Economic Value of Standardization

Submitted to the Standards Council of Canada
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Acronyms

CFIA	Canadian Food Inspection Agency
CHA	Canadian Hockey Association
CME	Canadian Manufacturers and Exporters Association
CSA	Canadian Standards Association
DIN	Deutsches Institut für Normung
EMS	Environmental Management System
EU	European Union
GE	General Electric
GTIN	Global Trading Identification Number
HACCP	Hazard Analysis and Critical Control Point
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
NSS	National Standards System
R&D	Research and Development
SCC	Standards Council of Canada
SDO	Standards Development Organization
TFP	Total Factor Productivity
UK	United Kingdom
ULC	Underwriters' Laboratories of Canada
WTO	World Trade Organization

Executive Summary

The Standards Council of Canada (SCC) retained The Conference Board of Canada to undertake a study to examine the impact of standardization on the Canadian economy. The study involved a review of the standards-oriented economics literature, an empirical analysis of the impact of the collection of standards on Canadian labour productivity, a series of interviews with Canadian leaders, and two case studies on the benefits of selected aspects of standardization.

Findings from the Literature Review

Four main subject areas exist in the economic literature that examines standards and their economic impact. These include the rationale for standards, the effect of standards on international trade, the effect of standards on growth and productivity and the significance of the age of standards. A review of these four areas identifies the many benefits of standards including improved compatibility, the identification of minimum admissable attributes, provision of information and product descriptions, the enabling of economies of scale, the facilitation of international trade, and the promotion of innovation.

Findings from the Empirical Work

The empirical work clearly showed that standards play an important role in enhancing labour productivity, measured as output per hour worked. Over the study period of 1981-2004, standardization accounted for 17 per cent of the growth rate in labour productivity which translates into approximately 9 per cent of the growth rate in output (real GDP). The impact, over time, of this positive contribution to output growth is substantial. In 2004, the level of economic output (real GDP) would be expected to be $62 billion lower if there had been no growth in standards over the 1981-2004 period.

Findings from the Interviews

The findings from the interviews provided significant qualitative data in support of the benefits of standardization. Interviewees were very vocal about the benefits of participating in the standards development process. They also mentioned the importance of standardization as the basis for continuous improvement, innovation and new product development. Interviewees indicated that standardization helps to establish a level playing field for business and without quality management standards that bolster and validate credibility, many would not be in business. Other respondents commented on the important role that standards play in improving productivity, facilitating trade and new market development as well as contributing to improved public safety.

Findings from the Case Studies

The study also examined the benefits of specific aspects of standardization in two Canadian companies, SaskPower and INFASCO. In one instance, ISO 14001 and its benefits were examined; in the other, ISO 9001 and ISO 17025 and their benefits were analyzed. The case studies provided useful insights into the rationale for standardization, the challenges of implementation and the rewards of achieving and maintaining certification and accreditation to ISO and IEC standards.

1. Introduction

The Standards Council of Canada (SCC) retained The Conference Board of Canada to undertake a study to examine the impact of standardization on the Canadian economy in order to highlight the economic benefits of standardization in Canada and provide Canada-specific standardization–related data.

The study was based on research methodology that was originally used in Germany and the United Kingdom and adapted to the Canadian situation. Studies in these countries concluded that standards have made an important contribution to growth in productivity, and the SCC was interested in verifying the degree to which this might also be true in Canada.

The study involved four components: a review of the standards-oriented economics literature; an empirical analysis of the impact of the Canadian collection of standards on Canadian labour productivity; a series of interviews with senior executives from the private and public sectors; and an in-depth examination of the benefits of specific aspects of standardization in two Canadian companies.

The purpose of the literature review was to identify theoretical studies that have examined the economic rationale and implications of standards, the emergence of standards, and further, to locate empirical studies which have examined the economic impact of standards on trade, the economic impact of standards on economic output and labour productivity, and the importance of the age of the collection of standards.

The second part of the study was an empirical analysis of the impact of the Canadian collection of standards on Canadian labour productivity (output per hour worked) based on a theoretical model which posits that the key sources of economic and labour productivity growth are improvements in multifactor productivity growth, the stock of capital, and the quantity of labour. It assumed that standards enhance multifactor productivity by promoting technological advancement and improving efficiency.

The third part of the study involved a series of interviews with executives of companies, standards development organizations (SDOs), trade associations and government departments in Canada in order to supplement the econometric work and provide further evidence of the benefits and cost savings of standardization.

The fourth part of the study examined the benefits of specific aspects of standardization in two Canadian companies, SaskPower and INFASCO. In one instance, ISO 14001 and its benefits were examined; in the other, the role of ISO/IEC 17025 and ISO 9000 and their contribution to INFASCO's excellent customer service and ability to export were analyzed.

2. Literature Review – Economic Impact of Standardization

Although economists have long surmised that standardization might have important benefits, the development of an economic literature that theoretically and empirically examines the role of standards is a relatively recent phenomenon, and is likley due to two factors. First, globalization and the increased need to develop compatible networks have increased the potential economic benefits of standardization. Second, the development of data on standards has made it possible to measure their benefits.

There are four major subject areas in the economics literature that examine standards and their economic impact. The first of these subject areas is theory-based and focuses on the economic rationale for standards and the emergence and implications of standards. The second subject area focuses on measuring the effect of standards on international trade. The third subject area focuses on the effect of standards on economic growth and productivity. And, more recently, a fourth subject area has emerged that looks at the importance of the age of the collection of standards. This section highlights some of the important findings in the previously mentioned four subject areas. References for the publications and articles reviewed are included in Appendix 1.

2.1 The Economic Rationale for Standards

The theoretical literature on standards has examined the rationale for technical standards, how and why standards emerged, and the economic implications of standards. David (1987) provides a useful taxonomy where standards are categorized into three groups based upon their economic benefits. We can think of each of these categories as a different rationale for the existence of standards.

Compatibility is the first, and most widely researched, rationale for the existence of standards. Compatibility provides what economists call “network externalities.” In the presence of network externalities the economic benefit one person receives from a product increases as the number of other users increases. For example, the benefit of owning one of the first telephones was relatively low but increased exponentially as more people owned telephones. Compatibility standards emerge to help maximize the size of the “network” and, hence, economic benefits. David (1987) provides a cautionary tale about the importance of the compatibility of standards. He describes the fighting of a massive fire in Baltimore, Maryland in 1904. The fire was so large that fire-fighting equipment from as far away as Washington, D.C., Philadelphia, and New York City was called in. However, much of this non-local fire-fighting equipment was of no use because their hose couplings did not fit Baltimore’s fire hydrants.

The theoretical literature suggests that the economic benefits of compatibility standards are high. These can be direct benefits, in the sense that the usefulness of a network to a person increases as the size of the network increases, or indirect benefits, in the sense that larger networks may have better availability of service and lower costs. For example, the United States National Aeronautical and Space Administration (NASA) recently announced that all of its future moon operations would use metric measurements. One of the reasons for this decision is that U.S. moon habitats and vehicles would be more compatible with habitats and vehicles of other space agencies and, in the event of an emergency, spare parts could be shared (Barry, 2007). Matutes and Regibeau (1996) further illustrate how compatibility standards can promote technological progress.

However, they (and others) caution that the existence of compatible standards may make it difficult to switch to a new, better technology.[1]

A second rationale for the existence of standards is to provide "minimum admissible attributes." These standards may be safety standards or minimum quality standards. Minimum quality standards arise to help eliminate a classic economic dilemma, the "lemon problem," which arises because of asymmetric information. The "lemon problem" derives its name from the problem posed by low quality cars, or "lemons," in the used car market. Akerlof (1970) described how the market for used cars functions poorly because buyers don't have as much information about a used car as sellers do; buyers tend to undervalue good used cars because they worry that they might be lemons and as a result, very few good used cars may appear on the market because sellers cannot get the true value for these cars. The existence of minimum quality standards can lower transaction and search costs since buyers do not have to investigate the quality characteristics of a product as thoroughly. Jones and Hudson (1996) present a theoretical model in which minimum quality standards reduce transaction costs. In their model, standardization reduces the potential for misleading quality signals. As a result, consumers can expend less effort when evaluating product quality. Swann (2000) discusses how minimum quality standards can improve a country's international trade performance by reducing transactions costs.

A third rationale for the existence of standards is to provide information and product descriptions. David (1987) calls these standards "technical reference standards." This group of standards includes standards of "measurement" and "grades" of a product. An example of measurement standards can be found in the lumber industry. The industry has agreed that a two-by-four piece of wood would, once sawn and dried, have the dimensions of 1.5 inches by 3.5 inches. An example of product grading can be found in the gasoline industry where the formula for determining the "grade" of gasoline has been established.

A fourth rationale for the existence of standards is to reduce variety. This rationale was not included in David's (1987) taxonomy, but has been discussed in-depth by Swann (2000). Although, on the face of it, this would seem to reduce economic well-being, Swann points out two important economic benefits.[2] First, businesses can operate on a larger, more efficient scale of production and, thus, goods can be produced at lower cost.[3] Second, the presence of variety reduction standards can provide more certainty to producers about the future direction of the industry and reduce the risk of research and development.[4]

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[1] For example, David (1985) discusses how the traditional "QWERTY" keyboard that was developed to minimize typewriter jams on manual typewriters, still remains the dominant keyboard configuration even though it has been demonstrated that other keyboard configurations, such as the Dvorak Simplified Keyboard, are significantly more efficient. In a theoretical paper, Arthur (1989) develops a model in which the free market, when faced with a choice between two competing technologies, may choose one that is not necessarily superior as a result of relatively insignificant historical events and that, once made, this choice is not easily reversed. Farrell and Saloner (1985) develop a theoretical model in which an industry can get locked into using an obsolete or inferior technology when a better alternative is available even though all firms in the industry would prefer to switch to the new technology. Farrell and Saloner (1986) develop a model where an industry is locked into an existing standard because no single firm wants to go out on a limb and be a first adopter of a new technology because they would prefer to use technology that is compatible with other firms.

[2] Standards that reduce product variety are quite prevalent. For example, in the North American shoe industry, shoes are only available in half sizes.

[3] One of the innovations that Henry Ford brought to the automobile production process involved the standardization of parts used in the production of the Model T. This was one of the innovations that helped Ford produce the Model T at a substantially lower cost than competing automobiles.

[4] DIN (2000) reports on a survey of companies from Germany, Austria, and Switzerland that indicates that businesses feel that standardization reduces the risk associated with undertaking research and development and reduces the costs of performing research and development.

Another important factor identified in the literature is the role of government in the standardization process. Swann (2000) suggests that there are two rationales for the government to be involved in standardization processes: market failure and strategic trade purposes. Market failure occurs when the free market, left to its own devices, fails to produce the socially optimal amount of a product - in this case, standards. For example, Swann argues that standards provide an "infrastructure" for innovation-led growth and, as such, have the characteristics of a public good in the sense that once a standard has been "published", other parties cannot be excluded from using it. In this case, the private benefit to a firm's "publishing" a standard is lower than the social benefit from the standard and, as a result, too few standards will be "published" by the free market. The second rationale for government intervention in the standards process arises from strategic trade theory. Standards can be trade creating, especially on the exports side. Swann suggests that national governments should be involved in the international standards creation process to ensure that those standards reflect national interests.[5]

However, others suggest that government intervention in the standards setting process should be used with caution. David (1987) suggests that there are windows of time when a small amount of government intervention can have a large impact on the outcome of competitions to see which technology becomes the standard. These windows of time are of uncertain length and often appear without much warning. David compares the government to a "Blind Giant" in the sense that the government has the most power to affect the future technology standard when it has the least information about what is the best choice. Furthermore, if the government supports an "inferior" technology too long it runs the risk of creating "Angry Orphans" when it finally allows the "superior" technology to prevail. These "Angry Orphans," whose technology has not been adopted as the standard, may then allocate resources to trying to regain government support through lobbying or other activities. This, from society's point of view, is an inefficient use of resources.

2.2 The Impact of Standards on International Trade

The second subject area in the economics literature on standards focuses on measuring the impact of standards on international trade. The most important recent work in this area is a study of the German experience by Blind and Jungmittag (2000). The authors suggest that there are three ways standards can influence international trade. First, standards can affect international trade because they act as a form of non-price competition. The existence of a strong national collection of standards can improve trade performance to the extent that standards provide information on quality. Strong national standards may increase exports if they help domestic firms compete with international firms along the quality dimensions of a product. However, strong national standards may act as non-tariff barriers to trade.[6] These barriers may be intentional (a practice prohibited by the World Trade Organization's Agreement on Technical Barriers to Trade) or they may represent the genuine preferences of domestic consumers, in which case they may provide valuable information to foreign producers. The third impact comes from the internationalisation of standards. International standards that focus on compatibility, product information and

[5] Businesses also have an interest in participating in standards development at the national level. DIN (2000) reports the results of a survey of German, Swiss, and Austrian companies. Seventy-five percent of survey respondents indicated they are involved in involved in activities at their national standards development organizations. Furthermore, the results suggest that much of this involvement is focused at the European or wider international level.

[6] Tariffs, or taxes, on imports reduce imports by raising the price on imported goods. Non-tariff barriers to trade reduce imports without imposing a tax. Examples of non-tariff barriers to trade include: import quotas, government procurement provisions, and domestic content provisions.

measurement would be expected to increase international trade. However, if international standards reduce product variety they may reduce cross-border trade[7].

In an effort to evaluate the net impact of these conflicting theoretical impacts of various types of standards on international trade, Blind and Jungmittag (2000) examined the impact of standards on international trade for 31 German manufacturing industries for the 1980-1995 period. They found that uniquely German standards had a negative effect on German exports. The authors argue that this is because the uniquely German standards reflect the preferences of German consumers and not the preferences of the international market. Uniquely German standards were found to not have a significant impact on imports suggesting that they do not represent a non-tariff barrier to trade. On net, the authors found that uniquely German standards have worsened German trade performance. They reach the opposite conclusion about the impact of international equivalent standards on the German trade balance. International-equivalent standards were found to not have a significant impact on German exports but to significantly reduce German imports. The authors suggest that this impact of international-equivalent standards on imports reflects a competitive advantage that Germany possesses in areas covered by these standards. This might also be a reflection of Germany's influence on international standards development activities.

2.3 The Impact of Standards on Economic Growth and Productivity

The third subject area in the economics literature on standards has focused on the effect of standards on economic growth and productivity. The two most comprehensive studies in this area were performed by Jungmittag, Blind, and Grupp (1999) using German data from 1961 to 1996 and the British Department of Trade and Industry [DTI (2005)] using British data from 1948 to 2002. Both of these studies begin with the premise that standards may be an important factor in determining aggregate economic activity and, as a result, productivity growth. The Jungmittag, Blind, and Grupp (1999) study finds that the collection of standards has played an important role in explaining long-run movements in economic output of the German business sector. The DTI (2005) study finds that the collection of standards has played an important role in explaining long run movements in British labour productivity (output per hour worked). The remainder of this subsection comments on their methodology.

The Jungmittag, Blind, and Grupp (1999) and DTI (2005) studies begin their analysis by examining the effects of standards on the economy as a whole using a formal model of economic output. Although there are many inputs into the production process, economists have found it useful to begin with a simple Cobb-Douglass model of production that focuses on the two most important inputs: capital and labour. Capital goods are produced inputs that are used in the production process but are not used up in the production process. As an example consider the production of books. The factories, machinery and software used would be considered capital goods but the paper and ink would not. The labour input into production includes the number of workers as well as the skill level of these workers. In these models, economy-wide output is assumed to be a function of capital inputs, labour inputs, and multifactor productivity. Multifactor productivity can be

[7] Intra-industry trade occurs when a country is both exporting and importing items in the same product classification category. Some intra-industry trade is generated because the range of tastes of consumers in any given country exceeds the variety of products produced in that country. If an international standard reduces product variety, domestic markets are more likely to be able to satisfy domestic consumers' needs and intra-industry trade will be reduced.

thought of as a combination of technology and efficiency and is a measure of how effectively capital and labour can be combined to produce output.[8]

In both of the models discussed here, the authors chose to explicitly model the multifactor productivity portion of the production function. In the case of the DTI (2005) study, the multifactor productivity portion of the production function is assumed to be a function of a time trend and the collection of standards. In principle, multifactor productivity could depend upon many factors, including measures of technological capacity or knowledge, and measures of the efficiency with which capital and labour are used. Measures of technological capacity or knowledge might include things such as patents, imports or foreign technology, standards, and spending on research and development. Measures of the efficiency with which capital and labour are used might include measures of structural shifts in the economy such as labour flows from one industry to another. The DTI (2005) study does consider including the stock of domestic patents and imports of foreign technology but, ultimately, chooses to exclude them from the analysis.[9] In the Jungmittag, Blind, and Grupp (1999) study, the multifactor productivity portion of the production function is assumed to be a function of the collection of standards, a measure of spending on licenses of foreign technology, and several variables to capture structural shifts in the German economy to explain movements in labour productivity.

Although the two studies are based upon the same theoretical model they use different dependent variables. The Jungmittag, Blind, and Grupp (1999) model uses output as the dependent variable. In this study, output was empirically modeled as a function of the capital stock, the quantity of labour utilized, the stock of patents, spending on licenses of foreign technology, the collection of standards, a time trend, and variables indicating important changes in the structure of the German economy. The DTI (2005) study uses labour productivity, or output per hour worked, as the dependent variable. In this study labour productivity was empirically modeled as a function of the capital-to-labour ratio, the number of standards, and a time trend.

Both studies conclude that standards have had a positive impact on the economy. Jungmittag, Blind, and Grupp (1999) found that standards have had a positive long-run impact on business sector output in Germany. DTI (2005) found that standards have had a positive long run impact on labour productivity in Britain.

2.4 The Importance of the Age of Standards

The most recent subject area in the economics literature examines the importance of the age of existing standards. The existence of standards can have important effects on innovation. On one hand, standards can provide information which aids innovation. For example, a standard can help reduce uncertainty about the future direction of a technology and, as a result, encourage research and development because it reduces the risk of investment in research and development. On the other hand, standards might constrain innovation. For example, one of the potential costs of having compatible standards is that their existence may make it more difficult to switch to a new, better technology.

[8] Multifactor productivity is not a variable that we can directly measure. It is usually calculated using data on output, capital input, and labour inputs.

[9] The stock of patents was excluded because it was highly correlated with the stock of standards and including it would have made it difficult to precisely estimate the impact of both patents and standards on productivity. Imports of technology were excluded for two reasons. First, data was only available beginning in 1964, which would have significantly reduced the sample size used in the study. Second, this data had a large variance making precise estimates of its effects very imprecise.

The DTI (2005) study used survey data to gauge the extent to which standards are a constraint to innovation and the extent to which standards provide information that aids innovation.[10] The authors used an ordered logit model[11] to examine the relationship between individual enterprise survey responses and the median age of existing standards for the industry in which the enterprise operates.

Two key observations emerged. First, they found that standards constrain innovation most when they are either very old or very new. When standards are brand new they can constrain innovation because innovators are still learning about the standards and the impact of those standards. When standards become old they can constrain innovation because they lock innovators into outdated systems. Second, the study found that standards provide the least information when they are either very new or very old. When standards are brand new they have not diffused enough to provide much information to innovators. When standards become old they lose their relevance and, hence, have little information content. Taken together, the results suggest that standards may be least useful and most harmful in industries that experience rapid turnover in technology. In these industries, by the time a standard has been in place long enough to provide useful information, it may already begin to constrain innovation.

The Standards Council of Canada accreditation requirements state that *whenever possible, in order to leave maximum freedom for technical development, the requirements of standards shall be expressed in terms of performance rather than design or descriptive characteristics*. This is a requirement of World Trade Organization (WTO) Technical Barriers to Trade Annex 3 and it essentially eliminates the constraint on innovation created by locking into a technology.

2.5 Summary of Findings

There are four major subject areas in the economic literature that examine standards and their economic benefits. These include the rationale for standards, the impact of standards on international trade, the impact of standards on growth and productivity and the importance of the age of standards. A review of this literature clearly highlights many important benefits of standardization and the most compelling are summarized here.

2.5.1 Rationale for Standards

Compatibility emerges as one of the most significant reasons for the evolution of standardization. A second rationale for the existence of standards is to provide " minimum admissable attributes", for example, safety standards or minimum quality standards. Also important is the need to provide information and product descriptions, often referred to as technical reference standards. Another reason for the development of standards is to reduce variety, which has enabled many organizations to take advantage of economies of

[10] The comprehensive Community Innovation Survey 2001 asked enterprises several questions which might provide insight about the extent to which standards aided or impeded innovation. One question asked the survey participants to rate the level of importance of "regulations or standards" in inhibiting their businesses' ability to innovate for the 1998-2000 period. Survey participants were given the choice of responding with "no effect," "low," "medium," or "high." Another question asked survey participants to rate the level of importance of technical standards as a source of information used in innovation activities. . Survey participants were given the choice of responding with "not used," "low," "medium," or "high."

[11] An ordered logit model is one regression technique that can be used to analyze a data set where the dependent variable can only take on discrete values where the order of the values has meaning. For example, survey participants might be given the choice of responding with "not used," "low," "medium," or "high." In this case we might assign the response "not used" a value of 1, the response "low" a value of 2, the response "medium" a value of 3, and the response "high" a value of 4. In principle, standard regression techniques require the dependent variable to be continuous rather than discrete and, as a result, cannot be used to examine this question.

scale. Government's role in standardization processes is highlighted as important in two areas: market failure and strategic trade purposes.

2.5.2 The Impact of Standards on International Trade

Standards impact international trade in three ways. They act as a form of non-price competition, they help to improve trade performance because they provide information on quality, and internationalized standards can also increase the potential for international trade by improving compatibility, product information and measurement.

2.5.3 The Impact of Standards on Economic Growth and Productivity

Recent studies done in Europe have concluded that standards have had a positive impact on the economy and have played an important role in improving labour productivity.

2.5.4 The Importance of the Age of Standards

Standards have an important impact on innovation by providing information and reducing uncertainty thus mitigating the risk of R&D investment. When standards are either very old or very new however, they can sometimes constrain innovation.[12]

[12] The Standards Council of Canada and the various SDOs spend considerable time and money to ensure the effective stewardship and maintenance of the National Standards System.

3. Empirical Analysis

3.1 Methodology

The empirical model used in this analysis is similar to the aggregate model used in DTI (2005). The model is based on the assumption that aggregate economic output can be modeled as a function of the amount of labour and capital used in the economy and how capital and labour are combined to produce goods and services. Following in the footsteps of DTI (2005), the purpose of the research was to estimate the impact of changes in the existing number of standards on labour productivity or output per hour worked. Labour productivity is seen as an important factor in generating economic wealth and the existence of standards can be expected to impact most directly on productivity.

Labour productivity (output per hour worked) can be thought of as arising from two sources: multifactor productivity and capital deepening, as shown in the following equation:

$$\left(\text{Labour Productivity}\right) = \left(\text{Contribution of Multifactor Productivity}\right) + \left(\text{Contribution of Capital Deepening}\right)$$

Capital deepening represents an increase in the amount of capital per worker. For example, consider the case of the production of rail transportation services. A single train engineer can produce more transportation services (transported goods for example) with 12 rail cars than with 6 rail cars. Multifactor productivity represents how smart we are in combining labour and capital together to produce output.

Multifactor productivity is itself divided into two parts: knowledge and efficiency. Standards, patents, research and development, and imports of foreign technology are some factors that might have an impact on the level of knowledge or technological capacity. Standards, improvements in infrastructure and structural shifts in the economy such as labour mobility between industries are some factors that might have an impact on the level of efficiency in the economy. Standards can thus potentially play an important role in enhancing multifactor productivity.

In this study, multifactor productivity in any given year is modeled as a function of time and the existing number of standards. Using the fact that labour productivity is determined by multifactor productivity and capital deepening means that labour productivity can be expressed as a function of the existing number of standards, a time trend to control for other important determinants of multifactor productivity and the degree of capital deepening which is measured by the ratio of the capital stock in the economy to employment. In effect, labour productivity can be expressed using the following equation:

Labour productivity = constant + A*(the existing number of standards) +

B* (the capital to labour ratio) + C*(time trend).

3.2 Data

The data on the number of standards over time was provided by the Standards Council of Canada in cooperation with the four SCC accredited Standards Development Organizations (SDOs): Bureau de normalisation du Québec (BNQ), Canadian General Standards Board (CGSB), Canadian Standards Association (CSA) and Underwriters' Laboratories of Canada (ULC). Data was collected from a variety of sources including SCC's Canadian Standards Database[13], standards catalogues published by the four SDOs, listings of withdrawn standards, and archived information provided by the SDOs.

The number of standards in existence in any one year was determined as follows:

Number of standards in a given year = number of standards in the previous year + the number of new standards introduced – the number of standards withdrawn.

3.3 Limitations of the Analysis

The most significant potential challenge to the analysis is the relatively short time period, i.e. 24 years, over which the analysis is performed. The Jungmittag, Blind, and Grupp (1999) study was based on 35 years of data. The DTI (2005) study was based on 55 years of data and they chose not to include imports of technology as an explanatory variable because it would reduce their sample period to 39 years. The relatively short time span analyzed in this study makes it more difficult to estimate the exact size of the coefficient on the number of standards. Nonetheless, the statistical significance of the positive relationship between the number of standards and labour productivity (output per hour worked) is very strong and this positive relationship remained solid under alternative specifications of the labour productivity equation. There is little doubt, therefore, that labour productivity in Canada is positively related to the number of standards.

3.4 Analysis

The macroeconomic data used in the analysis were obtained from Statistics Canada. The measure of labour productivity used was the index of labour productivity in the aggregate business sector. The capital-to-labour ratio was created by dividing a measure of the capital stock by a measure of the quantity of labour. The capital stock variable used was the hyperbolic end-of-year net stock of non-residential capital for all industries measured in chained 1997 dollars. The quantity of labour variable used was the total employment of all persons 15 years and over in all industries.[14]

Exhibit 1 shows the number of standards in existence from 1981 to 2004. Although the graph shows an overall increase from 1981 to 1989, the number of standards is much more volatile from 1989 to 2004. This decline in the number of standards from 1989 to 1990 is about 11 per cent, with a subsequent rebound from 1990-95 time period of a similar amount. During the entire 1981 to 2004 period, the net increase in standards was 532.

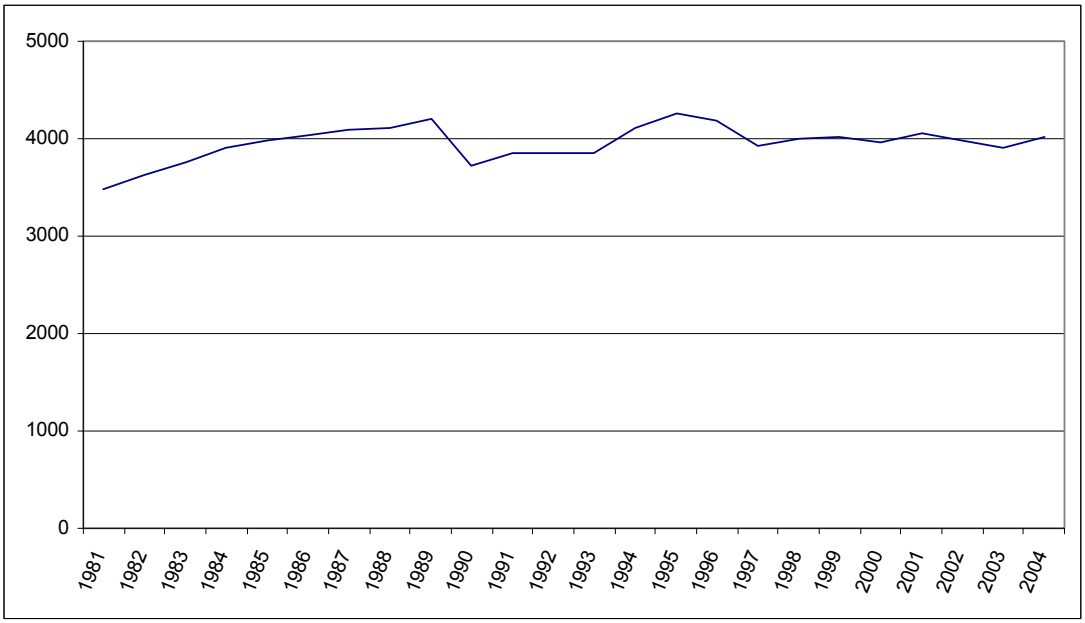
[13] The Canadian Standards Database, in existence since 1979, is a compilation of bibliographic information on standards published by SCC's accredited SDOs.

[14] The aggregate business sector includes private businesses (both incorporated and unincorporated) as well as government enterprises and agencies which operate on a profit or cost recovery basis.

The decline in the quantity of standards in 1990 can be traced to a one-time withdrawal of standards by one of the accredited SDOs when its mandate changed in 1989. The second decline cannot be traced to any one event, but it is most likely a combination of a series of changes in the national standards system, including a reduction in the funding available for translation of standards, periodic updating of standards collections, and increasing globalization leading to increased use of international versus national standards.

Exhibit 1

The Quantity of Standards in Canada: 1981-2004



(Sources: The Conference Board of Canada; The Standards Council of Canada).

The profile for Canada's collection of standards contrasts with the profile for the German collection of standards reported in the Jungmittag, Blind, and Grupp (1999) and the British collection of standards reported in DTI (2005). These profiles show strong growth since 1981. This strong growth might be due to an increased need for standards harmonization as European economic integration intensified. Indeed, DTI (2005) reported that although the total number of British standards has increased rapidly since 1986, nearly all the growth in the number of British standards is a result of an increase in the number of standards originating within European institutions. The number of British standards originating from within Britain actually fell over the 1986 to 2002 time period and by 1995 the number of British standards originating from European institutions exceeded the number of British standards originating from within Britain.

The results from estimating the coefficients in the labour productivity equation show that the elasticity of labour productivity with respect to the number of standards is estimated to be 0.356 (see Appendix 2, Exhibit A1) and is found to be statistically significant.[15] This means that a 10 per cent increase in the number of standards would lead to a 3.56 per cent increase in labour productivity, or output per hour worked. That is, standards play an important role in enhancing labour productivity in Canada.

This estimate of the impact of standards on labour productivity is quite large relative to the estimates published in other studies. For example, DTI (2005) reported an elasticity of labour productivity with respect to the number of standards of only 0.054.[16] However, these estimates must be put into context with respect to the differences in the rate of growth in the number of standards between these two countries. The DTI (2005) study reports that in Britain over the 1948 to 2002 period the average rate of growth in the number of standards was 5.1 per cent, while the average rate of growth in labour productivity was 2.1 per cent. Thus, given their estimate of the elasticity of labour productivity with respect to the number of standards they find that, on average, growth in the number of standards contributed about .28 percentage points to labour productivity growth or, in other words, accounted for about 13 per cent of all labour productivity growth over 1948-to-2002 time period.

The story for Canada is somewhat different. Over the 1981-to-2004 time period the number of standards rose 0.69 per cent on average per year. Given the relatively low growth rate in the Canadian number of standards and the relatively high estimate of the elasticity of labour productivity with respect to the number of standards (0.356), on average, growth in the number of standards contributed 0.246 percentage points to growth in labour productivity (output per hour worked) and economic output (real GDP) in each year.[17] Thus, the results suggest that growth in the number of standards accounted for 17 per cent of labour productivity growth and about 9 percent of growth in economic output (real GDP) over the 1981 to 2004 period.

These results imply that, in any given year, growth in the quantity of standards has been an important contributor to growth in labour productivity and output. The impact is even more substantial when one considers the cumulative impact that growth in standards has had over time. Appendix 2 (Exhibits A2 and A3) show that in 2004 economic output (real GDP) would be expected to be $62 billion lower if there had been no growth in standards over the 1981-2004 period. This is equivalent to 5.5 per cent of output in 2004.

Despite the relatively short sample period, the statistical significance of the positive relationship between the number of standards and labour productivity is very strong and this positive relationship remains solid under alternative specifications of the labour

[15] One of the implications of using a short time span for the analysis is that the coefficient estimates may be unstable with respect to relatively small changes in model specification. The coefficient on the number of standards is sensitive to the choice of sample period. When the estimation was performed over a shorter period, i.e. 1984-2004, a time during which the number of standards was relatively flat, the coefficient on standards shrinks to 0.141 and is no longer found to be significant.

[16] Comparison with the coefficient estimates for the stock of standards variable from the Jungmittag, Blind, and Grupp (1999) study is more difficult because they use output instead of labour productivity as the dependent variable. They report estimates that place the elasticity of output with respect to the stock of standards between 0.041 and 0.071.

[17] Output (or Gross Domestic Product, commonly called GDP) is measured in two ways. Real GDP, also known as constant dollar GDP, is the measure of GDP most often used by economists and is the measure of GDP that most often discussed in the press. It measures the market value of all goods in services produced in the economy using the prices that prevailed in some fixed base year. In this study, output is measured in 1997 dollars. Nominal GDP, also known as current dollar GDP, measures the market value of all goods and services using current market prices. For example, suppose 1997 is our base year. The real GDP in 2004 is the market value of all goods and services produced in 2004 that is calculated using the prices that prevailed in 1997 and nominal GDP in 2004 is the market value of all goods and services produced in 2004 that is calculated using the prices that prevailed in 2004.

productivity equation. There is little doubt, therefore, that labour productivity and economic growth in Canada are positively related to the number of standards. According to our results, the change in the quantity of standards in Canada accounted for approximately 9 per cent of the growth in economic output (real GDP) over the 1981-2004 time period. The empirical results confirm that the main findings in the DTI (2005) and Jungmittag, Blind, and Grupp (1999) studies of the impact of standards in Britain and Germany also apply to Canada – standards are an important source of Canadian economic growth.

4. Interviews

The econometric analysis was supplemented by fifteen interviews that were carried out with executives of companies, standards development organizations (SDOs), trade associations and government departments in Canada in order to gain additional insights into issues such as benefits and cost savings from standards.

The questionnaire outline for the interviews probed respondents on the benefits of standardization using the following framework:

- benefits of participating in the standards development process;
- the strategic importance of standards;
- the development of new markets;
- cost savings;
- innovation;
- public safety;
- standardization bodies;
- challenges to standardization.

Interviews were conducted by phone and a full list of interview questions and interviewees is included in Appendices 3 and 4.

4.1 Findings from the Interviews

Most interviewees were fairly knowledgeable about standards although this knowledge was often narrowly defined and limited to their specific business area. All interviewees cited significant benefits as well as some challenges from standardization but few interviewees were able to quantify these benefits in an economic way. Individuals who represented organizations with a significant stake in the standardization process had problems quantifying benefits in economic terms, although some were able to speak about benefits in terms of a reduction of fatalities or a reduction in accidents or adverse incidents. Others were sometimes reluctant to disclose the specific details of situations where standardization had benefited their organizations because of competitive or proprietary concerns.

Interviewees supported the perspective that standardization establishes a level playing field for business and enables companies to produce quality products in an ethical manner. Interviewees highlighted the importance of participating in the standards development process as a way of influencing the direction of standards. They also noted the importance of standardization as the basis for continuous improvement, innovation and new product development. Some interviewees indicated that their organizations would not be in business but for the quality management standards that bolster and validate their credibility with customers. Others commented on the important role that standards play in facilitating trade and new market development. Improved productivity, reduced costs and improved public safety were also mentioned frequently by interviewees. Detailed findings are discussed in the following sections.

4.1.1 Benefits of Participation in the Standards Development Process

Interviewees unanimously agreed that there are significant benefits to participating in the standards development process and these benefits are far reaching, accruing not just as

private sector benefits to specific companies but also as public interest benefits to the broader economy at large. These benefits are discussed under two headings: private sector and public interest.

4.1.2 Private Sector Benefits

The majority of interviewees were extremely positive about the benefits that their organizations received from participating in the standards development process. Many companies participate in order to influence the development of standards, and they do this for different reasons, e.g. to create a demand for higher quality and technically superior products. In other cases, participation may be driven by the desire of technical experts and scientists to contribute their expertise. No matter what the motivation, both companies and their employees benefit from the technical and professional interaction with others. Jim Brock, Executive Director, Manufacturing and Engineering at 3M Canada indicated that "3M's factories benefit in the long run from employee involvement in the standards development process because employees have a pragmatic approach to the development of standards which makes it easier to implement them in our production facilities."

Interviewees commented that early involvement in the standards development process was of particular advantage. Not only does early involvement mean early awareness of product compliance standards, but it also enables a company to tailor product design, or in some cases, enables a company to set the standard in the marketplace that the competition has to meet. Some respondents felt that the first company to get to market with a good product has a greater chance of securing and successfully defending market share.

Interviewees also felt it was important to be part of the standards development process on an ongoing basis. Jim Dymond, Technical Counselor for GE Systems indicated that, "what we did find was that if we did not have people serving on the standards development committees, things sometimes crept into the regulations that produced a disadvantage to us. This was one of the main reasons we continue to be involved in the standards development process. Also as a technology leader, GE did not want something to come up that blocked our advancement in the technology."

A few interviewees commented that it was particularly important to have representation at the working group level of the standards development process rather than at the oversight committee level. Working groups were populated with technical people who willingly exchanged information on the work they were doing which would not happen at the higher level committees. This was where technical decisions were made and this was where you could get exposure to what other companies are doing in the field.

Several interviewees commented that smaller businesses can benefit considerably from participation in the standards development system if they are strategic about their involvement. By being embedded in the standards development community, small companies can have access to information they would not normally receive. Other respondents indicated that they liked the flexibility of the process, e.g., companies do not actually have to be present at every committee meeting to hear about what is going on. Information is usually available through minutes or simply through follow up conversations with individuals who did participate.

Another interviewee suggested that the National Standards System provides real cost savings to industry. It would be very difficult for one company within an industry to develop a standard alone, without the intellectual capital and in-kind contribution from the other industry participants.

4.1.3 Public Interest

The previous section discussed the benefits accruing to the private sector of participating in the standards development process. This section looks beyond the benefits to the private sector, and focuses on the broader societal benefits of the standards development process.

“Canada seems to have a special brand when it comes to standards development ─ a brand of consensus that denotes openness, transparency and inclusiveness as the driving factors” indicates Pat Keindel, President Standards, Canadian Standards Association. “So when you look at the standards that are produced by the Canadian Standards Association, you've got widespread participation with balanced committees bringing opposing views to the table ─ the balanced matrix approach. That in itself adds value because no one interest group in Canada drives the development of a standard. So if I'm a regulator or I'm someone from industry or I'm a consumer, I'm sitting at the table involved in the standards development process from my own perspective and bringing my own expertise to the table. This provides wonderful value to everyone who participates because everyone gets their say. This is quite different from the processes used in other countries where standards may be industry driven without widespread participation from all factions. So we begin by believing that we have a better brand of standardization.”

Is it in the public interest to involve industry in standards development? Interviewees responded, “absolutely, it can’t be done any other way”. Most of the time the technical expertise required to develop standards is resident in companies and is provided to the standards development process for free. When standards development is being done on an international basis, the time and cost involved can be very significant. It is true that many of the company experts involved in standards development do so with a view to influencing the standard; however this does not necessarily mean that they want to hijack it or impact it at the expense of someone else. They often just bring the technical expertise that is necessary to develop the standard in a selected field. If you are developing a building code, it is wise to have some civil engineers at the table. They may represent companies with a vested interest, but you still need their input. Usually the balanced matrix approach means that standards development committees are populated with technical people who in their hearts are committed to safety so they will usually come up with a standard that is practical, safe and in the public interest.

4.1.4 Strategic Importance of Standards

Interviewees were asked about the strategic importance of standards for their companies. Interviewees generally agreed that the nature of the business determined the degree of their importance. Jayson Meyers, Senior Vice-President and Chief Economist of the Canadian Manufacturers and Exporters Association indicated, “In some cases if you don’t meet the standard, you don’t do business, so one could argue that 100% of your business depends on your ability to meet that standard.” For example, some large companies require ISO 9001 registration before they will use a company as a supplier. In other situations, products are required to meet US FDA standards before their sale can be approved in the American marketplace. Other interviewees mentioned that standards are fundamental if you want to continue to improve your existing business. Given that standards form the basis of continuous improvement, it is not enough to just meet the voluntary standards set out by the industry or to comply with existing best practices. A company must continually improve its performance and its product lines to be successful.

Several interviewees talked about the importance of standards in setting a level playing field for business. One interviewee provided the analogy that operating without standards

was like the military fighting a war against guerrillas. In that instance, a standardized organization like the army is dealing with another organization that is anything but standard. Without standards, large organized companies are at a real disadvantage because the business environment is ruthless. They pride themselves in having high levels of safety and compliance and business ethics but wouldn't be competitive without a level playing field with respect to standards. The existence of standards enables businesses who want to provide a safe product that is ethically produced, to operate successfully knowing that domestic and international competitors are required to follow the same rules. Rae Dulmage, Director, Standards & Government Relations, Underwriters Laboratories of Canada indicated that, "sometimes business groups really push ULC to get standards done because they have a significant need and want a level playing field. Standards don't favour a particular manufacturer ─ they apply equally to everyone". Of course, globalization has presented some challenges with counterfeit and sub-standard products appearing, but with the move to increasing acceptance of the international harmonization of standards, companies know what is required for a product to enter worldwide markets.

Catherine Swift, President and Chief Executive Officer of the Canadian Federation of Independent Business, commented that many of her members appreciate clear standards and value the stamp of approval that standards provide. Other interviewees commented that standards help in convincing a customer of the quality of their products and processes and that standards help in qualifying potential suppliers and business partners. For example, 3M will only use suppliers who have or are in the process of acquiring ISO 9001 registration unless there is no alternative. The downside of standards, at least from Catherine Swift's perspective, is that they are sometimes developed with large corporations in mind, and small businesses with four or five employees are often unable to absorb the costs of conforming to such standards.

4.1.5 Trade and New Market Development

Most interviewees agreed that standards significantly facilitated trade and market development although most interviewees also mentioned special situations where some part of the standardization system had caused them problems and made it difficult to enter a foreign market. On the side of encouraging trade, "harmonization is the key to globalization in the standards community", said Pat Keindel. "CSA has a policy that it first tries to harmonize internationally. If that isn't possible, it looks at regional harmonization, then bi-national harmonization. CSA only produces a uniquely Canadian standard when there is no opportunity for broader harmonization or when there is a uniquely Canadian problem that has to be resolved. Standards are market driven so when they are developed, the specific market segment dictates the level of harmonization necessary for the development of the standard. So different markets harmonize internationally, regionally or bi-nationally at different rates."

Pat Keindel also indicated that "though international harmonization may be the ideal state, it is not always possible or appropriate to set up an international standard. However, where international standardization is the appropriate approach, it clearly increases the free flow of goods and services. The optimum is obviously one standard, one test, one certification. To be engaged in international harmonization at the country level is essential for the growth of the country because standardization is an issue of nations ─ and, it is strategically important that we remain competitive and globalize to the greatest degree. An appropriately used international standard levels the playing field for all and improves the free flow of goods and services."

"In the food industry, standards clearly help to facilitate trade", said Ebo Budu-Amoako, Senior Microbiologist at the P.E.I. Food Technology Centre. "Take a shipment of processed lobsters from Atlantic Canada that is destined for the American market. Prior to establishing the Hazard Analysis and Critical Control Point (HACCP)[18] food safety system, processed lobster meat would be held for months at the border. Now with HACCP documentation in place and certification by the Canadian Food Inspection Agency (CFIA), the lobster meat usually just sails through. This results in a significant cost savings for the seller and an expansion of the potential market for the product as well. Buyers look for manufacturers with quality systems because they want to buy quality products. Grocery stores send their buyers to places with quality systems. Buyers audit these systems and if they are judged satisfactory, they buy from the manufacturers."

One interviewee commented that the introduction of standardization has had a positive impact on the organic farming industry in British Columbia. The actual setting of the organic standards ended a decade of turmoil in the industry as to what standards would be applied and enabled the organic farming industry, which is characterized by small sized producers, to develop some institutional capacity. With the increased institutional capacity, producers are more aggressively pursuing opportunities for market development with the result that the sector is growing and capturing a premium place in the marketplace.

One interviewee cited the work being done to establish a Global Trading Identification Number (GTIN) which will clearly facilitate global commerce. Currently different numbering systems are used for bar codes in Europe and North America so the increased importance of global commerce means that such systems have to be increasingly aligned. Many other standards also have global reach such as the ISO quality management standards and environmental management standards.

The rise of globalization and emerging market economies and the impact this is having on standardization is clearly on people's minds, especially on those of individuals involved with standards development. Globalization is creating interesting challenges for the world of standardization. Increasingly, new trade agreements, and shifting trends in world demand and supply are creating new demand for standards. The rate of technological change has increased so there are more new products and the demand for interoperability of standards has also increased. At the same time, there is increasing complexity and change in world trading patterns. New producers and consumers are entering the system – many from countries with very different levels of development and with differing standardization infrastructures. This is causing challenges and pressures to standardization as systems adapt to transitions in the world economy.

Following her recent trip to China, Pat Keindel reported, "that China intends to be a major participant in international standards development; in fact, it intends to play a leadership role over the next five years. Given its population and potential market and the economic development underway, China will become a dominant force in standards development. India too will have a huge role."

[18] The Food Safety Enhancement Program (FSEP) is the Canadian Food Inspection Agency's (CFIA) approach to encourage and support the development, implementation and maintenance of Hazard Analysis Critical Control Point (HACCP) systems in all federally registered establishments.

Although many interviewees were able to cite specific situations where some part of the standardization system had been an irritant, most agreed that the benefits of standardization to trade and market development far outweighed any challenges they had encountered.

4.1.6 Cost Savings

"In a perfect world there should be considerable cost savings from standardization," commented Jayson Meyers. "But it depends on how companies see the standardization process and how they use it. If standards are fossilized and impact the company's ability to move forward with innovative products, there will be significant costs in the form of reduced revenue and profits, and poorer prospects. If companies layer systems such as ISO 9000 on top of things they are already doing or if companies pay lip service to quality just to get the piece of paper, there will be significant additional costs. But if companies think of standardization as part of the continuous improvement process for business, there can be huge savings."

Jim Brock provided some real life examples of the benefits of standardization, continuous improvement and its application at 3M. "ISO 9000 helped 3M to get more disciplined, for example, it helped us to get better at documenting processes, and at reviewing and systematically following-up on action items. As a result, overall measurement and management improved. Product quality got better and waste levels went down. When 3M fixed their processes to improve quality, they got more productive and costs improved. Recently 3M has embarked on something called *Lean Manufacturing*[19], which is an approach that depends to a great degree on standardizing work and work processes. *Lean* means to simplify, to make it easier to find things and it is the supposed secret behind Toyota's success. Since 3M implemented *Lean Manufacturing* it is seeing productivity improvements of as much as 20% in one year in some factories. This number is huge and is simply due to the implementation of *Lean Manufacturing*."

Jim Dymond commented that, "savings from standardization tended to be more pronounced when production volumes were high, as in the production of many consumer products where millions of units are sold. When products are more customized, as in the production of large customized motors where only 100 to 150 may be produced in a year, the advantage of product standardization is less evident. Standardization does help in some aspects of customized motor production, for example when standardized items are purchased such as thermocouples or terminal blocks; having standardized performance tests also helps with cost savings. These tests can take a long time, as much as two weeks on an item such as a large electric motor depending on the problems that are encountered ─ so you don't want to do many of them."

One interviewee cited a recent situation in which he was analyzing the costs of materials in circumstances where manufacturing did not conform to industry standards. The plant was using an aerosol line with a non-standard configuration with the result that it was paying a much higher price for aerosol cans. In a situation like this, two options exist: The company can buy the equipment to enable the use of the standard configuration or they can continue to pay consistently higher material prices. In manufacturing, it is very

[19] Lean Manufacturing is a unified, comprehensive set of philosophies, rules, guidelines, tools, and techniques for improving and optimizing discrete processes.

important to understand what the industry standards are and to build products and processes to take advantage of that. As with most things it is cheaper to do it right the first time.

Several interviewees commented that standardization can help to reduce the cost of regulation and expedite the process. The savings can be large, in terms of both cost avoided and time saved. The regulatory process in Canada is rigorous. After considerable work on the part of government officials, regulations are published using a two step process. Step 1 involves the initial publication of the regulation and an invitation to the public for comments. Step 2 involves the publishing of the final regulation. Between step 1 and step 2, much work takes place to address the comments that are received and if the comments are complex or very contentious, the entire regulatory process may be derailed.

Standards development, on the other hand, typically starts with significant input from stakeholders that represent many different interests. Much expertise is provided on a low cost of participation basis. The process is very transparent and open and usually means that the buy-in to a standard is significant. Although standards development is sometimes described as slow, it is much faster than the development of a regulation.

When regulations are developed by referring to existing standards, the regulatory process is shortened because there are usually very few negative comments and the regulation is published expeditiously and efficiently. It is also much easier to revise and revitalize a standard than it is a regulation. Regulations based on standards are easier to administer since the initial constituency for the standard is wider and broader based. Ultimately, the regulation that is based on a standard is of higher quality. It is a win-win system. Everyone benefits. Regulatory authorities reduce their cost while getting a high quality regulation with broad based support. Consumers get safer products and increased product choice. Industry gets a level playing field characterized by practical standards.

Unfortunately, standardization does not always result in cost-savings. Several respondents highlighted concerns about the cost of complying with standards. As the market moves towards more and specific standards, the cost of compliance increases, which is particularly difficult for small companies. The administrative costs associated with compliance may also be a barrier. An example cited was the globally harmonized system for the classification and labelling of chemicals. The motivating factor for implementing such a system was that its cost would be offset by the gains in having compatibility of markets, but this is most applicable in the case of large multinationals or companies that are exporting. Such a change to standards for companies that are small and not exporting is a significant cost with no offsetting benefits. So in some cases globalization of standards helps multinationals more than it helps small companies.

4.1.7 Facilitating the Client Supplier Relationship

Almost all interviewees agreed that one of the major advantages of standardization was improved interoperability. Manufacturers across the globe are able to specify a standard in a bid solicitation or purchase requisition and then accept or reject bids or products based on that standard. Standardization facilitates the development of global supply chains and offers a broader range of choices than would otherwise be available. Process standards such as ISO 9000 enable companies to have confidence in the quality systems of suppliers which helps to strengthen the relationship. In some instances, suppliers actually have to perform to higher standards for certain manufacturers. For example, 3M which typically has high performing products, has detailed specifications that are required for vendors. They have an active vendor management system and are increasingly analyzing

vendors through the same filters that they apply to their own factories. In order to sell to 3M, suppliers must have or be in the process of acquiring ISO 9001 certification.

When interviewees were asked whether their organizations used strategic alliances and consortia to set special standards, a few responded that Canadian companies did not typically use this as a business strategy. What they had seen was Canadian companies coming together to use international standards. With so many Canadian companies being focused internationally, there is more of an incentive to use international standards than to develop consortia standards. Where companies have successfully used consortia standards to gain market advantage is in Japan and Korea. One interviewee commented that an informal business standard was developing with respect to companies partnering with and or supplying the oil sands. Alberta companies are asking for some indications that suppliers are compliant with a number of different standards before they are accepted as qualified suppliers.

4.1.8 Facilitating Innovation and Research and Development (R&D)

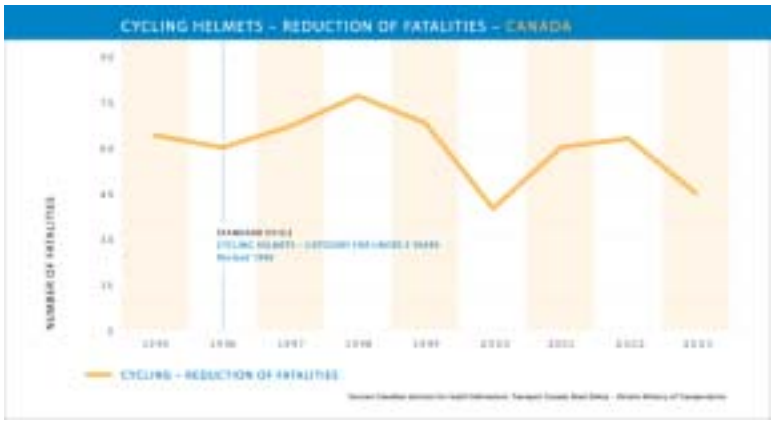
When asked about how standardization contributes to R&D, one interviewee commented that R&D was really two things. Research typically involved investigating new materials, new technologies or other leading edge items. Standards are typically not very helpful in this area since everything is new and ahead of the curve. Where standards are a real help is in the development of new products. Standards provide a base of knowledge for such things as documentation, and performance information. In industrial areas, the individuals who test products and materials are very knowledgeable and it is often possible to incorporate these people into the product development team.

Standards are the building blocks and the basis for continuous improvement. If standards are treated as procedures that become very rigid and not improved, then clearly innovation is negatively impacted. A process needs to be in place for standards revision. Also, whether or not standards contribute to innovation in an organization depends on how the organization uses standards. If they see standards as rigid documents that they have to comply with, they will be less successful than if they see them as an ongoing dynamic in the process of continuous improvement. An example provided by Jim Brock illustrates this. 3M is a chemical company that is very concerned about emissions. Emission standards are evolving and the bar is getting higher. Engineers at 3M are constantly benchmarking 3M and its emissions to ensure its ongoing compliance with current standards but more importantly to anticipate and respond to changing standards. This is just part of its approach to the continuous improvement and innovation process.

4.1.9 Benefits to Public Safety/Liability/ Public Interest

One interviewee summed up the benefits of standardization by saying that standardization simplifies things; complexity is what drives mistakes and mistakes cause accidents. When a company has hazardous processes where even one mistake will kill someone or result in a real safety hazard, it is imperative that standards exist to define how work processes are carried out. For example, if a tanker carrying a volatile organic solid is going to dispense that solid into a holding tank there needs to be standards for every aspect of the process.

Pat Keindel is convinced of the contribution that standards make to increasing public safety, e.g., the bicycle helmet standard and the consequent reduction in head injuries. "Since 1996 when the standard was amended, there has been a significant reduction in the number of deaths per year."



"However, making valid, reliable and quantifiable statements about the benefits to public safety and tracking and justifying them is not easy. Quantifying them in economic terms by going back to government, insurance companies, the health system, lost taxes would be extremely interesting but is not something that has been done."

CSA currently uses key performance indicators to demonstrate the impact that its standards have had. Some examples[20] of situations where public safety has definitely been improved include:

- While the number of Canadian Hockey Association registered players has increased significantly, the number of reported eye injuries has dropped from about 290 per year to less than 10 today. It is estimated that 90% of all sports eye injuries can be prevented with proper use of the right equipment.
- By continually improving gas standards for domestic water heaters and central furnaces, CSA has contributed to a steady decline in fire incidents. In the past 10 years, the number of injuries caused by household fires involving these products in the U.S. has declined by more than half.
- In 1979, CSA published a standard for child-resistant packaging. In 1982, it introduced a certification program. Since then, the rate of young children being hospitalized for poisoning from medications has declined 72%.

Milos Jancik, President and Chief Executive Officer of the Electro-Federation Canada recounted how past experiences and adverse incidents in the area of high voltage fluorescent lighting have led to a change in a standard which will result in a safety improvement to the industry. Office buildings often have high-voltage lighting (347 volts) that contain ballast which burns out and has to be replaced. Normally this involves turning off the power, thus shutting down all of the lights in the office. Unfortunately, many have tried to replace the ballast without turning off the power and been severely injured. New CSA standards require that each fixture have an individual turn off switch which reduces the potential for injury during replacement.

One item which continually comes up in the situation where standards change, and which underscores the growing complexity of the standards landscape, is the need to harmonize with the United States to ensure that such a change does not end up in the creation of two separate products. Timing becomes extremely important because industry wants the

[20] http://www.csa.ca/kpi/?language=english

change done for the entire North American market simultaneously so that requirements are harmonized and companies don't end up producing different variations of the same item. Such a change in a standard ultimately results in business improvement for all.

Societal priorities evolve over time. Safety and the prevention of adverse incidents has been a concern of the standards development community for many years. But, increasingly other societal priorities are being added. Chantal Marin-Comeau, Acting Director, Canadian General Standards Board indicated that "societal priorities such as climate change and the environment are having an increasing impact on the development of standards. These priorities are affecting every aspect of the lifecycle of a product ─ from its inception to its retirement and eventual destruction. Take the example of computers. Rapid technological change in the computer industry has led to millions of obsolete and discarded computers. Increasingly there is a move to consider all aspects of a product's life cycle when standards are developed. Such moves are in the long term interest of the public."

4.1.10 Benefits of Having Standardization Bodies

On the whole, interviewees were quite knowledgeable about standardization and provided a number of comments mostly about the Standards Council of Canada or about SDOs in general.

One interviewee commented that it was important to have an organization such as the Standards Council of Canada in place since it provided co-ordination for the National Standards Systems and acted as a focal point for the process of continuous improvement within that system.

Another interviewee noted that the existence of SDOs makes it possible for industry to have a level playing field with respect to standards, i.e. it would be very difficult and costly for industry to establish and agree on its own standards. Of course, not all the comments about standardization bodies were positive. One interviewee mentioned that working with standards development organizations and with voluntary standards is not always easy. As with regulations, some standards development organizations are very bureaucratic and inflexible and very difficult to change. Another interviewee commented that there is significant cost to participating in standards development organizations. He gave the example of participating in an international committee where meetings were held three times per year for at least 3 days. With the preparatory work required, this represented a huge cost.

4.2 Challenges to Standardization on a Go-Forward Basis

Although most interviewees were very positive about the benefits of standardization, some individuals mentioned real concerns about declining levels of participation in the development of standards. They were concerned that companies were missing out on the very real advantages of participating in the standards development process ─ advantages that include influencing the direction and content of standards and acquiring new knowledge about the potential directions of technology development in competitor companies.

Interviewees commented that organizations have fewer and fewer individuals who are involved or knowledgeable about standards development. Ten years ago it was very common to have the same individuals attending every meeting of the standards development committees. These people were typically highly skilled technical or engineering people and there was considerable continuity within the committees. Now, companies are often providing members to committees only if the company has a very

specific interest in an issue, and the same individual may cover more than one area of expertise. In other cases, different individuals participate on a particular committee for the duration of the development of the standard. This consolidation has broad implications for the standards development process and is causing some SDOs to rethink their approach to the standards development process entirely. And the problem is likely to get worse over time as the structure of manufacturing changes in the country. Without a large manufacturing base, there are fewer engineers and technical individuals available to populate the standards development committees. If a company only has a marketing or sales organization in the country, the right people are not available to participate in standards development.

5. Case Studies

The econometric analysis and interviews were supplemented by two case studies undertaken to further examine the benefits of standardization at the firm level. The two organizations involved were: SaskPower and INFASCO.

SaskPower was the first full-service electrical utility in Canada to achieve corporate wide ISO 14001 registration[21] and consequently had enough history to be able to discuss the related benefits in very concrete terms. INFASCO was selected because standardization has helped it to develop excellent customer service and facilitated the continuance of its export business to the United States.

ISO 14000

What is ISO 14000?: ISO 14000 is a series of international standards on environmental management. It provides a framework for the development of an environmental management system and the supporting audit programme. The main thrust for its development came as a result of the Rio Summit on the Environment held in 1992.

The History of ISO 14000: As a number of national standards emerged (BS 7750 being the first), the International Organization for Standardisation (ISO) created a group to investigate how such standards might benefit business and industry. As a result this group recommended that an ISO committee be established to create an international standard.

What is ISO 14001?
ISO 14001 is the corner stone standard of the ISO 14000 series. It specifies a framework of control for an Environmental Management System against which an organization can be registered by a third party.

Other ISO 14000 Series Standards
These standards are actually guidelines to help achieve registration to ISO 14001. These include the following:

- ISO 14004 provides guidance on the development and implementation of environmental management systems.
- ISO 14010 provides general principles of environmental auditing (now superseded by ISO 19011).
- ISO 14011 provides specific guidance on how to audit an environmental management system (now superseded by ISO 19011).
- ISO 14012 provides guidance on qualification criteria for environmental auditors and lead auditors (now superseded by ISO 19011).
- ISO 14013/5 provides audit program review and assessment material.
- ISO 14020+ provides guidance on labeling issues.
- ISO 14030+ provides guidance on performance targets and monitoring within an Environmental Management System.
- ISO 14040+ covers life cycle issues.

Of all these, ISO14001 is not only the most well known, but is the only ISO 14000 standard against which it is currently possible to be certified by an external certification authority.

Source:
http://www.iso14000-iso14001-environmental-management.com

5.1 SaskPower

5.1.1 About SaskPower

SaskPower is the principal supplier of electricity in Saskatchewan. Its mission is to deliver power in a safe, reliable, cost-effective and environmentally responsible manner. Founded as the Saskatchewan Power Commission in 1929, SaskPower was incorporated in 1949 and operates primarily under the mandate and authority of The Power Corporation Act.

SaskPower serves more than 441,000 customers and manages $4.1 billion in assets. SaskPower maintains 154,269 kilometres (km) of power lines: 12,159 km of transmission lines and 142,110 km of distribution lines to serve Saskatchewan's large geographic area and widely-dispersed population.

SaskPower supplies about three customers per circuit kilometre, while most utilities in North America average about 12 customers over the same

[21] Registration and certification are used interchangeably in the case studies. ISO reports that certification seems to be the term most widely used worldwide, although registration (from which "registrar" as an alternative to registration/certification body) is often preferred in North America, and the two are used interchangeably. See discussion on the ISO website. http://www.iso.org/iso/en/iso9000-14000/certification/publicizing/publicizing_6.html. SCC uses the term certification.

distance. SaskPower's aggregate generating capacity is 3,655 megawatts (MW). This includes the 3,206 MW capacity of SaskPower's own facilities –three coal-fired stations, seven hydro stations, four natural gas stations and two wind generation facilities. SaskPower has 2,425 permanent full-time employees who are employed in three business units, eight corporate groups and three wholly-owned subsidiaries.

5.1.2 Why Did SaskPower Decide to Implement ISO 14001?

In the mid to late 1990s, SaskPower went through a major reorganization. It needed to invest in better business processes, including processes to bring its environmental management into line with other companies who were increasingly putting more effort into controlling and minimizing the impact of their operations on the environment. This trend towards increased environmental commitment was supported by the activities of the International Organization for Standardization Technical Committee 207,[22] who were just finalizing ISO 14001, the new environmental management standard.

SaskPower had some early experience with an environmental management system (EMS) and insight into ISO 14001 since it had participated in a Canadian Standards Association EMS Pilot Program in 1995-1996. With this experience in hand, and the desire to implement a world class EMS, SaskPower decided to adopt ISO 14001 as the vehicle for their EMS. In October 2000, SaskPower was the first full service electrical utility in Canada to be registered corporate-wide to ISO 14001. Its smaller size made the logistics of implementing ISO 14001 more manageable than it was for larger utilities.

Currently each member of the Canadian Electrical Association (CEA) is required to have an EMS in place and the CEA is the first industry association in Canada to set a timetable for its members to establish an EMS system consistent with the requirements of the international ISO 14001 standard.[23]

5.1.3 ISO 14001 Implementation

SaskPower decided to implement ISO 14001 on a corporate-wide basis including in all of its subsidiaries. This was a big undertaking that involved the partitioning of the organization into 8 registerable units. Subsidiaries were included under the Corporate Registerable Unit (RU) and implementation for this unit was carried out in the same manner as for other business units.

ISO 14001 Implementation Strategy

- Current state assessment – Gap analysis
- Senior executive commitment
- Software selection
- Project organization: – 8 RUs (Registerable units) with EMS representatives, and a 2.5 person dedicated team
- Initial consultant support
- Identify and select a registrar
- Submit documentation to registrar for review
- Undergo registration audits

Having corporate wide registration was advantageous for many reasons. From a marketing perspective, it helped to bolster credibility on the domestic and international stage ─ at the time, one of SaskPower's divisions, SaskPower International, was actively involved in seeking out international opportunities and ISO 14001 certification provided added credibility with foreign customers.

ISO 14001 was a relatively new standard when SaskPower began its implementation, so the company was not able to benefit from the experiences of other utilities; however,

[22] ISO TC 207 Environmental Management chaired by Canada.
[23] http://www.canelect.ca/en/industryissues/industry_issues_environment_ecr_response.html

similar systems such as BS 7750[24] and EMAS[25] had been in place in Europe and appeared to be successful. ISO 9000, the quality management standard, had also been well-established internationally. In addition, a small number of other companies involved in the CSA Pilot were impressed with the ISO 14001 standard and saw its potential for application in Canada.

SaskPower followed a rigourous implementation plan for ISO 14001 (see text box, ISO 14001 Implementation Strategy). Each of the 8 units to be registered were required to undertake a gap analysis to determine the scope of work that would be required to upgrade their existing environmental management practices to the new ISO 14001 standard. Based on the results of the gap analysis, each unit was required to prepare a separate implementation strategy and set a budget. Extremely important to the successful implementation of ISO 14001 was unwavering senior management commitment and an understanding that the work was just beginning with the achievement of ISO 14001 registrations. The process of implementing and registering to the ISO 14001 standard took five years from start to finish. One of the cornerstones of ISO 14001—and SaskPower's implementation of it—is a total commitment to continuous improvement (see text box, Implementation Timeline).

Implementation Timeline

1995–Business Unit Review and Recommendations

1996–Benchmarking and EMS Options

- Canadian Standards Association (CSA) Pilot Project

1997

- January–EMS Gap Analysis
- June–Executive Approval to Proceed with ISO 14000 EMS implementation
- December–ISO 14000 Software and Consultant Selected

1998/99

- ISO 14000 Implementation at SaskPower

1999/2000 and ongoing

- Internal Audits (for each of the 8 RUs)
- 1999/2000–Registration Audits (for each of the 8 RUs)

Taking the time to ensure work groups in each RU were involved in implementation and that they took ownership of their own EMS was very important. Having permanent, dedicated resources at the corporate level was not only key to successful implementation of ISO 14001 but it also helped and continues to help ensure that the EMS remains a high priority at SaskPower.

The direct costs of the implementation phase were tracked; however, this tracking did not include the identification of indirect costs associated with time spent by non-project team personnel. For the most part, non-project team personnel who were involved in the implementation phase had some environmental responsibilities already associated with their positions, so the time spent on ISO 14001 was deemed to be related to their normal duties.

5.1.4 Setting Targets and Objectives

Goals and objectives were set for each of the eight RUs, with the primary target of achieving ISO 14001 registration for each unit within prescribed timeframes. Initial targets were mainly quantitative and were based on implementing all the required components for each element of the standard for each RU's significant aspects[26].

Some examples of the kinds of targets that were set for an EMS are shown here. (see Exhibit 2, Environmental Management System: Sample Objectives and Targets)

[24] British Standard (BS7750) is a specification for an environmental management system.
[25] EMAS - the Eco-Management and Audit Scheme, is a voluntary initiative designed to improve companies' environmental performance.
[26] An environmental aspect is the element of an organization's activities, products or services that can interact with the environment.

Exhibit 2: Environmental Management System: Sample Objectives and Targets[27]

ISO 14001 Registrable Unit	Objective	Target	Results
Boundary Dam Power Station Coal-fired generation with installed capacity of 874.5 MW	Reduce particulate emissions	Install an ESP on BDPS Unit #5 designed to achieve a 99% particulate removal rate by November 2001 in accordance with Saskatchewan Environment partnership	ESP on BDPS Unit #5 was successfully installed in June 2001
Shand Power Station Coal-fired generation with installed capacity of 305 MW	Reduce and/or maintain SO_2 and NO_x emissions	Meet SO_2 emission targets of 476 ng/J, and NO_x emission targets of 258 ng/J by year end as agreed with provincial and federal regulatory authorities	SO_2 emissions were reduced to below 476 ng/J, and NO_x emissions were reduced to well below the targeted level of 258 ng/J by year end
Poplar River Power Station Coal-fired generation with installed capacity of 610 MW	Reduce potential of spills from power station ash system	Replace ash lines by 2004	Replacement of ash lines is 35% complete
Western Plants Natural gas-fired generation with installed capacity of 385.5 MW	Reduce potential of oil entering the south Saskatchewan River through circulating water system	Redesign the oil cooling system for Units #1 and #2	Oil cooling system is redesigned, installed and operating on QEPS Unit #1; installation of system on Unit #2 is planned for 2002.
Northern Hydro Hydroelectric generation with installed capacity of 854.5 MW	Maintain or improve fish population in the Saskatchewan River	Complete E.B. Campbell fish stranding investigation, to determine if the fish populations are affected by the Nipawin Hydro Station and look at alternatives to correct the problem	Field work on the effects of E.B. Campbell Hydro Station operations on fish stranding was carried out in the fall of 2001; work is ongoing with the Saskatchewan River Issues Committee to determine the need for fish raising ponds on Codette Lake

(Continued on next page)

[27] SaskPower Environment Review 2001, page 4.

Exhibit 2: Environmental Management System: Sample Objectives and Targets

(Continued)

ISO 14001 Registrable Unit	Objective	Target	Results
Transmission & Distribution Service area of 526,600 square kilometers	Reduce impacts to land and water associated with the use of herbicides for vegetation management on transmission line rights-of-way	In cooperation with Saskatchewan Environment, develop an environmental protection plan for northern transmission line rights-of-way	The environmental protection plan has received approval by Saskatchewan Environment and implementation is underway
Fuel Supply Acquisition of fuel (coal, natural gas, and water) and sorbent (gound limestone) and administration of related contracts for generating stations	Reduce potential of pesticides and oil-based substances from entering the constructed wetlands near Estevan	Ensure compliance by the City of Estevan with the operating agreement for the constructed wetlands	Sampling and analyses provided data indicating no evidence of extraneous substances from the City of Estevan pumped to the wetlands in 2001; monitoring of the process is ongoing
Corporate Support Groups Includes Shand Greenhouse, Customer Services, SaskPower International and others	Maximize production and survival of trees and shrubs at the Shand Greenhouse near Estevan	Increase production of plants by 30% by 2003	In 2001, over 480,000 trees and shrubs were distributed, far exceeding the objective of a 30% increase in production

The use of customized software and a series of directed questions for each element of the EMS were very effective in tracking progress. Another key tactic was to involve local staff with the implementation and encourage them to set their own objectives and timelines. This helped to promote ownership of the EMS.

Baselines were established for each of the 8 RUs using their existing environmental practices. The common target of achieving ISO 14001 registration was embraced by all of the RUs. Achieving the registration was a greater challenge for some RUs than for others. Depending on the outcome of the gap analysis, some significant changes were required to the existing EMSs to qualify for ISO 14001 registration. Fortunately, initial registration was achieved for all RU's by 2000. A dedicated implementation team and the cooperation of RU Managers and designated EMS representatives at each RU facilitated steady progress through to registration. Progress is still measured today, in part, by maintenance of registration of each RU following successful annual EMS audits.

SaskPower had to do some things quite differently as a result of ISO 14001 implementation. It added two levels of annual EMS audits, and designated EMS representatives in each of the 8 RUs. It established and continues to maintain 2.5 full-time EMS positions in the Corporate Group as well as the equivalency of a full time person in

the Transmission and Distribution area. SaskPower initiated Vice President EMS meetings with each of the 8 RUs, increased and improved environmental training, and increased reporting on the EMS.

5.1.5 Maintaining ISO 14001 Registration

SaskPower continues to manage and monitor the EMS with staff from the Corporate Environment Group and the Transmission and Distribution area working closely with local staff in each RU, as well as with various managers and vice-presidents to ensure all ISO 14001 elements remain implemented at satisfactory levels. Annual internal and external audits are required for ongoing registration, and efforts are directed towards setting and achieving objectives, targets and programs that lead to continuous improvement. Now that these processes have been in place for several years, they are well integrated into work procedures and job responsibilities. The ongoing management from the Corporate Environment Group ensures that the EMS remains a priority across the RUs.

5.1.6 Benefits of Adopting the ISO 14001 Standard

Quantifying benefits, especially in terms of dollars saved, is difficult. Although SaskPower knows it is doing a better job of managing its environmental performance, there were few adverse incidents in the past that resulted in large cash outlays or penalties which could be used as a barometer to estimate savings.

Overall, SaskPower believes that it is operating more efficiently as a result of implementing ISO 14001. These efficiencies have allowed SaskPower to do more things with the same resources and to do other things more diligently. However, because of the undertaking of new activities, the efficiency gains are partially offset by increased costs. For example, SaskPower is now more effective at updating, tracking and interpreting legal requirements, which saves time, but it is spending more time and effort on training staff regarding the content of acts, regulations, bylaws and their impacts on operations. Just in the area of regulatory compliance alone, SaskPower estimates that it has saved 50 person days per year.

5.1.7 Risk Management Benefits

When looking for benefits from an ISO 14001 based EMS, it is important to keep in mind that the 14001 Standard is a 'process' standard and not a 'performance' standard. As a result, the achievements from the implementation of an EMS may not translate directly into obvious performance improvements. For example, much of the benefit of implementing ISO 14001 is directed at avoidance of environmental risks. Quantifying the benefits of avoiding environmental risk is difficult, as it is tough to link a reduction of ‘adverse incidents’ directly to the implementation of an EMS. It is impossible to know with certainty what adverse incidents would have taken place in the past if ISO 14001 had not been implemented. However, it is possible to model the determinants of adverse incidents and control for the impact of the adoption of ISO 14001.

Take for example, the number of reportable spills[28] that take place in a year. Such spills are very dependent on the weather. Canadian spill statistics for 1998 are highly distorted because of the destruction of transformers during the ice storm in Quebec and Ontario.

[28] A reportable spill requires reporting to an external body. A priority spill is a reportable spill which contains petroleum or PCB material and is greater than 500 litres or enters a waterbody.

The consequent spills were totally beyond the control of any EMS. Thus any modelling of reportable spills would need to control for weather.

In 2005, the most recent year for which data are available, SaskPower had 15 reportable spills, which was slightly under the 5-year average. One might ask two questions: Was the result significantly positive? If so, was it attributable to the new EMS? The decrease is probably indicative of a positive result because over the previous 5 years, SaskPower had added facilities and increased the number of employees—all items which could be expected to increase the potential for spills. Answering the question of whether the decline in spills was due to a new EMS is more difficult but SaskPower is convinced that ISO 14001 implementation has definitely helped it to manage and avoid environmental risks.

SaskPower believes that it has benefited significantly by implementing ISO 14001. Management has increased confidence that through the rigor of ISO 14001 and the discipline imposed around the identification of negative consequences, environmental risks are being identified and better managed. Risks have always been managed at SaskPower, for example, risks associated with PCBs, but since ISO 14001 was implemented procedures have been improved, quality training is in place, and documentation and record keeping is better. ISO 14001 implementation is further bolstered by EMS audits and oversight by the Corporate Environment Group.

5.1.8 Improved Regulatory Efficiencies

Another intrinsic benefit of ISO 14001 registration is the credibility that it brings to the EMS and to SaskPower. The public and regulators accept the rigor and quality control of the ISO Standards and they respect the third party audit process, which lends added credibility. By adhering to criteria around “legal and other requirements” in the standard, SaskPower believes they have a better understanding of legal requirements and are able to improve their compliance with them. Staff are now more aware of the legal requirements, information is broadly distributed, is of better quality and is more easily available on-line. Training is more focused and regular audits ensure that ongoing attention to regulatory requirements continues.

Some specific efficiencies have resulted from ISO 14001 implementation. For example, regulatory requirements used to be tracked by each plant or facility. Dozens of staff around the province were engaged in tracking an assortment of acts, regulations and bylaws. With ISO 14001, all of this changed. SaskPower implemented a new system but designated responsibility to two people in their corporate group for ensuring that SaskPower is aware of current legal requirements, that these requirements are available electronically to all staff in the province, and that they are respected and maintained. This is especially important given the need to stay up to date with changing regulations, for example, the expected need to reduce air emissions and monitor the impact of operations on affected wildlife habitats over the next decade. SaskPower now has a more efficient system that does a better job with fewer resources, thus freeing up field staff for other important work. This is an obvious productivity improvement—although one that is difficult to quantify because the amount of time spent on regulatory review was not specifically tracked prior to ISO 14001 implementation.

SaskPower provided some rough estimates of the costs and savings. Before ISO 14001 implementation, SaskPower had approximately 30 people spending an average of 2 days per year working on more than 130 environmental acts, regulations and by-laws applying to SaskPower’s various operations. SaskPower now has 2 people who spend about a week each throughout the course of the year working on regulations resulting in a savings of 50 person days per year. As well, the quality, monitoring and availability of their

environmental regulations are significantly better than they were prior to ISO 14001 implementation.

SaskPower is just beginning to see another benefit of ISO 14001 implementation—a reduction in their regulatory burden that is demonstrated by a decline in the number of permits required and a lessening of reporting requirements from provincial regulators. Currently SaskPower's permit to upgrade their Boundary Dam Power Station is under review by Saskatchewan Environment with the intention to make the process quicker and more streamlined. ISO 14001 registration and ongoing scrutiny of operations by third party registration audits provide regulators with the confidence that requirements are being met.

5.1.9 Better-Trained Staff

SaskPower is also more confident that their staff are increasingly competent, more aware, and better trained regarding the environmental aspects of their work than they were prior to ISO 14001 implementation. The ability to provide staff with effective training is especially important to SaskPower. It faces a particular challenge because 31% of its workforce is expected to retire in the next ten years. There is also a shortage of skilled trades people needed to support power plant construction retrofits and maintenance which has been further exacerbated by the opportunities in the Alberta oil sands. ISO 14001 has resulted in the development of established training requirements for positions with environmental responsibilities. Records are kept, training is tracked by the EMS, and training reps have been designated in each of the RUs. Training reports are generated, and training compliance is audited.

Although the human resources department at SaskPower does not track applicant enquiries regarding ISO 14001 implementation, it is clear that candidates are pleased to work for a company that is environmentally progressive. Applicants for designated environmental jobs have mentioned and inquired about SaskPower's ISO 14001 program.

5.1.10 Tracking Progress

SaskPower's monitoring and reporting on environmental issues and incidents has improved since ISO 14001 has been implemented, allowing management to be in a better position to make changes to policies and procedures at an earlier stage. PCB[29] Storage and handling is an area that has seen improved procedures, monitoring and compliance as a result of the EMS. Enhanced waste management practices such as increased recycling have also been implemented under the EMS.

Two elements of ISO 14001 that have definitely contributed to improvements at SaskPower is the requirement to establish objectives and targets, and to audit progress against their achievement. Establishing and broadly communicating objectives is one very good way to focus resources; tracking progress continually against objectives significantly aids in ensuring that the objectives are achieved. For each objective that is successfully met, there is an incremental improvement in the EMS. Each negative finding identified during a system audit, results in corrective action and another incremental improvement to the EMS. ISO 14001 implementation has helped to support a climate of continuous improvement at SaskPower.

From the perspective of SaskPower's senior management, and their Board of Directors, ISO 14001 provides good evidence that a high level of attention has been directed toward management of the corporation's environmental issues.

[29] Polychlorinated biphenyls.

5.1.11 Conclusion

In conclusion, SaskPower has seen a number of benefits to ISO 14001 implementation as summarized below, although it is tough to assign an actual dollar value to them.

- added credibility with customers and regulators;
- increased confidence that environmental risks have been identified and are being managed;
- improved understanding and compliance with legal requirements;
- enhanced confidence of senior executives that a high level of attention has been directed towards the management of the corporation's environmental issues;
- more effective deployment of staff resources in managing and complying with regulations;
- better trained and environmentally sensitive staff;
- improved monitoring and reporting on environmental risks;
- reduced regulatory burden;
- greater focus and attention to priority areas through objective setting and progress monitoring.

SaskPower plans to maintain registration to ISO 14001 over the long term. In fact, since the successful implementation and ongoing use of ISO 14001, SaskPower is confident of its benefits and sees it as a very effective management tool, which ultimately leads to improved environmental performance. SaskPower would likely consider implementing other ISO standards in future.

5.2 INFASCO

5.2.1 About INFASCO

INFASCO, a division of IFASTGROUPE LP Inc. is one of the largest producers of standard steel fasteners in the world. Unique to INFASCO and part of the reason for its success is its vertically integrated manufacturing process. For example, most of the wire rod used in the making of its fasteners comes from IVACO Rolling Mills, one of its sister companies. Key processes such as annealing[30] , pickling[31] , cold forming[32] and heat treating are all performed at its Marieville manufacturing plant, while various plating processes for fasteners are done at a sister company, Galvano, another member of Ifastgroupe LP Inc. Vertical integration provides INFASCO's distributors with a higher quality fastener at a competitive price and also offers other benefits such as absolute traceability, single source testing and documentation.

In an effort to produce higher quality fasteners more efficiently and at a lower cost, INFASCO continuously acquires state-of-the-art equipment and technologies. Some examples of this include:

[30] Annealing is a heat treatment that alters the micro structure of a material causing changes in properties such as strength and hardness.

[31] Pickling is a treatment of metallic surfaces in order to remove impurities, stains, or scales with a solution called pickle liquor before subsequent processing, such as extrusion rolling or galvanizing.

[32] Cold forming is a manufacturing process where metal is shaped without removal of material, thus cold forming the component. A blank is placed within a die and a punch is pressed into the blank to cold form the part. The blank then takes on the form of the punch and the die.

- Computerized Statistical Process Control (SPC) throughout the manufacturing process;
- Soft Drop handling equipment to protect thread integrity;
- Spectrometric chemical analysis equipment;
- Computerized non-contact dimensional measuring equipment;
- Accreditation to ISO/IEC 17025;
- Magnaflux examination equipment;
- Continuous human resource development and training.

In fact, INFASCO is quickly transforming its supply chain by integrating products, customer service, and inventory management with state of the art systems that can eliminate duplicate activities, lower inventories and reduce overall costs.

From a 1 million square foot manufacturing plant located outside Montreal in Marieville, INFASCO supplies a network of warehouses located across North America (5 in Canada and 7 in the United States). INFASCO fasteners are shipped by air and sea to more than 30 countries on five continents. INFASCO is committed to excellent service and maintains some of the world's largest inventories of raw materials and finished fasteners. At any point in time, more than 30,000 tons of fasteners are inventoried at its main warehouse in Montreal. Customers benefit from shorter lead times due to its distribution network and inventory control.

Fastener Quality Act

The Fastener Quality Act (FQA), Public Law 101-592, was signed by President Bush on November 16, 1990. Since its enactment the FQA has been amended three times (Pub L. 104-113, Pub L. 105-234, and Pub L. 106-34) to further clarify and define the requirements of the original Act.

The Act protects the public safety by: (1) requiring that certain fasteners sold in commerce conform to the specifications to which they are represented to be manufactured, (2) providing for accreditation of laboratories engaged in fastener testing, and (3) requiring inspection, testing and certification in accordance with standardized methods.

5.2.2 What Drove the Move to Standardization at INFASCO?

In the 1990's, INFASCO recognized that its business was being significantly impacted by a piece of legislation, called the Fastener Quality Act, that was passed in the United States to protect American consumers from poor quality fasteners that were increasingly being imported into the United States. This act essentially required that companies in the fastener business be accredited to ISO/IEC 17025 (formerly Guide 25) or endure very difficult and onerous inspection processes at the United States border. Since more than 50% of INFASCO sales were to the United States, INFASCO had to become accredited or they would be out of business.

INFASCO also chose to go through the ISO 9001 registration process at the same time as it was accreditated to ISO/IEC 17025. ISO/IEC 17025 provides the general requirements for competence of testing and calibration laboratories which are very important to INFASCO's business since it is always manufacturing fasteners to technical standards such as the Society of Automotive Engineers (SAE), or American Society for Testing and Materials Standards (ASTM).

Accreditation to ISO/IEC 17025 also solved a smaller but ongoing problem encountered by INFASCO ─ how to prove to customers that the fasteners they produced were manufactured using appropriate quality processes. Hard questions were being asked about these processes by customers who were frequent visitors to the plant. For example,

customers wanted to make sure that procedures were in place to make sure that if they purchased 1000 nuts and bolts from one lot, that the fasteners were all manufactured from the same steel. Without appropriate testing and quality management procedures in place, there would be no way of guaranteeing that there had not been a mixing of raw materials. Traceability was extremely important.

5.2.3 Implementing ISO 9001

INFASCO benefited significantly from the experiences of its sister company, Galvano, which had implemented ISO 9001 in 1996. Galvano was a smaller organization and was chosen as the first in the Ifastgroupe of companies to go through the ISO 9001 process.

Galvano's experiences helped INFASCO so it was able to complete the registration process in under a year. The decision to register was made in 1998, and registration was achieved in 1999. A brief outline of the key steps followed by INFASCO during its ISO 9001 implementation are shown here. (See textbox, ISO 9001 Implementation Strategy)

ISO 9001 Implementation Strategy

- Get Top Management Commitment
- Hire ISO 9001 Implementation Consultant
- Train Personnel
- Prepare Quality Policy Manual and Documentation
- Prepare Operating Procedures
- Hold Internal Audit
- Select registrar
- Go through the registration process
- Take corrective action
- Obtain ISO 9001 registration

5.2.4 Benefits from ISO 9001 and ISO/IEC 17025 Implementation

INFASCO considers that ISO 9001 registration and ISO/IEC 17025 accreditation have provided them with some outstanding benefits. In fact, without this, it is unlikely that INFASCO would be in business today. It would have lost much of its American customer base and would not be able to compete in today's environment especially given the increasing appearance of low cost fasteners from emerging market countries. With accreditation to ISO/IEC 17025 and registration to ISO 9001, customers have confidence that INFASCO meets their quality requirements.

ISO 9001 quality processes have also helped INFASCO to develop excellent customer service. As a company selling a highly technical product, detailed scrutiny of each customer contract is needed to make sure that the right quantity, of the right fastener, composed of the right material is being sent to the right client at the right time. Contract review is done in the same standardized way for every order. The sales agent goes through many steps but the result is fewer customer surprises.

In a company such as INFASCO that sells thousands of varieties of low margin items such as nuts and bolts, inventory control is tedious, and complex but highly important. ISO 9001 provides the procedures necessary for good warehouse management and storage procedures. It also gives management the confidence that the information provided by

About ISO 9001

The ISO 9000 family of standards is widely known. ISO 9000 has become an international reference for quality management requirements in business-to-business dealings.

The ISO 9000 family is primarily concerned with "quality management". This covers what an organization does to fulfill:

- the customer's quality requirements,
- applicable regulatory requirements

while aiming to enhance customer satisfaction, and achieve continual improvement of its performance in pursuit of these objectives.

ISO 17025 is an International Standard (published by the International Organization for Standardization) that specifies the general requirements for the competence to carry out tests and/or calibrations. There are 15 management requirements and 10 technical requirements. These requirements outline what a laboratory must do to become accredited.

these systems is accurate. Therefore, there is no need to over-inventory an item just in case. Sales agents know and trust their inventory levels and customers are rarely disappointed.

ISO 9001 and ISO/IEC 17025 quality processes now mean that INFASCO has better metrics on its performance. For example, INFASCO uses two important quality measures: its internal and external rejection rates. These measures are publicly posted in the manufacturing facility and production teams strive to keep the reject rate low. The internal rejection rate is the proportion of product that is scrapped by the internal quality team prior to customer shipment; the external rejection rate is the proportion rejected by the customer. The targets are determined annually at the management review meeting which is a key requirement of the ISO 9001 standard.

INFASCO has also improved its ability to ensure that its products meet standard specifications. INFASCO does not manufacture or design customized fasteners. It produces fasteners that meet a given standard, for example an SAE standard. Through external document control, a requirement of ISO 9001, any update of the SAE standard is immediately implemented within INFASCO's quality procedures. With ISO 9001, procedures are in place to ensure that all processes are regularly updated, verified, and audited and that corrective action is taken when gaps are identified.

Another benefit of ISO 9001 introduction at INFASCO was the implementation of formalized training programs in the key areas of INFASCO's activities which is another requirement of ISO 9001. In the early 2000's, a number of key employees retired from INFASCO. These retirements were quite worrisome to the organization; however, the investment that INFASCO had made in ISO 9001 and training programs infrastructure provided the unexpected benefit of serving as a source of corporate memory, with the added advantage of being in the form of well documented processes and procedures; consequently they were less affected by the personnel turnover.

ISO 9001 and ISO/IEC 17025, with their standardized approaches to documentation have also made it easier for INFASCO to train and develop new staff. All customer service staff attend a many-week training program inside the plant and in its quality assurance area. In addition, cross training is provided in the other sister companies. As well, many technical staff participate in consensus based standards development organizations to provide their expertise and to learn. The result of this training is well demonstrated when INFASCO participates in trade shows and technical seminars for the industry. INFASCO staff are proud of their company's commitment to quality.

5.2.5 Conclusion

INFASCO has benefited in many ways from implementing ISO 9001 and ISO/IEC 17025. A summary of these benefits is highlighted here:

- financial viability and continued ability to ship to customers in the United States;
- increased credibility with customers;
- excellent customer service;
- better inventory control;
- better performance and performance metrics;
- improved quality and ability to meet standard specifications;

- better knowledge management; and,
- better training for staff.

INFASCO is completely committed to standardization and attributes much of its business success to it. It continues to renew its ISO 9001 registration and ISO/IEC 17025 accreditation and has recently been registered to the ISO 14001 Environmental Management System Standard. If INFASCO were to change anything about its experiences with standardization, it would have been to adopt the appropriate quality management standards at an earlier date.

Appendix 1 – Bibliography

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Appendix 2 – Methodology and Detailed Econometric Results

Methodology

The empirical model used in this analysis is similar to the aggregate model used in DTI (2005). The model is based on the assumption that aggregate economic output can be represented by a production function that takes following the form:

$$Q_t = A_t K_t^{\alpha} L_t^{(1-\alpha)}$$

The model states that output for the economy (Q_t) is a non-linear function of multifactor productivity (A_t), the capital stock (K_t), and the quantity of labour (L_t). In this production function capital and labour inputs are combined to produce output. The ability of capital and labour to produce output is augmented by the level of technology and efficiency in the economy that is captured in the multifactor productivity term.

In this model labour productivity, or output per hour worked, can be thought of as arising from two sources as shown in the following equation:

Labour Productivity	=	Contribution of Multifactor Productivity	+	Contribution of Capital Deepening		

Capital deepening represents an increase in the amount of capital per worker. For example, consider the case of the production of rail transportation services. A single train engineer can produce more transportation services (transported goods for example) with 12 rail cars than with 6 rail cars.

Multifactor productivity is itself divided into two parts: knowledge and efficiency. Standards, patents, research and development, and imports of foreign technology are some factors that have an impact on knowledge or technological capacity. Standards, improvements in infrastructure and structural shifts in the economy such as labour mobility between industries are some factors that have an impact on the level of efficiency in the economy.

Standards can thus potentially play an important role in enhancing multifactor productivity. For example, consider the case of rail transportation services again. Suppose we initially begin with one train engineer, an engine, and 6 rail cars. An addition of 6 rail cars represents a significant capital deepening. Standardization ensures that this capital deepening is translated into increased output. If the couplings on the 6 new rail cars were incompatible with the old rail cars the additional capital would not result in an increase in output.

In this study multifactor productivity is modeled as a function of time and the number of standards. Multifactor productivity is assumed to take the functional form:

$$A_t = \exp(\lambda T_t) \times STA_t^{\varepsilon}$$

where T_t is a time trend vector and STA_t is the number of standards in year t. Additional variables, that might in principle be important in explaining multifactor productivity, are excluded from the analysis because of the short time period analysed.

These assumptions on the production function and multifactor productivity yield the following model for labour productivity:

$$\ln(Q_t / L_t) = \beta + \alpha \ln(K_t / L_t) + \lambda T_t + \varepsilon \ln(STA_t)$$

In this model $\ln(Q_t / L_t)$ is the natural logarithm of labour productivity, $\ln(K_t / L_t)$ is the natural logarithm of capital-to-labour ratio which captures capital deepening, T_t is a time trend vector, STA_t is the number of standards, and u_t is an error term.

Empirical Implementation and Results

The first step in the analysis was to examine the individual variables themselves to determine whether or not they exhibited stochastic (or random) trends. The choice of estimation method depends upon whether or not the variables exhibit stochastic trends. Labour productivity, the capital-to-labour ratio, and the number of standards all exhibited stochastic trends indicating that the cointegration techniques first developed by Engle and Granger (1987) are the appropriate ones to use for the analysis.[33]

The empirical model estimated is given by:

(Equation 1) $$\ln(Q_t / L_t) = \beta + \alpha \ln(K_t / L_t) + \lambda T_t + \varepsilon \ln(STA_t) + u_t$$

where $\ln(Q_t / L_t)$ is the natural logarithm of labour productivity, $\ln(K_t / L_t)$ is the natural logarithm of capital-to-labour ratio, T_t is the time trend vector, STA_t is the number of standards, and u_t is an error term. The time trend vector includes two elements to capture an important structural shift in the Canadian economy that occurred as a result of the North American Free Trade Agreement (NAFTA) coming into effect in 1994. A structural change, such as NAFTA, may cause changes in demand patterns across industries. This change in demand patterns may lead to changes in the efficiency with which capital and labour are used as, for example, labour shifts between industries. Thus, “Trend 1” is a deterministic trend from 1981 to 1993 and takes the value of zero from 1994 on and “Trend 2” takes the value of zero from 1981 to 1993 with a deterministic trend beginning in 1994.

Estimating long run models such as the one given in Equation 1 when the variables have stochastic trends may lead to incorrect conclusions about the significance of the relationship among the variables of interest. Engle and Granger (1987) proposed a widely accepted methodology to determine whether the results from estimating a long run model in which the variables have stochastic trends are meaningful. In the first step, a long run model, such as the one given in Equation 1, is estimated. The residuals or errors from the

[33] Augmented Dickey-Fuller tests were performed on the natural logarithms of labour productivity, the capital-to-labour ratio, the baseline stock of standards, and the two additional measures of standards. These tests included a constant and a linear trend. Because of the short length of the time series a lag length of 1 was chosen. In all cases the tests were unable to reject the null hypothesis of a unit root (i.e. the presence of stochastic trend) at the 10% level.

estimation, in this case u_t, are then tested using an Augmented Dickey-Fuller (ADF) test to see whether they contain stochastic trends. If they do not contain stochastic trends then the conclusions based upon the estimation results can be considered meaningful.

The results from estimating Equation 1 are presented in Exhibit A1 below.

Exhibit A1

Estimation Results for Existing Number of Standards (in logarithms)

Sample: 1981 to 2004

Method: Least Squares

Variable	Coefficient	Std. Error	T-Statistic	P-Value
Constant	-1.058	0.697	-1.516	0.1459
Log (Number of Standards)	0.356	0.070	5.070	0.0001
Log (Capital-to-Labour ratio)	0.550	0.069	7.984	0.0000
Trend 1	0.003	0.001	2.733	0.0132
Trend 2	0.023	0.002	13.369	0.0000

Adjusted R-squared:	0.976725
Durbin-Watson statistic:	1.851447
ADF test of the residual:	-4.3227
P-value for ADF test:	0.0028

Notes:

a) Standards errors are White heteroskedasticity-consistent standard errors.

b) The P-Value represents the degree of certainty with which we can reject the hypothesis that the variable has no impact on labour productivity.

c) The ADF test of residual included a constant and lag lengths were chosen using the Schwartz Information Criteria.

The ADF test of the residual reported near the bottom of the table indicates that the residuals from the model do not contain stochastic trends. This suggests that the results obtained from estimating the model are not spurious. Both capital deepening, as measured by the capital-to-labour ratio, and the existing number of standards have a significantly positive impact on labour productivity.

The Results in Context

The results from estimating the coefficients in the labour productivity equation show that the elasticity of labour productivity with respect to the number of standards is estimated to be 0.356 (see Appendix 2, Exhibit A1) and is found to be statistically significant. This means that a 10 per cent increase in the number of standards would lead to a 3.56 per cent increase in the level of labour productivity (output per hour worked).

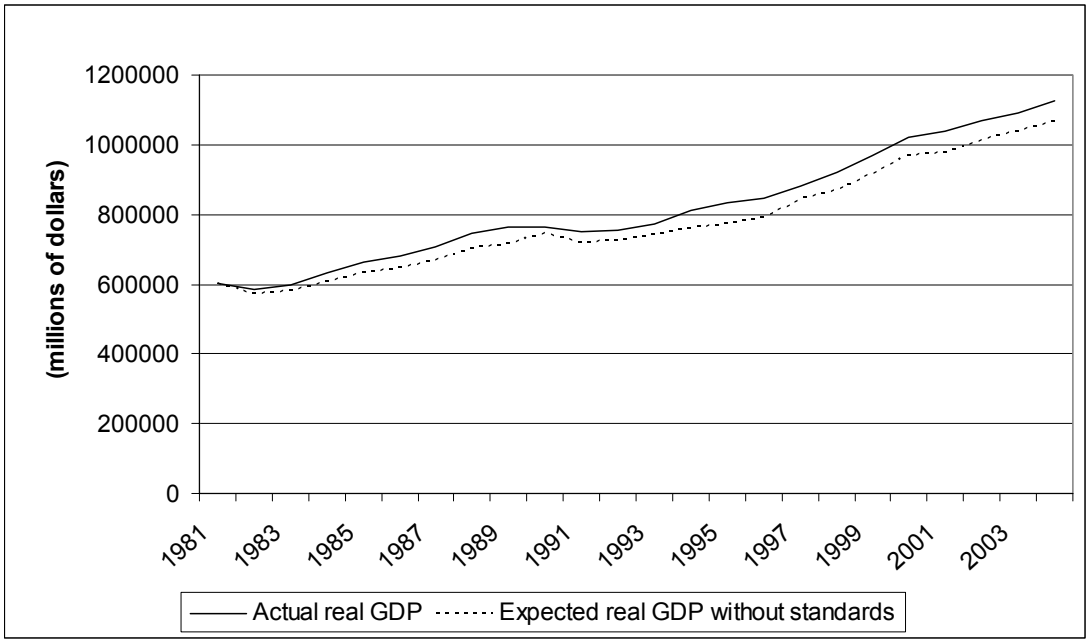
Over the 1981 to 2004 time period the number of standards rose 0.69 per cent on average per year. Given the relatively low growth rate in the number of standards in Canada and the relatively high estimate of the elasticity of labour productivity with respect to the

number of standards (0.356), on average, growth in the number of standards contributed 0.246 percentage points to the growth rates of labour productivity and output (real GDP) in each year. Thus, the results suggest that growth in the number of standards accounted for 17 per cent of the labour productivity growth rate and about 9 per cent of the growth rate in economic output (real GDP) over the 1981 to 2004 period.

The implications of these findings for the evolution of economic output are significant. Exhibit A2 shows the evolution of actual real GDP (economic output measured in 1997 dollars) and real GDP that would be expected in the absence of standards.[34] The Exhibit shows how the effects of standards on the growth rate are cumulative. In 2004, the difference between actual real GDP and expected real GDP without standards was $62 billion. This is equivalent to 5.5 per cent of real GDP in 2004. In terms of labour productivity (output per hour worked), the results imply that in 2004 workers could produce 5.5 per cent more per hour worked than they would have been able to had there been no growth in standards over the 1981-2004 period.

Exhibit A2

Actual Real GDP and Expected Real GDP Without Standards



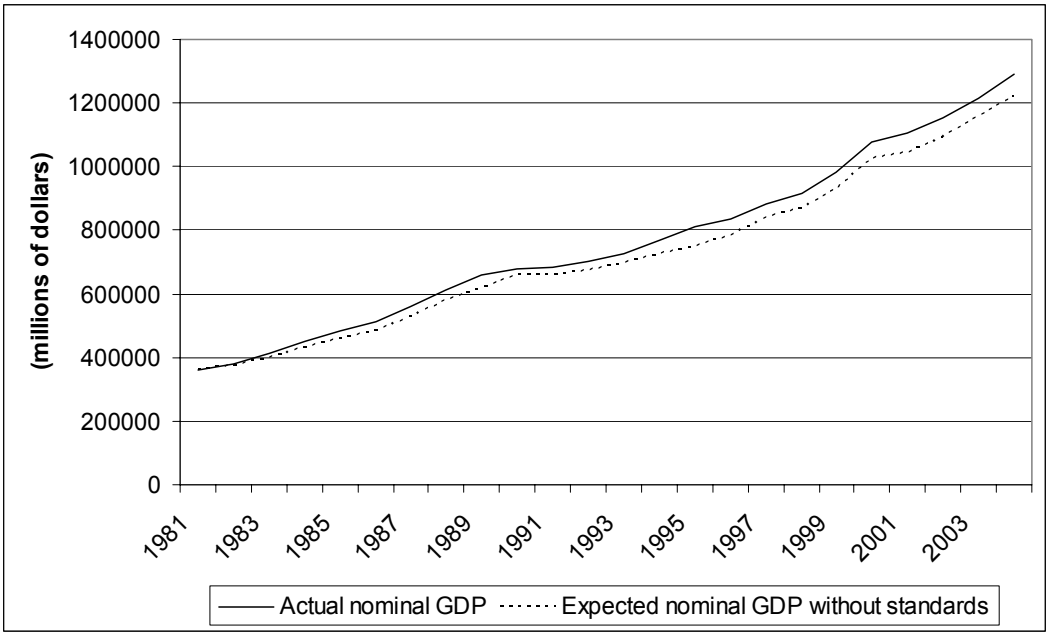
(Sources: The Conference Board of Canada; Statistics Canada; The Standards Council of Canada).

[34] The expected real GDP without standards was calculated as follows. First, for each year between 1982 and 2004, the percentage point impact of standards on real GDP growth was calculated by multiplying the growth rate of the quantity of standards in that year by the elasticity of labour productivity with respect to the number of standards (0.356). Second, for each year the growth rate of real GDP in the absence of standards was calculated by subtracting the percentage point impact of standards on real GDP growth from the actual growth rate of real GDP. Finally, a series for expected real GDP without standards was created by applying those growth rates to the actual value of real GDP in 1981. For example, in 1981 actual real GDP was $600,253 million. In 1982 and 1983 the expected growth rates of real GDP in the absence of standards were (approximately) -4.5 per cent and +1.5 per cent, respectively. Thus, expected real GDP without standards would be calculated to be $573, 241 million (=$600,253 million*(1+(-0.045)) in 1982 and $581,839 million (=$573,241*(1+(0.015)) in 1983.

Exhibit A3 shows the evolution of actual nominal GDP (economic output measured in current dollars) that would be expected in the absence of standards.[35] In 2004 the difference between actual nominal GDP and expected nominal GDP without standards was $71 billion.

Exhibit A3

Actual Nominal GDP and Expected Nominal GDP Without Standards



(Sources: The Conference Board of Canada; Statistics Canada; The Standards Council of Canada).

[35] The expected nominal GDP without standards was calculated by multiplying the expected real GDP without standards by the implicit price deflator for GDP.

Appendix 3 – Outline of Inquiry

Participation in the process of developing standards

- To what degree has your organization been involved in developing standards used in your industry (technical or management system standards)?
- What have been the positive and negative aspects of this process / involvement?

Strategic importance of standards

- To what degree does standardization play a role in the success or failure of your business (and/or specific products or services)?
- Thinking of the various types of standards in your business – product standards, management system standards, conformity assessment / testing standards, accreditation standards either national or international standards – how do they each affect your business? Which are more important to your business and why?

Globalization and adapting to the standards of foreign markets

- To what degree does standardization in your industry / sector encourage or discourage global competition?
- To what degree does your industry face more global competition as a result of international standardization? Could you provide examples?
- To what degree has this changed over the past five years? What do you see happening in future?

Costs/Savings as a consequence of standardization

- To what degree do you see standardization having an impact on transaction costs?
- What are the effects of standardization on your productions costs? Could you quantify this?
- What are the opportunity costs of not having a standard where it would be better had one existed?

Effects of standardization on the "client – supplier" relationship

- How does standardization impact the client – supplier relationship? Examples?
- Has standardization ever caused you to abandon or to go to another supplier?
- To what degree does standardization impact your confidence in suppliers?
- With global supply chains becoming increasingly the norm, how do you see standards impacting these relationships?

Strategic alliances

- To what degree does standardization make it easier or harder to form strategic alliances with other companies? How do they do this? Could you give us examples?
- To what extent do your strategic alliances or consortiums engage in standard development among themselves? Please provide examples.
- To what extent do these alliances have special advantages? What are they?

Innovation and R&D

- To what degree does the existence of standards encourage or discourage innovation in your firm? How does standardization affect the cost of R&D?

- To what degree has standardization contributed to technology transfer in your industry? Examples?
- How have standards impacted product variety, or the development of new sectors of business?
- How does the vintage of standards impact innovation?

"Reaction time" to standardization

- How long does it typically take to establish a standard used in your industry? How does this timeframe affect the usefulness of the standard?
- Is there a relationship between the time it takes to produce a national/international standard and the lifecycle of a product?
- When do you see standards / standardization as most useful or most problematic? Could you provide an example?

Product safety/liability/public interest

- To what degree does standardization influence product safety? To what degree does standardization influence accident rates in the industry?
- Could you quantify these costs and/or benefits? Could you provide specific examples?
- Do you work with any organizations (for example consumer organizations) to help improve the safety of your product/environment?
- To what degree has standardization helped you to reduce your liability on products / services?

Standardization Bodies (including SDOs, Conformity Assessment Bodies, Accreditation Bodies)

- To what degree do you think your firm would face additional costs if standardization bodies did not exist?
- What are the major advantages and disadvantages of having such standard?

Appendix 4 – Interviewee List

Name	Title	Organization
Jim Brock	Executive Director, Manufacturing and Engineering	3M Canada
Bernard Bolen	Supervisor, Environmental Issues Management	SaskPower
Ebo Budu-Amoako	Senior Microbiologist	P.E.I. Food Technology Centre
Jim Dymond	Technical Counsellor	GE Industrial Systems
Milos Jancik	President and Chief Executive Officer	Electro-Federation Canada
Chantal Marin-Comeau	Acting Director	Canadian General Standards Board, Public Works and Government Services Canada
Abdelhaq El Ouardi	ISO Co-ordinator	INFASCO, (Division of IFASTGROUPE INC.)
Pat Keindel	President, Standards	Canadian Standards Association
Jim Mabee	Supervisor, Quality Assurance	SaskPower
Jayson Myers	Senior Vice-President and Chief Economist	Canadian Manufacturers & Exporters Association
Graham Rae Dulmage	Director, Standards & Government Relations	Underwriters' Laboratories of Canada
Daphne Stancil	Assistant Deputy Minister, Strategy, Policy and Legislation	British Columbia Ministry of Agriculture and Lands
Bob Stelzer	President and Chief Executive Officer	The Electric Safety Authority
Catherine Swift	President and Chief Executive Officer	Canadian Federation of Independent Business
Sandra Wright	Acting Manager, National Compliance and Information Systems	Health Canada