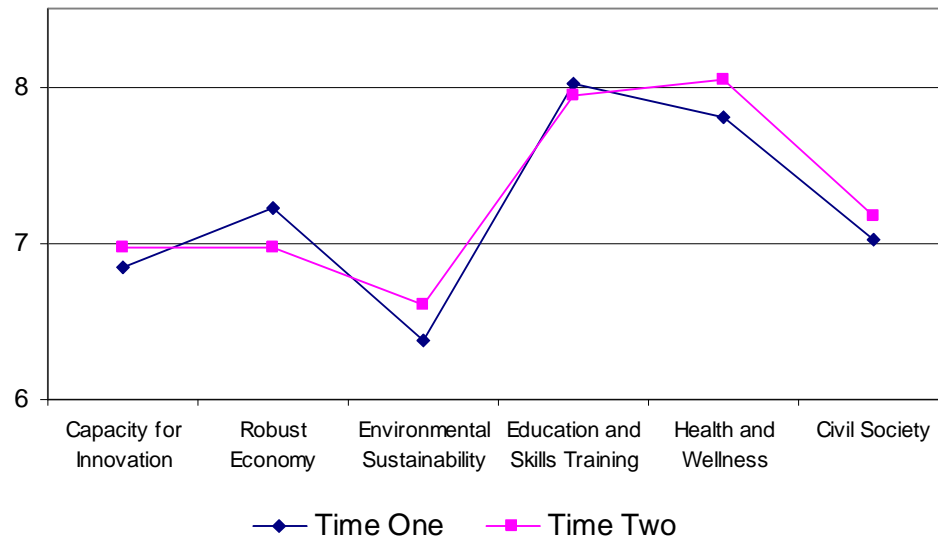
Even though the ratings of Capacity for Innovation and Environmental Sustainability were not found significantly different, it can be shown in the following graph that both ratings increased from Time One to Time Two. The increase pattern did not appear as predicted in hypothesis 1 in which Environmental Sustainability is predicted to become more important than Capacity for Innovation. Note that the ratings of Capacity for Innovation and Environmental Sustainability increased by 0.12 and 0.22 respectively over time.

Figure 8 Capacity for Innovation & Environmental Sustainability - Developed Country Group
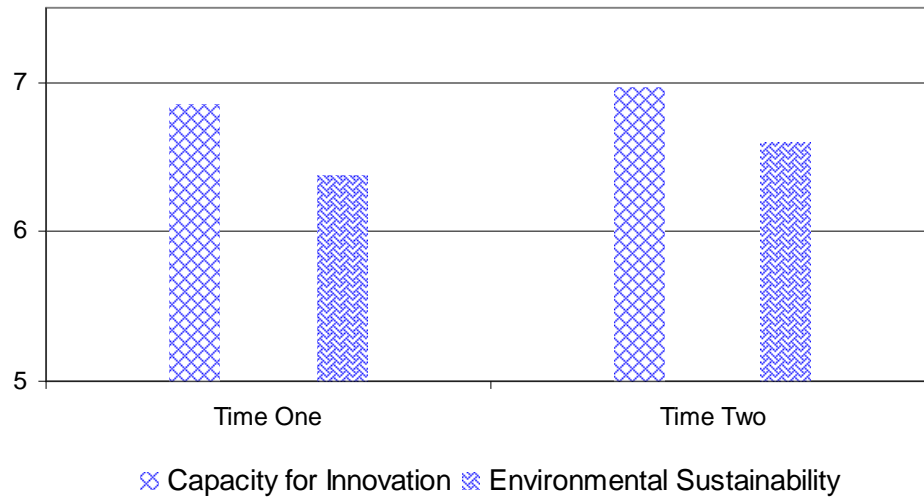
Table 9 below shows that participants from developed countries, on average, believed that Education and Skills Training, Health and Wellness were very important in developing national well-being, though Environmental Sustainability was consistently kept low in the rankings, it indicated that Environmental Sustainability was not viewed so important that other values had to be traded off under the constrained rating condition.

Table 9 Constrained Mean Ratings by the Developed Country Group

Rankings	Time One		Time Two	
1	Education and Skills Training	8.02	Health and Wellness	8.05
2	Health and Wellness	7.80	Education and Skills Training	7.95
3	Robust Economy	7.23	Civil Society	7.17
4	Civil Society	7.03	Capacity for Innovation	6.97
5	Capacity for Innovation	6.85	Robust Economy	6.97
6	Environmental Sustainability	6.38	Environmental Sustainability	6.60

7.2.2 Test-Rest Comparison for the Developing Country Group

A t-test on the mean ratings of the developing country group did not find significant differences. Similar to the group from developed countries, with the constrained condition, participants from developing countries tended to value the importance of the social values with consistency; though unlike the developed country group, the ratings of Robust Economy increased and remained as the second most important value.

Positive correlations of ratings from test to retest ranging from 0.6 to 0.75 indicated that, with the constrained conditions, participants from developing countries viewed the social values with strong consistency over time. The following Figure 9 shows the average value ratings over time.

Figure 9 Mean Plot of Constrained Ratings of the Developing Country Group
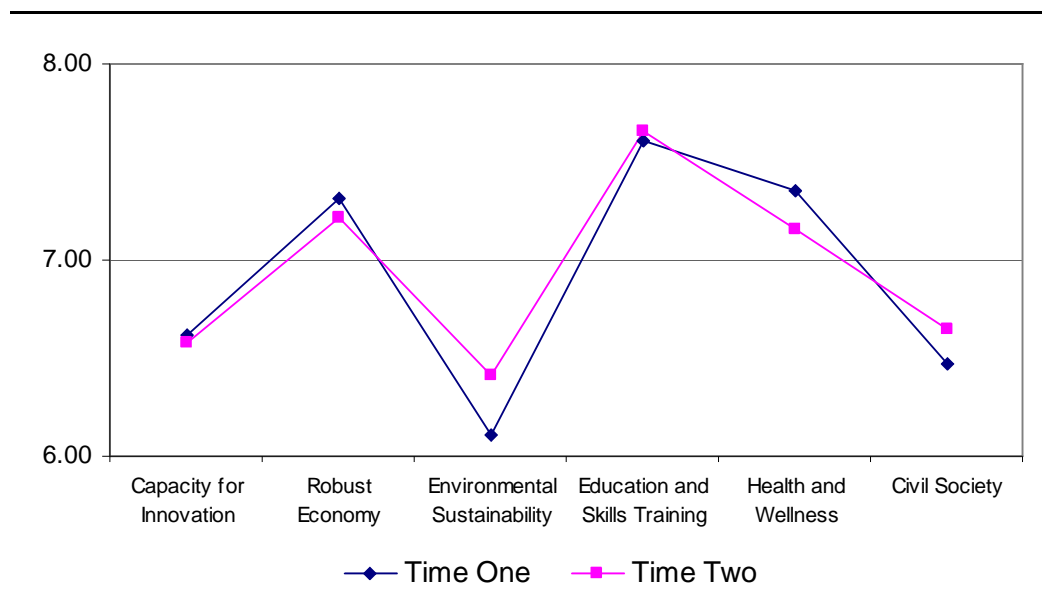
Figure 10 is a plot of the mean ratings of Capacity for Innovation and Environmental Sustainability. As it is shown, Environmental Sustainability did not become more important than Capacity for Innovation at Time Two.

Figure 10 Capacity for Innovation & Environmental Sustainability - Developing Country Group
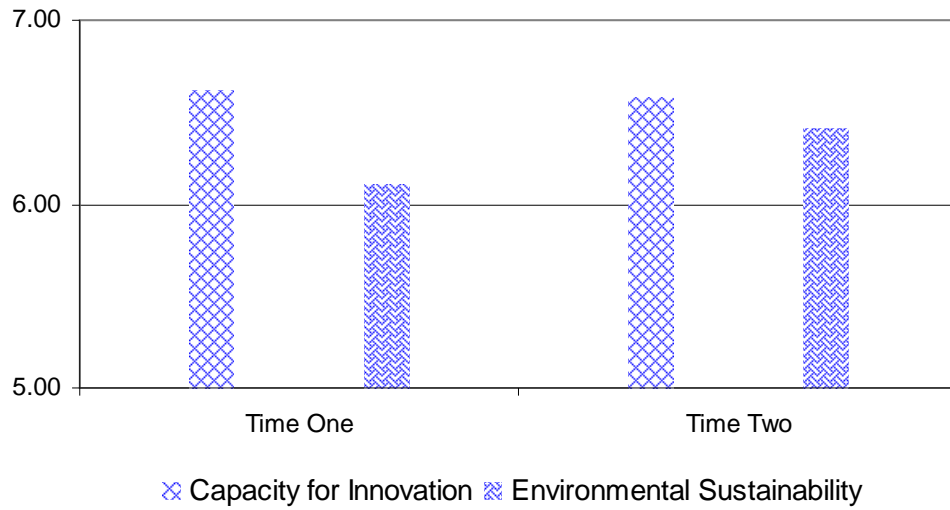
Under the constrained condition, participants from developing countries followed similar increasing pattern as these from developed countries. The ratings of Capacity for Innovation and Environmental Sustainability increased over time without exchanging their ranking positions against each other. The following Table 10 shows that the rating of Capacity for Innovation increased by 0.28 from test to retest, and the rating of Environmental Sustainability increased by 0.61. The relatively low ratings of these two values again showed that participants did not believe that Environmental Sustainability was so urgent that other values should be traded off.

Table 10 Constrained Mean Ratings by the Developing Country Group

Rankings	Time One		Time Two	
1	Education and Skills Training	7.69	Education and Skills Training	7.92
2	Robust Economy	7.29	Robust Economy	7.41
3	Health and Wellness	7.19	Health and Wellness	7.39
4	Capacity for Innovation	6.62	Civil Society	6.95
5	Civil Society	6.34	Capacity for Innovation	6.90
6	Environmental Sustainability	6.17	Environmental Sustainability	6.78

7.2.3 Time One Comparison Between Developed and Developing Country Groups

Mean ratings of each social value at Time One were compared between participants from Developed and Developing countries. The tested groups did not show significant differences in the mean ratings indicating that, at Time One, participants from both developed and developing countries viewed the social values with similar levels of importance.

The descriptive statistics summarized in Table 11 also showed that, at Time One, participants from both country types viewed the values with similar importance. For example, on average, Education and Skills Training was rated the highest by both developed group (M=8.02) and developing group (M=7.61) and Environmental Sustainability was rated the least important with the average ratings of 6.38 and 6.11 respectively.

Table 11 Constrained Mean Ratings at Time One

Rankings	Values	Ratings Developed	Values	Ratings Developing
1	Education and Skills Training	8.02	Education and Skills Training	7.61
2	Health and Wellness	7.80	Health and Wellness	7.36
3	Robust Economy	7.23	Robust Economy	7.31
4	Civil Society	7.03	Capacity for Innovation	6.62
5	Capacity for Innovation	6.85	Civil Society	6.47
6	Environmental Sustainability	6.38	Environmental Sustainability	6.11

7.2.4 Time Two Comparison Between Developed and Developing Country Groups

Mean ratings of each social value at Time Two were compared between participants from Developed and Developing countries. The tested groups showed significant differences in the ratings of Health and Wellness (p=0.007) indicating that, at Time Two, the level of importance of the value was significantly higher for participants from developed countries (M=8.05) than these from developing countries (M=7.15).

The descriptive statistics shown in Table 12 indicated that, at Time Two, both groups rated similar ratings on Capacity for Innovation and Environmental Sustainability, and the importance of these two values were ranked the lowest comparing with the others. Participants from developed countries valued Health and Wellness the most important (M=8.05) whereas those from developing countries believed that Education Skills and Training was the most important (M= 7.66). Note that, on average,

the developing country group rated Robust Economy more important than Environmental Sustainability and Health and Wellness after the introduction of Economic Prosperity.

Table 12 Constrained Mean Ratings at Time Two

Rankings	Values	Ratings Developed	Values	Ratings Developing
1	Health and Wellness	8.05	Education and Skills Training	7.66
2	Education and Skills Training	7.95	Robust Economy	7.22
3	Civil Society	7.17	Health and Wellness	7.15
4	Robust Economy	6.97	Civil Society	6.64
5	Capacity for Innovation	6.97	Capacity for Innovation	6.58
6	Environmental Sustainability	6.60	Environmental Sustainability	6.42

The two values, Education and Skills Training and Health and Wellness, were rated the highest by both groups over time. Values of Capacity for Innovation and Environmental Sustainability were rated, on average, the least important by all subjects. Overall, values were rated in comparable orders over time and a significant mean difference had only been identified in the rating of Health and Wellness between the two groups. This finding suggests that both groups significantly maintained their value consistency by assigning similar ratings over time to the same values; it also suggests that participants did not intend to trade off or to change the importance of innovation and sustainability under the forced choice condition.

7.3 Difference Score Analysis

The difference scores between Time One and Time Two were calculated for all social values to reduce the Times factor in the Repeated Measures Analysis. Using one Within-Subject factor (Values) and two Between-Subject factors (Country Type and Constraint Conditions), a significant Three-Way interaction effect was identified. To better interpret the effects, mean difference scores were compared between the tested groups.

A mean plot of the difference scores (Figure 11) was included for each test. The plot primarily explains to what extend the value ratings have changed from Time One to Time Two.

7.3.1 Analysis by Country Types Under Unconstrained Condition

A t-test was used on the difference scores between the tested groups from developed and developing countries under the unconstrained condition, and no significant difference of mean ratings was identified.

Figure 11 Difference Score Plot Under Unconstrained Condition
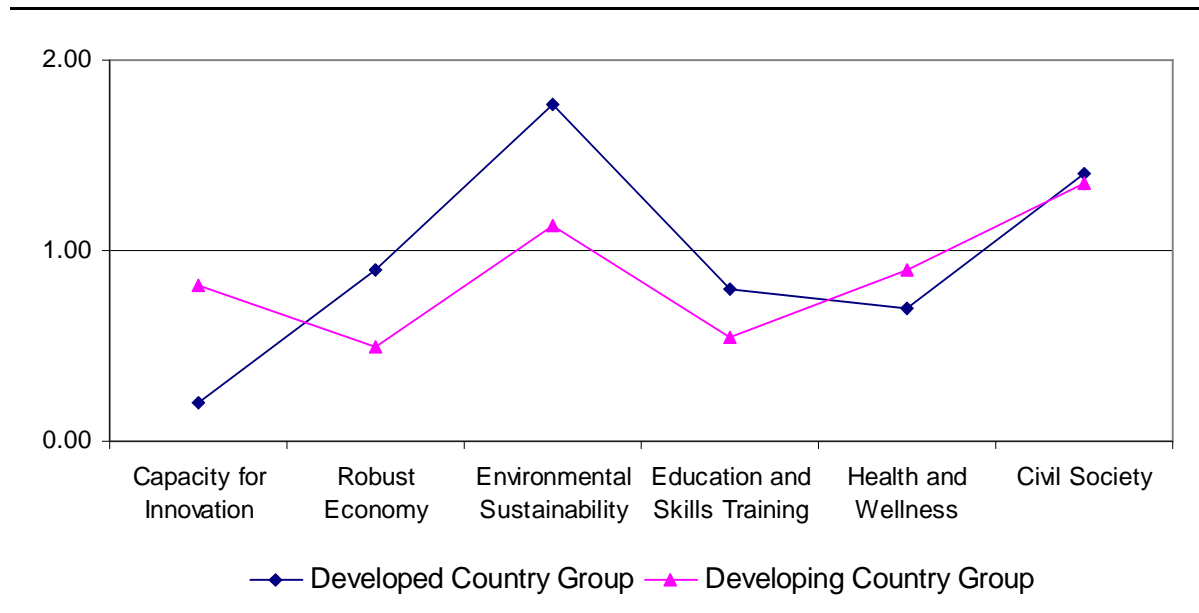
The overall insignificant difference implied that both groups had similar degrees of value changes from test to retest. The overall trend of the values is shown on Figure 11, it indicates that, for the developed country group, the importance levels of Capacity for Innovation (M=0.2), Robust Economy (M=0.9) and Health and Wellness (M=0.7) did not increase to the same extent, over time, as Environmental Sustainability (M=1.77) and Civil Society (M=1.4). On the other hand, for the developing country group, the levels of importance of Robust Economy (M=0.5), Education and Skills Training (M=0.54) increased much less than that of Environmental Sustainability (M=1.13) and Civil Society (M=1.36).

As stated in hypothesis 2, the change of importance level of Capacity for Innovation (M=0.81) for the developing country group was more than the developed country students (M=0.2); however, the importance level of Environmental Sustainability rated by the developed country group (M=1.77) increased more than that of the developing country group (M=1.13).

43

The mean plot of difference scores (Figure 12) for Capacity for Innovation (Value 1) and Environmental Sustainability (Value 2) was created under the unconstrained condition. It was found that the increase of Environmental Sustainability was significantly greater than that of Capacity for Innovation (p=0.002) which is predicted by hypothesis 1; this relationship was not found significant in the developing country group. The plot also shows that the change of value ratings moved in different directions for participants from developed countries, and it moved toward each other for participants from developing countries.

Figure 12 Unconstrained Difference Score Mean Plot
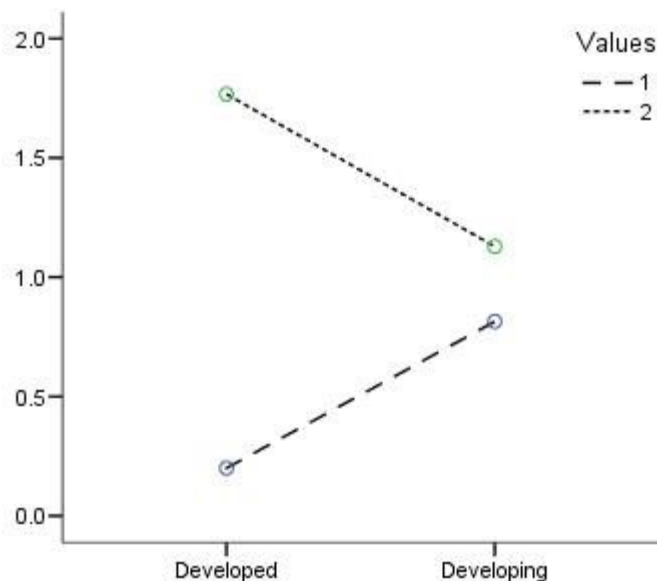
*Value 1 represents Capacity for Innovation and Value 2 represents Environmental Sustainability

7.3.2 Analysis by Country Types Under Constrained Condition

A t-test was conducted on the difference scores between the tested groups from developed and developing countries under the constrained condition. The statistics showed that there were no significant differences in the mean difference scores. Only Health and Wellness had a p-value (p=0.087) close to the 0.05 significance level.

Figure 13 Difference Score Plot Under Constrained Condition
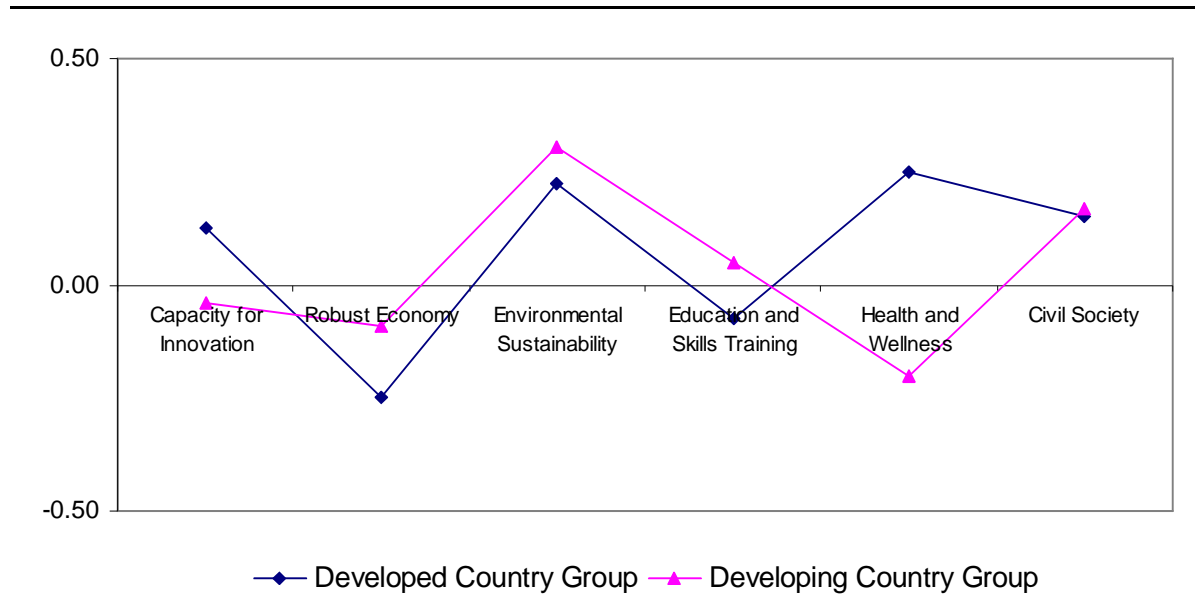
Even though no significant differences were identified between the difference scores of both groups, the above difference score mean plot (Figure 13) shows an overall trend for each value. As it is shown, for the developed country group, such values as Robust Economy (M=-0.25) and Education and Skills Training (M=-0.08) were downgraded to some extent so that Capacity for Innovation (M=0.13), Environmental Sustainability (M=0.23) and Health and Wellness (M=0.25) could become more important to their perceptions of national well-being. On the other hand, for the developing country group to realize the importance of Environmental Sustainability (M=0.31) and Civil Society (M=0.17) related to national well-being, as expected, the importance of values such as Capacity for Innovation (M=-0.04), Robust Economy (M=-0.09) and Health and Wellness (M=-0.2) were reduced.

Figure 14 highlights the means of difference scores of Capacity for Innovation and Environmental Sustainability. On the graph, Value 1 represents Capacity for Innovation and Value 2 represents Environmental Sustainability. As it is shown, under the constrained condition, the importance levels of these two values tended to move towards each other for the developed country group whereas the developing country group tended to have a change of value that moved in opposite directions

Figure 14 Constrained Difference Score Mean Plot
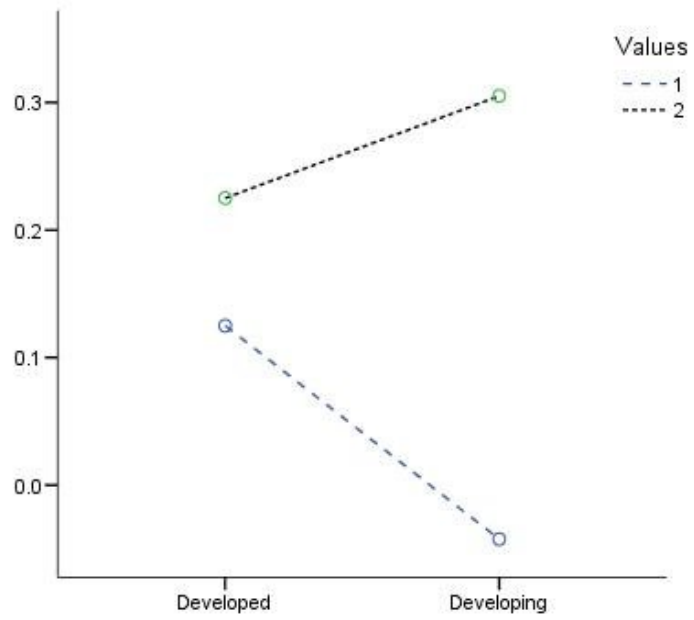
* Value 1 represents Capacity for Innovation and Value 2 represents Environmental Sustainability

Chapter 8

Analysis of Concern for Economic Prosperity

The participants were asked if they are concerned about the economic prosperity in their home country. In this chapter, they were divided into three groups: the group that believed that Economic Prosperity was a priority for developing national well-being, the group that believed it was not a priority but important and the group that was not concerned about economic prosperity in their home country.

Out of all participants (n=272), 91% of the participants from developed countries (n=70) and 99.5% of the participants from developing countries (n=188) believed economic prosperity should be concerned in developing national well-being. For participants from developed nations, 51.4% considered Economic Prosperity as a priority; 39.7% believed it was important but not a priority and 8.9% were not concerned about Economic Prosperity. For participants from developing nations, 78.7% considered Economic Prosperity as a priority; 20.8% believed it was important but not priority; and only 0.5% believed that Economic Prosperity was not concerned. These statistics suggested that economic prosperity is widely believed to be associated with the development of national well-being and it was as predicted concerned with greater attention in the developing nations. The tested groups are summarized in Table 13.

Table 13 Grouping by Opinion Toward Economic Prosperity

Country Type	Priority*	Important But Not Priority**	Not Concerned
Developed Country	51.40%	39.70%	8.90%
Developing Country	78.70%	20.80%	0.50%

*Participants who considered economic prosperity as a priority. **Participants who believed economic prosperity was important but not priority

This section intended to locate value changes in the three tested groups by using statistical t-tests. The simple size of participants who were not concerned about Economic Prosperity was very limited, therefore, this analysis primarily focused on the other two groups.

8.1 Value Change Over Time

8.1.1 Unconstrained Condition

No significant value changes occurred over time in the developed country group who believed Economic Prosperity was a priority, though significant differences occurred in Environmental Sustainability (p=0.009) and Civil Society (p=0.016), in the developed country group who believed Economic Prosperity was not a priority.

Value changes also occurred among participants from developing nations who believed Economic Prosperity as a priority in such values as Capacity for Innovation (p=0.009), Environmental Sustainability (p=0.004), Health and Wellness (p=0.001) and Civil Society (p=0.001); participants from developing nations who believed Economic Prosperity was not a priority did not demonstrate any value changes in these values over time.

8.1.2 Constrained Condition

No significant value changes were identified over time between both groups under the constrained condition.

For all participants (from both country groups) who believed Economic Prosperity was a priority, there was no significant rating difference over time; and no significant value changes were identified for participants (from both country types) who believed Economic Prosperity was not a priority.

8.1.3 Section Summary

The findings this section showed that value changes were more likely to occur under the unconstrained condition in which values were allowed to interchange. Participants who had significant value changes from developed countries believed that Economic Prosperity should not be concerned in improving national well-being, and participants from developing countries who had significant value differences considered Economic prosperity as a priority. The following table summarizes the value rating differences in each tested group.

Table 14 Summary of Section Findings

Country Type	Priority*	Important But Not Priority**
Developed Country Group	No Significant Value Changes	Environmental Sustainability Civil Society
Developing Country Group	Capacity for Innovation Environmental Sustainability Civil Society	No Significant Value Changes

*Participants who considered economic prosperity as a priority. **Participants who believed economic prosperity was important but not priority

8.2 Difference Score Analysis

8.2.1 Unconstrained Condition

A t-test was applied to identify mean differences between the tested groups from each country type. With the unconstrained condition, the only significant difference among participants from developed countries occurred in the ratings of Environmental Sustainability (p=0.05), the group that believed Economic Prosperity was not a priority had a greater positive value change, it may indicate that people whose basic needs have been consistently satisfied have a greater demand for higher level needs such as environmental sustainability. Shown in Table 15, the value change trend was mostly the same except Capacity for Innovation where a reverse trend took place between the two groups, the group that considered Economic Prosperity as a priority increased their ratings, whereas the other group downgraded the average rating of Capacity for Innovation as the hypothesis 4 predicted.

Table 15 Unconstrained Group Statistics for the Developed Country Group

Developed Unconstrained	Groups*	Mean**	Std. Deviation
Capacity for Innovation	1	.3889	1.57700
	2	-.3636	2.61812
Robust Economy	1	1.1111	2.05480
	2	.4545	2.06706
Environmental Sustainability	1	1.1667	1.42457
	2	2.7273	2.68667
Education and Skills Training	1	.5000	1.29479
	2	1.3636	1.68954
Health and Wellness	1	.6667	1.68034
	2	.7273	2.24013
Civil Society	1	1.0556	1.98442
	2	1.8182	2.35874

* Group 1 represents participants who believed Economic Prosperity was a priority; group 2 represents these who believed Economic Prosperity was important but not a priority. **The mean value was derived by taking the difference of ratings from Time One and Time Two.

For participants from developing countries (Table 16), the only significant difference occurred in the rating of Civil Society (p=0.09), where these who believed Economic Prosperity was a priority increased the importance of civil Society over time. All other values had the positive increasing trends. Statistical outputs are summarized in Table 15 and Table 16. Group 1 represents participants who believed Economic Prosperity was a priority; group 2 represents these who believed Economic Prosperity was important but not a priority. The mean value was derived by taking the average of the difference of ratings from Time One and Time Two in each group.

Table 16 Unconstrained Group Statistics for the Developing Country Group

Developing Unconstrained	Groups*	Mean**	Std. Deviation
Capacity for Innovation	1	1.0612	1.96223
	2	.2941	2.33893
Robust Economy	1	.6327	1.93320
	2	.1765	2.32474
Environmental Sustainability	1	1.3469	1.99532
	2	.5294	1.46277
Education and Skills Training	1	.6327	1.92239
	2	.1765	1.84510
Health and Wellness	1	1.1020	1.79403
	2	.3529	2.59666
Civil Society	1	1.8776	2.43783
	2	.0000	2.52488

* Group 1 represents participants who believed Economic Prosperity was a priority; group 2 represents these who believed Economic Prosperity was important but not a priority. **The mean value was derived by taking the difference of ratings from Time One and Time Two.

Overall, participants who believed Economic Prosperity is the priority showed a significantly higher value increase in Capacity for Innovation than those who did not (p=0.03), and the value increases from both groups on Environmental Sustainability were not significantly different (Hypothesis 3).

8.2.2 Constrained Condition

A t-test was applied to identify mean differences between the tested groups from each country type. The developed country group, under the constrained condition, showed a significant difference in the difference scores of Health and Wellness (p=0.05) between participants who believed economic prosperity as a priority and who did not believe so (Table 17), which indicated these two groups had opposite value preferences over Health and Wellness. Participants who believed Economic Prosperity was not a priority had a significant positive change in the value rating (M=0.56), while these who believed it was a priority had a negative value change (M=-0.06). In Table 17, Group 1 represents participants who believed Economic Prosperity was a priority; group 2 represents these who believed Economic Prosperity was important but not a priority. The mean value was derived by taking the average of the difference of ratings from Time One and Time Two in each group.

Table 17 Constrained Group Statistics for the Developed Country Group

Developed Constrained	Groups*	Mean**	Std. Deviation
Capacity for Innovation	1	.3125	.87321
	2	-.1250	2.15639
Robust Economy	1	-.0625	.85391
	2	-.4375	1.45917
Environmental Sustainability	1	.0625	.92871
	2	.2500	1.43759
Education and Skills Training	1	-.1875	1.55858
	2	-.2500	1.12546
Health and Wellness	1	-.0625	.85391
	2	.5625	.89209
Civil Society	1	.1875	.83417
	2	.5000	1.36626

* Group 1 represents participants who believed Economic Prosperity was a priority; group 2 represents these who believed Economic Prosperity was important but not a priority. **The mean value was derived by taking the difference of ratings from Time One and Time Two in each group.

No significant difference was identified among participants from developing countries (Table 18), which implied that the value changes of the developing country participants may have followed similar patterns over time. Statistical outputs are summarized in Table 18. Group 1 represents participants who believed Economic Prosperity was a priority; group 2 represents these who believed Economic Prosperity was important but not a priority. The mean value was derived by taking the average of the difference of ratings from Time One and Time Two in each group.

Table 18 Constrained Group Statistics for the Developing Country Group

Developing Unconstrained	Groups*	Mean**	Std. Deviation
Capacity for Innovation	1	-.0421	1.54311
	2	-.0952	1.04426
Robust Economy	1	-.0105	1.34081
	2	-.2381	1.57812
Environmental Sustainability	1	.3263	1.96481
	2	.3333	1.77012
Education and Skills Training	1	.0737	1.37796
	2	.0000	1.00000
Health and Wellness	1	-.2842	1.66096
	2	.0952	1.22085
Civil Society	1	.1474	1.65007
	2	.0476	1.32198

* Group 1 represents participants who believed Economic Prosperity was a priority; group 2 represents these who believed Economic Prosperity was important but not a priority. **The mean value was derived by taking the difference of ratings from Time One and Time Two.

Chapter 9
Conclusion and Discussion

9.1 Implication of the Study

This study has several implications regarding people's perceptions in social values in the developed and developing countries.

9.1.1 Value Consistency

The desire for personal consistency is one of the most basic human motives (Gawronski and Strack 2003); research have found that people change their personal attitudes, behaviours or the personal importance of an attitude object in order to achieve a state of cognitive consistency (Festinger 1957, Festinger and Carlsmith 1959). The findings of this study confirmed this theory that people tend to maintain their personal consistency.

Under the unconstrained condition, the value ratings significantly shifted upwards from test to retest (Section 7.1) following similar increase pattern, this finding indicates that the importance level of a social value against the others remained the same over time (Figure 3, Figure 5)

Under the constrained condition, it was found that both groups did not raise the value ratings as a result of the survey instrument and there was little evidence of a trade-off (Section 7.2). It indicates that there was a strong resistance from participants to change their current value system. Moreover, this study finds that environmental sustainability was consistently perceived as the least important on the value ladder by participants from both developed and developing countries, this rating was not changed after the economic prosperity manipulation.

Therefore, we conclude that it is very difficult to change people's perceptions on certain social values against competing values; instead people tend to keep the importance levels of values at a constant. Even in situations where greater importance is assigned to environmental sustainability, people would not trade off other values and would raise them to a corresponding level.

9.1.2 Direction of Value Change

The Rokeach (1973) Value Change Instrument studied the perceptions of 18 personal values using a ranking method which restrained the ability of participants to shift value ratings and forced value changes to take different directions, whereas the rating method used in this research allowed value

54

ratings to change with both free choice and forced choice options, thus, it permitted value change in both positive or negative directions.

The average levels of importance of the social values have generally gone up by 0.96 for participants from developed countries and 0.88 for those from developing countries. The significant overall positive value change indicates that this study has been effective in enhancing participants' understanding or awareness of the level of importance of these social values on national well-being. It also indicates that a self-dissatisfaction was created by the economic prosperity manipulation and the introduction of the Study One results.

9.1.3 Value Change and Education

Rokeach (1973) concluded that, as a result of his survey treatments, the experimental groups had undergone long-term increases in the importance they attached to the two values, equality and freedom and that the increases in freedom rankings in all groups are without exception smaller than the equality increases. This study can reasonably conclude that participants have raised the importance they attach to Capacity for Innovation and Environmental Sustainability as a result of the Global Representative Value Change Survey. However, it is unknown if the value change can be a long-term effect without follow up studies in the future.

The increase in ratings of Capacity for Innovation was much smaller among the participants from developed countries than those from developing countries, whilst the increase in Environmental Sustainability is greater for the developed country group than the developing country group (Section 7.3).

An important implication is that citizens in the two different types of countries have different value preferences when facing value trade-offs. Therefore, it would be very important for the governments and educators of these countries to understand how their citizens perceive difference policies and programs towards such social values and to design policies and programs that tally with the general value preferences, and simply adopting policies of others may not work.

9.1.4 Effects of the Forced Choice Setting

The fact that significant value increases were found under the unconstrained condition indicates that rating increases were influenced by the rating system, in which room has been given to participants to amplify their ratings after the introduction of economic prosperity manipulation. The rating method

used in this study allowed value changes in the same directions, for example, participants may choose to increase or decrease importance of all values. It offered more freedom to change value ratings than Rokeach (1973) survey where the ranking method forced value change to take place in both positive and negative directions.

The study found that all participants tend to believe that these social values are important to the national well-being in their home country, and they tend to rather maintain their personal consistency by rating the values at the same importance level over time, than increase certain values by devaluing others. This indicated that the self-dissatisfaction created by the survey instrument was not effective to generate value changes under the constrained condition.

Under the unconstrained condition, the study found that all participants tend to raise their value ratings over time on all social values. Given the free choice rating option, the survey instrument effectively identified a contradiction between self-conceptualization and terminal values and induced value changes among the unconstrained group.

9.2 Summary of Major Findings

As described above, significant value changes were found mainly under the unconstrained condition and very few under the constrained condition. The following table summarizes the major findings under the unconstrained condition.

Table 19 Summary of Major Findings

Hypothesis	Description of Hypothesis	Findings of the Study
1 (Developed Country)	Time One: ES* is rated more important than CFI* Time Two: Change of ES is greater than that of CFI, and greater than that of ES rated by Developing Country Group	Time One: Not Supported Time Two: Supported (Significant)
2 (Developing Country)	Time One: CFI is rated more important than ES Time Two: Change of ES is greater than that of CFI, and less than that of ES rated by Developed Country Group	Time One: Trend found (Not Significant) Time Two: Trend found (Not Significant)
3 (Economic Prosperity)	Group 1*: Increase in CFI is greater than Group 2 Group 2*: Increase in ES is greater than Group 1	Group 1: Supported (Significant) Group 2: Trend found (Not Significant)
4 (Rating Methods)	Constrained: Less effective in creating change Unconstrained: More effective in creating change	Constrained: Supported (Significant) Unconstrained: Supported (Significant)

* ES stands for environmental sustainability; CFI stands for capacity for innovation; EP stands for economic prosperity; Group 1 represents participants who believe EP is the priority, Group 2 represents EP is not priority.

9.3 Limitations

The limitations in this study include:

1. Sample size. The participants in both surveys were students from the University of Waterloo. Although the total simple size reached to 276, it was a proportionally small group of the target population, which led to limitations in generalizing the survey findings.

2. Sample location. The University of Waterloo has a reputation for strengths in innovation, more so than its reputation for strengths in sustainability. Its students may be influenced by their experience in the innovation-focused environment and biased towards that.

3. Interpretation of the study. Subjects participated in the study may interpret the definitions of values or the purpose of this study differently and may, therefore, deviate from the original objective of the study.

4. Demographics of participants. The participants possess certain attributes that may not apply to other citizens in their home country. For example, factors such as profession,

overseas experience, income level may encourage them to rate differently than the citizens in the home country. Therefore, the survey results may not be absolutely error free as their value preference may be tilted by the demographics. Furthermore, living in Canada may have changed the values of students from other countries and they may no longer represent their home country.

5. Value change may not be genuine. Researchers have argued that a value change may be a result of methodological artefacts arising from demand characteristics, evaluation apprehension, or experimenter bias (Orne 1962, Rosenberg 1965, Rosenthal and Rosnow 1969). The significant findings of this study may be due to the manipulations used in the survey instrument and may not be permanent. Follow up research should be conducted in the future to validate these findings.

9.4 Future Research

A number of areas for future research are suggested by the findings and the experience of conducting this research.

Value change in under-developed countries is an important and urgent phenomenon to better understand how people perceive social values associated with national well-being, such as innovation and sustainability. Such study may provide insight for decision makers to better recognize value preferences by the general public in these countries, and may improve the quality of policy making in these countries.

Follow on research as to whether the value change has a long-term effect will be required to determine if the changes endure for innovation and sustainability as long as changes Rokeach found for freedom and equality. This should provide further implications in educational and political policy making.

Extended studies in perceptions of intergenerational justice may be of interest, and may include finding out if participants perceive themselves as the last generation to enjoy unconstrained energy consumption or the first generation to implement new limitations imposed by a sustainable environment. Such findings may mark the ending of one social value trend and the beginning of another.

Research into people's perceptions of innovation, sustainability and technology development trends may provide not only valuable insight for policy makers to design successful policies but also

important marketing information for corporations to better plan future technological development model and may provide insights to direct R&D investment.

Further research in why environmental sustainability was consistently rated very low on the value ladder in all targeted types of countries may provide a practical bottom-up approach to elevate the perceived importance of the value with public mass acceptance.

A study of participant dispiration would be useful to help understand whether the participants in this study were atypical of their "national perspectives" on innovation and sustainability, this could arise because of self-selection (to attend one of Canada's most innovative universities) or because of situational learning and exposure to extreme perspectives in the university context.

Future research may be conducted on what it takes, at this defining moment in an innovation-sustainability crisis, to locate a "trigger" for humankind's awareness of this situation and to mobilize massive action. It might consider what the consequences are if this crisis remains divisive, prolonged, and unmanageable.

Appendix A

Management Sciences Graduate Student Survey

Introduction: Thank you for your participation. As you begin, please think of yourself as a graduate student at a university in your home country. Please provide the name of the country and whether you perceive your country as developed, developing or under-developed economically. Your participation is greatly appreciated!

- Country of origin:

(If you were not raised in your country of origin, please put the country where you were raised)

- Please highlight one of the following categories for your country:

☐ Developed country

☐ Developing country

☐ Under-developed country

- Number of years spent in countries other than your country of origin:

➢ Your task is to list two to five values that you feel are important to NATIONAL WELL-BEING OF YOUR HOME COUNTRY and then to rate each in an order of their importance to you as a student at a university in your home country. Next, evaluate the importance of the seven values given in the following table.

Table of Values related to National Well-being

Please list the two to five additional values in the corresponding blank cells and put your rating at a proper location on the dashed line that reflects the importance of the value related to national well-being. For example, given a value that you feel is the most important to national well-being, you should put 5 at the right-end of the dashed line under "Important", which indicates your rating of the value is the highest. If you feel that value is not related to national well-being, please put its 0 in the corresponding "Indifferent" cell.

Rating / Values	Unimportant -5 -4 -3 -2 -1	Indifferent 0	Important 1 2 3 4 5
Innovation	--- --- --- --- ---		--- --- --- --- ---
Economy	--- --- --- --- ---		--- --- --- --- ---
Environment	--- --- --- --- ---		--- --- --- --- ---
Education and skills	--- --- --- --- ---		--- --- --- --- ---
Health	--- --- --- --- ---		--- --- --- --- ---
Society	--- --- --- --- ---		--- --- --- --- ---
Sustainability	--- --- --- --- ---		--- --- --- --- ---
	--- --- --- --- ---		--- --- --- --- ---
	--- --- --- --- ---		--- --- --- --- ---
	--- --- --- --- ---		--- --- --- --- ---
	--- --- --- --- ---		--- --- --- --- ---
	--- --- --- --- ---		--- --- --- --- ---

Now we are interested in knowing how you feel about the way you rated the values. Please indicate one number on the following scale:

1	2	3	4	5	6	7	8	9	10	11

I care very
much about
the rating

I do not care
much about
the rating
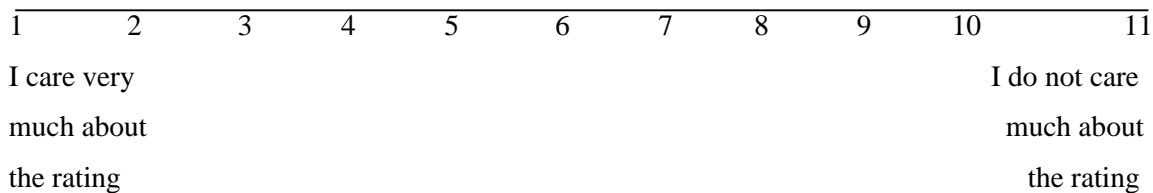
I would like to introduce some definitions for two of the values above:

Innovation: A process through which economic or social value is extracted from knowledge – through the **creation**, **diffusion** and **transformation** of knowledge to produce new or significantly improved products or processes that are put to **use** by society.

A robust measure of innovation is the share of revenue from new or significantly improved goods or services. (Conference Board of Canada)

Sustainability: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (The United Nations)

In order to make this study more meaningful and relevant to you personally, please answer honestly the following question on economic prosperity:

Are you concerned about the economic prosperity of your home country? (Please highlight your choice of answer)

      A. Yes and I think it is the priority for developing national well-being.

      B. Yes, but I do not think it is the priority for developing national well-being.

      C. No

Do you have any comments you wish to make about this study? Please comment below. Remember, everything in this questionnaire is absolutely confidential and to be used only for scientific purposes.

      Thank you for your cooperation.

Appendix B
Global Representative Value Change Survey

<u>Introduction</u>: Thank you for agreeing to participate in our study. As you begin, please think of yourself as a student at a university in your home country. Please indicate whether you perceive your country as developed, developing or under-developed economically. Your participation is greatly appreciated!

- Please select one of the following categories for your country:

  ☐ Developed country
  ☐ Developing country
  ☐ Under-developed country

Part 1

1.1 Please consider the following six value terms and their definition:

-Capacity for Innovation-

This is a focus on the process through which economic or social value is extracted from knowledge — through the creation, diffusion and transformation of knowledge to produce new or significantly improved products or processes that are put to use by society. A robust measure of innovation is the share of revenue from new or significantly improved goods or services.

-Robust Economy-

This is a focus on controlling inflation and unemployment, fostering gross domestic product (GDP) growth, labour productivity growth, GDP per capita, outward foreign direct investment (FDI), and inward FDI.

-Environmental Sustainability-

This is a focus on the quality of air, water, biodiversity, land and mitigation on climate change. It seeks development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

-Access to Education and Skills Training-

This is a focus on education systems at all levels, including: secondary, university, post-graduate and doctorial levels. Among the indicators are: reading literacy, math literacy, problem-solving proficiency.

-Health and Welfare-

This is a focus on reducing death rates from influenza and pneumonia, but also the public's perception of health status, life expectancy, premature mortality, the suicide rate and death from chronic diseases such as cancer, circulatory diseases and respiratory disease.

-Civil Society-

This is a focus on reducing child poverty and poverty among the working age population, poverty among elders, crime, rate of homicides, assaults and burglaries, while also increasing social cohesion (participate in communities, how they feel about their lives and communities), voter turnout and trust in political institutions, and social spending as a percentage of GDP.

➢ Your task in this part is to rate the following six values they relate to national well-being. Please do this by considering to your home country such that you choose 5 if you think the value is very important to NATIONAL WELL-BEING, or you choose (-5) if you think the value is very unimportant. Feel free to use any point on the 11-point scale to reflect your opinions.
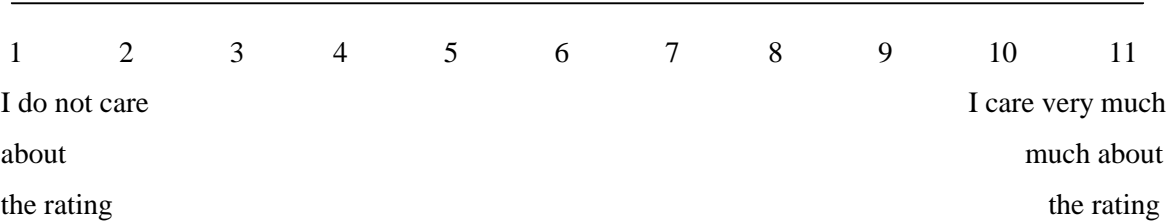
Table I. Values Related to National Well-being

Now please rate the following six values in terms of their importance to the NATIONAL WELL-BEING to your home country, please use the same rating only once:

Rating / Values	Very Unimportant -5 -4 -3 -2 -1	Neutral 0	Very Important 1 2 3 4 5
Capacity for Innovation	--- --- --- --- ---		--- --- --- --- ---
Robust Economy	--- --- --- --- ---		--- --- --- --- ---
Environmental Sustainability	--- --- --- --- ---		--- --- --- --- ---
Education and Skills Training	--- --- --- --- ---		--- --- --- --- ---
Health and Wellness	--- --- --- --- ---		--- --- --- --- ---
Civil Society	--- --- --- --- ---		--- --- --- --- ---

1.2

Now we are interested in knowing how you feel about the way you rated the values. Please indicate one number on the following scale:

_____

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

I do not care
about
the rating

I care very much
much about
the rating

Part 2

The same survey was filled out by a group of graduate students at a Canadian university. The average ratings of Capacity for Innovation and Environmental Sustainability were obtained and aggregated together, the table below shows the results.

Table I.

Average Rating Based on Economy Type		
	Economy Type A	**Economy Type B**
Capacity for Innovation	*Low*	*High*
Environmental Sustainability	*High*	*Medium*

Note that one of the interesting findings shown in the table is that the students from Economy Type A, on the average, rated environmental sustainability more important than capacity for innovation, while students from Economy Type B felt that capacity for innovation is more important than environmental sustainability.

This suggests that students from some economies concerned less about economic growth and more about sustaining the capability to meet future needs. Moreover, students from other economies tend to perceive the reverse.

Feel free to spend a few minutes comparing your own ratings with those of the Canadian graduate students.

2.1

In order to gauge this study's relevance to you personally, please answer honestly the following question on economic prosperity:

Are you concerned about the economic prosperity of your home country?

      Yes, and I think it is the priority for developing national well-being.

      Yes, but I do not think it is the priority for developing national well-being.

      No

A group of Canadian graduate students were asked this same question. They were divided into two groups according to how they responded. Table II shows the average ratings of Capacity for Innovation and Environmental Sustainability for each of these two groups.

Table II.

Average Rating Based on the Choice of Economic Prosperity		
	Economic Prosperity IS a Priority	**Economic Prosperity is NOT a Priority**
Capacity for Innovation	*High*	*Low*
Environmental Sustainability	*Low*	*High*

2.2

The table above shows that people who give priority to economic prosperity rate Capacity for Innovation higher than Environmental Sustainability and people who do not give priority to economic prosperity rate Environmental Sustainability higher than Capacity for Innovation. An interpretation may be that people who give priority to economic prosperity tend to focus on Short Term cost benefit and people who do not give priority to economic prosperity tend to focus on Long Term cost benefit.

What do you think of the above interpretation?

1	2	3	4	5	6	7	8	9	10	11
I disagree with this interpretation					I'm not sure					I agree with this interpretation

2.3

We are now interested to find out how you feel about this study.
Did you find it thought-provoking?

1	2	3	4	5	6	7	8	9	10	11
Not at all thought-provoking										Very Though-provoking

2.4

Do you think this technique will lead you to do more thinking about your own values?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Not at all   Very much

2.5

How satisfied do you feel about the way you have rated the values?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Very Dissatisfied   Very Satisfied

2.6

Now please reflect your own ratings for a moment, which ratings do you feel satisfied or dissatisfied with?

Values	Satisfied(Y/N)	Values	Satisfied(Y/N)
Capacity for Innovation		Education and skills	
Robust Economy		Health and Wellness	
Environment Sustainability		Civil Society	

2.7

Please re-rate the values in the following list:

| Rating ⟍ Values	Unimportant -5 -4 -3 -2 -1	Indifferent 0	Important 1 2 3 4 5
Capacity for Innovation	--- --- --- --- ---		--- --- --- --- ---
Robust Economy	--- --- --- --- ---		--- --- --- --- ---
Environment Sustainability	--- --- --- --- ---		--- --- --- --- ---
Education and skills	--- --- --- --- ---		--- --- --- --- ---
Health and Wellness	--- --- --- --- ---		--- --- --- --- ---
Civil Society	--- --- --- --- ---		--- --- --- --- ---

2.8

Are there additional values that you think are important to National Well-Being? Please list them in the following textbox.

Do you have any comments you wish to make about this study? Please comment below. Remember, everything in this questionnaire is absolutely confidential and to be used only for scientific purposes.
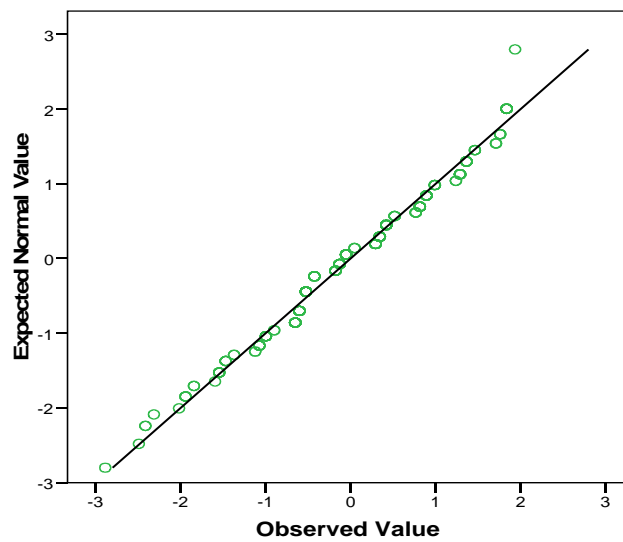
Appendix C

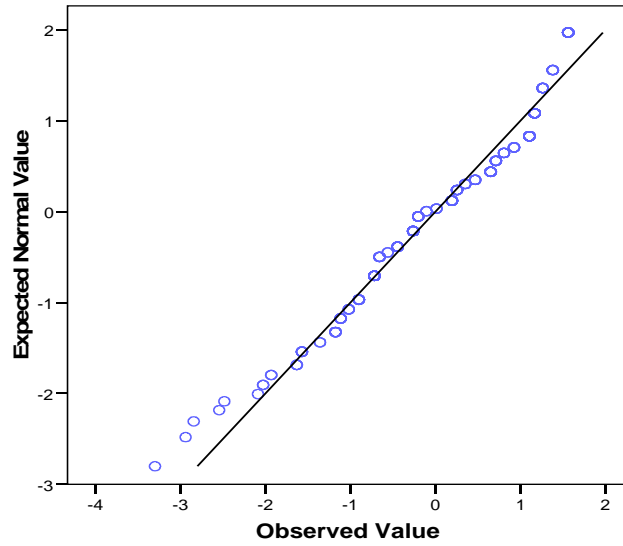# Normality Assumption: Sample Plots of Standardized Residual

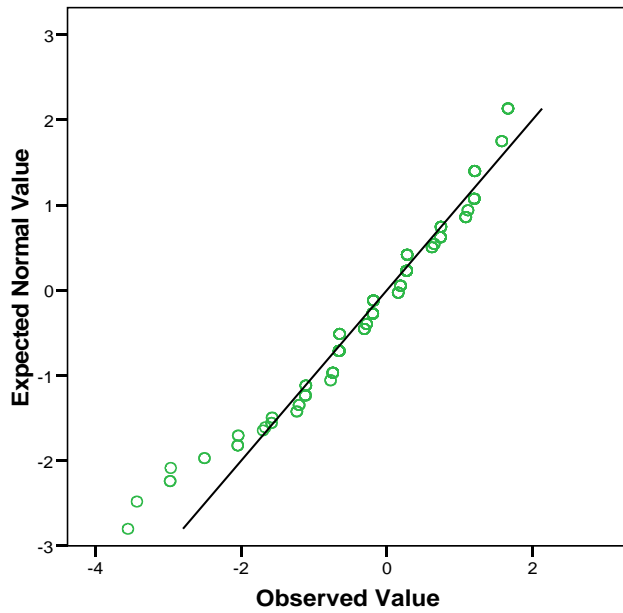**Normal Plot of Standardized Residual for Capacity for Innovation at Time One**
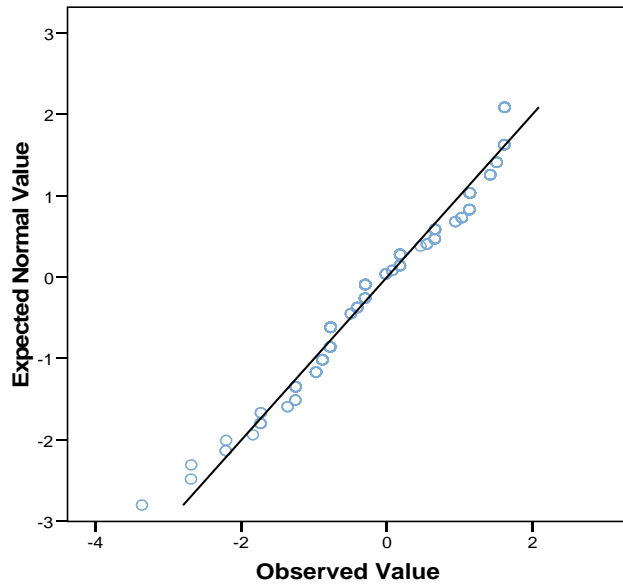
Normal Plot of Standardized Residual for Environmental Sustainability at Time One

Normal Plot of Standardized Residual for Capacity for Innovation at Time Two

Normal Plot of Standard Residual for Environmental Sustainability at Time Two

Bibliography

Abramson, P. R., Ellis, S., & Inglehart, R. (1997). Research in context: Measuring value change. *Political Behavior, 19*(1), 41-59.

Allison, P. D. (1990). Change scores as dependent variables in regression analysis. *Sociological Methodology, 20*, 93-144.

Allport, G. W. (1961). *Pattern and growth in personality*. New York: Holt, Rinehart and Winston.

Alwin, D. F., & Krosnick, J. A. (1985). The measurement of values in surveys: A comparison of ratings and rankings. *The Public Opinion Quarterly, 494*(4), 535-552.

Beloff, B., Tanzil, D., & Lines, M. (2004). Sustainable development performance assessment. *Environmental Progress, 23*(4), 271-276.

Campbell, S. (1996). Green cities, growing cities, just cities? Urban planning and the contradiction of sustainable development. *Journal of the American Planning Association, 62*(3), 296-312.

Clarke, H. D., & Dutt, N. (1991). Measuring value change in western industrialized societies: The impact of unemployment. *American Political Science Review, 85*(3), 905-920.

Clarke, H. D., Dutt, N., & Rapkin, J. (1997). (Mis)measuring value change: A brief postscript. *Political Behavior, 19*(1), 60-63.

Clarke, H. D., Kornberg, A., McIntyre, C., Bauer-Kaase, P., & Kaase, M. (1999). The effect of economic priorities on the measurement of value change: New experimental evidence. *American Political Science Review, 93*(3), 637-647.

Collier, R. O., & Baker, F. B. (1963). The randomization distribution of F-ratios for the splitplot design: an empirical investigation. *Biometrika, 50*(3 and 4), 431.

Festinger, L. (1957). *A theory of cognitive dissonance*. Evanston, IL: Row, Perterson & Company.

Freeman, C. (1996). The greening of technology and models of innovation. *Technological Forecasting and Social Change, 53*, 27-39.

Freeman, C. (1995). The national system of innovation in historical perspective. *Cambridge Journal of Economics, 19*, 5-24.

Gawronski, B., & Strack, F. (2004). On the propositional nature of cognitive consistency: Dissonance changes explicit, but not implicit attitudes. *Journal of Experimental Social Psychology, 40*(4), 535-542.

Hart, S. L., & Milstein, M. B. (1999). Global sustainability and the creative destruction of industries. *Sloan Management Review, 41*(1), 23-33.

Haughton, G. (1999). Environmental justice and the sustainable city. *Journal of Planning Education and Research, 18*(2), 233-243.

Hellström, T. (2006). Dimensions of environmentally sustainable innovation: The structure of eco-innovation concepts. *Sustainable Development, 15*(3), 148-159.

Hill, T., & Lewicki, P. (2007). *STATISTICS methods and applications*. Tulsa, OK.: StatSoft.

Huesemann, M. H. (2003). The limits of technological solution to sustainable development. *Clean Technology and Environmental Policy, 5*, 21-34.

Inglehart, R., & Abramson, P. R. (1994). Economic security and value change. *American Political Science Review, 88*(2), 336-354.

Jackson, D. J., & Alwin, D. F. (1980). The factor analysis of ipsative measures. *Sociological Methods and Research, 9*(2), 218-238.

Keselman, H. J.; Huberty, C. J.; Lix, L. M.; Olejnik, S.; Cribbie, R. A.; Donahun, B.; Kowalchuk, R. K.; Lowman, L. L.; Petoskey, M. D.; Keselman, J. C.; Levin, J. R. (1998). Statistical practices of educational researchers: An analysis of their ANOVA, MANOVA and ANCOVA analyses. *Review of Educational Research, 68*(3), 350-386.

Klepper, G., & Stähler, F. (1998). Sustainability in closed and open economies. *Review of International Economics, 6*(3), 488-506.

Lindman, H. R. (1974). *Analysis of variance in complex experimental designs*. San Francisco: W.H. Freeman & Co.

Lunney, G. H. (1970). Using analysis of variance with A dichotomous dependent variable: An empirical study. *Journal of Educational Measurement, 7*(4), 263-269.

Marsh, A. A., Elfenbein, H. A., & Ambady, N. (2003). Nonverbal "accents": Cultural differences in facial expressions of emotion. *Psychological Science: A Journal of the American Psychological Society / APS, 14*(4), 373-376.

Maslow, A. H. (1943). *A theory of human motivation. Psychological Review, 50*(4), 370-396.

Miller, G. A. (1994). The magical number seven, plus or minus two: Some limits on our capacity for processing information. 1956. *Psychological Review, 101*(2), 343-352.

Monfort, J. (2008). *Oil consumption continues slow growth.* Worldwatch Institute.

Montgomery, D. C. (2005). *Design and analysis of experiments* (6th ed.) John Wiley & Sons, Inc.

Moran, D. D., Wackernagel, M., & Kitzes, J. A. (2008). Measuring sustainable development - nation by nation. *Ecological Economics, 64*(2), 470-474.

Mulder, P., & Van Den Bergh, J. C. J. M. (2001). Evolutionary economic theories of sustainable development. *Growth and Change, 32*(1), 110-134.

Neill, J. (2008). Research methods and design in psychology.

O'Donnell, W. G. (1951). The theory of value in social science. *The American Journal of Economics and Sociology, 10*(4), 333-344.

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist, 17*(11), 776-783.

Patel, P., & Pavitt, K. (1994). The nature and economic importance of national innovation systems. *STI Review, 14,* OECD, Paris

Pearce, D., & Atkinson, G. (1993). Capital theory and the measurement of sustainable development: An indicator of "weak" sustainability. *Ecological Economics, 8*(2), 103-108.

Perry, F. L. (2005). *Research in applied linguistics: Becoming a discerning consumer* Lawrence Erlbaum Associates.

Pope, J., Annandale, D., & Morrison-Saunders, A. (2004). Conceptualising sustainability assessment. *Environmental Impact Assessment Review, 24*(6), 595-616.

Rokeach, M. (1979). From individual to institutional values: With special reference to the values of science. In M. Rokeach (Ed.), *Understanding human values* (pp. 47-70). New York: The Free Press.

Rokeach, M. (1973). *The nature of human values*. New York: The Free Press.

Rokeach, M. (1967). *Value survey*. Sunnyvale, Calif.: Halgren Tests.

Rokeach, M., & Cochrane, R. (1972). Self-confrontation and confrontation with another as determinants of long-term value change. *Journal of Applied Social Psychology, 2*(4), 283-292.

Rosenberg, M. J. (1965). When dissonance fails: On eliminating evaluation apprehension from attitude measurement. *Journal of Personality and Social Psychology, 1*(1), 28-42.

Rosenthal, R., & Rosnow, R. L. (1969). *Artifact in behavioral research*. New York: Academic Press.

Schumpeter, J. A. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press.

Smits, R. (2002). Innovation studies in the 21st century: Questions from a user's perspective. *Technological Forecasting and Social Change, 69*(9), 861-883.

Steckler, M., & Oleson, K. (2005). *The basics of SPSS.* http://academic.reed.edu/psychology/RDDAwebsite/spssguide/spsshome.html

The Conference Board of Canada. (2007). *How Canada performs: A report card on Canada*

Thompson, R., & Green, W. (2005). When sustainability is not a priority: An analysis of trends and strategies. *International Journal of Sustainability in Higher Education, 6*(1), 7-17.

Tuzlak, A., & Moore, J. C. Jr. (1984). Status, demeanor and influence: An empirical reassessment. *Social Psychology Quarterly, 47*(2), 178-183.

United Nations. (1992). *Agenda 21: The United Nations programme of action on sustainable development.* New York: United Nations.

van Deth, J. W. (1983). The persistence of materialist and post-materialist value orientations. *European Journal of Political Research, 11*(1), 81-91.

Vickers, A. J. (2005). Analysis of variance is easily misapplied in the analysis of randomized trials: A critique and discussion of alternative statistical approaches. *Psychosomatic Medicine, 67*(4), 652-655.

WCED. (1987). *Our common future, report of the world commission on environment and development.* World Commission on Environment and Development.

Williams, R. M. Jr. (1979). Change and stability in values and value systems: A sociological perspective. In M. Rokeach (Ed.), *Understanding human values - individual and societal* (pp. 15-46). New York: The Free Press.

Wilson, J., Tyedmers, P., & Pelot, R. (2007). Contrasting and comparing sustainable development indicator metrics. *Ecological Indicators, 7*(2), 299-314.