DEVELOPMENT OF AN INDEX FOR EVALUATING NATIONAL QUALITY COMPETITIVENESS BASED ON WEF AND IMD COMPILED INDICES

DOI: 10.12776/QIP.V18I1.319

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Received 12 May 2014, Revised 7 June 2014, Accepted 10 June 2014

1 INTRODUCTION

Globalization, rapid technical change, and shrinking economic distance are presenting newer challenges that change constantly causing stressful competitive environments (Lall, 2001). Meaningful attempts undoubtedly have been made to cope with this situation, including the creation of competitiveness indices that serve to evaluate and improve performance when national or international organizations implement their policies. For instance, international organizations such as the World Economic Forum (WEF) and the International Institute for Management Development (IMD) have developed and disseminated standard indices that help in evaluating and comparing the level of advancement and capabilities among countries (Cho and Moon, 2005). These indices are used not only as data for simple analyses but also as a reference data when countries must create pertinent policies. These indices also have considerable effects on the real economy.

Contrasted with research about national competitiveness, the current understanding of quality competitiveness is still inadequate, in part due to the lack of detailed indicators for measurement and management of quality. Also, businesses operating beyond their national boundaries cannot depend upon previously proven domestic quality practices (Mehra and Agrawal, 2003). Therefore, it is necessary to revise and manage its quality-based elements of competitive strategy in national level (Mehra and Agrawal, 2003).

This study presents a new index of national quality competitiveness based on the national competitiveness indices created by the world's leading organizations. The national quality competitiveness index (NQCI) offers three advantages. First, NQCI allows countries to identify the status of their national quality and provide a systematic policy direction. Second, NQCI helps carry out efficient index

management by focusing their capabilities on the critical factors. Finally, as this index will continually be based on annual data by the WEF and IMD it helps countries to acquire data with ease and ensure the sustainability of their NQCI.

The following sections of this study comprises of four chapters. In Chapter 2, national quality competitiveness is defined and the criteria with which to select the quality competitiveness index are identified based on a review of previous studies and future trend reports. In Chapter 3, the WEF and IMD, which provide the raw data for quality competitiveness indices are reviewed. Based on the analysis of the WEF and IMD, we select the indicators for the NQCI and present statistical verifications to determine the validity of the NQCI. In Chapter 4, the NQCI is implemented in the target countries and its practicality is examined. Lastly, Chapter 5 addresses the implications of the NQCI.

2 FRAMEWORK OF QUALITY COMPETITIVENESS

2.1 Definition of quality competitiveness

Although quality management and national competitiveness have been researched from various perspectives, the term, national quality competitiveness is rather unfamiliar. This section helps clarify the concepts of quality and competitiveness and presents a definition of national quality competitiveness.

Quality

Because quality is considered one of the most important factors behind a company's economic growth (Feigenbaum, 1982), many studies related to quality have been undertaken (Reeves and Bednar, 1994). Buzzell and Gale (1987) as well as Gronroos (1990) defined quality as the extent to which a product or service fulfils or exceeds the expectations of the customer. Moreover, the concept of quality tends to be applied to all functions within a company, including marketing, R&D, accounting, production, transportation, and distribution/logistics (Blackiston, 1996).

As described above, the definition of quality has expanded to accommodate the changing business circumstances and the demands of the times. Therefore, quality should be understood as a universal concept and not pigeonholed into a specific sector, industry or function (Reeves and Bednar, 1994; Juran, 1988).

National competitiveness

Some studies define national competitiveness as a critical factor that determines company's competitiveness. In these studies, the government's roles must include supporting companies in their effort to sustain competitiveness (Porter, 1998; Tyson, 1993). In a similar vein, the IMD defines competitiveness as a country's abilities to create and maintain conditions that help companies sustain their competitiveness (Garelli, 2006). The WEF defines competitiveness as government's policies, rules and regulations that allow continued economic growth and long-term prosperity (Schwab, 2010).

This study also acknowledges the need for governmental intervention in the matter of quality. Thus, the concept of competitiveness is applied here with a focus shifted from the roles of businesses to those of government.

National quality competitiveness

Combining the aforesaid definitions of 'quality' and 'national competitiveness,' this study presents a definition of 'national quality competitiveness' that suits the research purpose: A country's competencies involve creating and maintaining conditions under which the quality of products and services can satisfy the expectations of interested parties and in which this state of satisfaction can be sustained.

2.2 Critical factors in quality competitiveness

A large number of researchers have suggested factors for quality management striving to find criteria and principles. For instance, Saraph, Benson and Schroeder (1989) conducted an extensive literature review on the principles that are related to conventional quality management practices. Based on their review, they identified and analysed eight categories: top management support, quality information availability, quality information usage, employee training, employee involvement, product/process design, supplier quality, and customer orientation. Porter and Parker (1993) also undertook a similar empirical study, proposing eight critical factors: management behaviour, strategy, organization, communication, training, employee involvement, process and systems, and quality technologies.

Black and Porter (1996), on the other hand, devised 10 critical factors by incorporating the criteria of the Malcolm Baldrige National Quality Award: people and customer management, supplier partnerships, communication of improvement information, customer satisfaction orientation, external interface management, strategic quality management, teamwork structures for improvement, operational quality planning, quality improvement measurement systems, and the corporate quality culture. Black and Porter (1996) proposed that their proposed factors were more realistic and were adaptable to the fast-changing market environment.

Based on the critical factors proposed by previous studies, this study presents its own five critical factors: leadership for quality, support from the internal work force, the relationship with the external environment, customer orientation, and continuous improvement. First, leadership for quality establishes the orientation and criteria of the programs aiming at an improvement in quality competitiveness. Second, concerning support from the internal work force, education/training and compensation are offered to help promote the spontaneous cooperation and participation of the internal personnel. Third, in relationship to the external environment, an amicable relationship is formed with interested parties involved in quality competitiveness improvement efforts (e.g., suppliers, governments). Fourth, for customer orientation, the focus of quality competitiveness is placed on the customer's expectations and degree of

satisfaction. Lastly, regarding continuous improvement, effort is made to ensure appropriate responses to the ever-changing environment as well as continuous improvement and advancement.

2.3 Analysis of global trends

Trend analysis reports published by several prominent research institutes were examined to identify issues related to quality.

Global Trends, a report published every four years by the US-based National Intelligence Council, is analysed by government agencies as well as the world's leading academic and specialized research institutions. They conduct research in the following seven areas: the global economy; global demographic trends; international politics; energy, food and resource issues; regional conflicts; international systems; and leadership (Fingar, 2009). Table 1 summarizes the key words and main points of the Global Trends 2025 report.

Table 1 – Global Trends 2025

Key Word	Global Trend 2025
The Globalizing Economy	Back to the Future
	Bumpy Ride in Correction Current Global Imbalance
The Demographics of Discord	Populations Growing, Declining, and Diversifying-at the same time
	The Pensioner Boom: Challenges of Aging Populations
The New Players	Rising Heavy weights: China and India
	Other Key Payers
Scarcity in the Midst of Plenty	The Dawning of a Post-Petroleum Age?
	Water, Food, and Climate Change
Growing Potential for Conflict	Growing Risk of a Nuclear Arms Race in the Middle East
	Terrorism: Good and Bad News
International System	Multipolarity without Multilateralism
	How Many International Systems?
Power-sharing in a Multipolar World	New Relationships and Recalibrated Old Partnerships
	Less Financial Margin of Error

Secondly, Tracking Global Trends, an annual report by the global financial and management consulting services company Ernst & Young (2010), publishes forecasts for the world economy. Ernst & Young published in 2010 'Business 2020: a Futurizon report', suggesting six global trends. Table 2 lists the main points and key words of the proposed trends.

Table 2 – Key Words and Main Points of Six Global Trends

Key Word	6 Global Trends
Rise of emerging markets	Emerging markets increase their global power
Cleantech for climate	Cleantech becomes a competitive advantage
The transformed financial landscape	Global banking seeks recovery through transformation
Increased role of government	Governments enhance ties with the private sector
The next evolution of technology	Rapid technology innovation creates a smart, mobile world
Movement of the global workforce	Demographic shifts transform the global workforce

Based on the examination of trend-analysis reports, this study identified four quality issues that are appropriate for the national quality competitiveness. The first issue identified is global management. This involves issues such as globalization and the global economy, all of which require companies and countries to embrace a new quality management. Second, environmental and energy crises are raising the need for the industries to 'go green'. Thus, this issue demands directions for quality improvements that take environmental and energy issues into account as regards challenging tasks such as the depletion of fossil fuels, pollution, and climate change. The third issue, technological innovation, is becoming increasingly important with the advent of the industrial convergence era, the acceleration of technological evolution, and the active integration between technologies. Lastly, socio-cultural emphasis is placed on the increased value of individuals. As the importance of this value is rising, consumer behaviour is changing, personal values are becoming refined, and the value of culture is increasing. These changes require that personal/individual values be taken into account when dealing with quality.

3 NATIONAL QUALITY COMPETITIVENESS INDEX (NQCI)

The study was conducted primarily to devise a quality competitiveness index that can be compared and utilized at the national level. To that end, an analysis was conducted of reports published in the WEF and IMD both of which enjoy public confidence. Based on the analysis, indices were selected and subjected to statistical tests such as factor analysis and cluster analysis. Using the statistical data, a national quality competitiveness index (NQCI) was developed.

3.1 Competitiveness index analysis based on WEF and IMD data

To develop the NQCI, the World Economic Forum (WEF) and International Institute for Management Development (IMD) data were used as the material for the analysis because they are open source data that are available to the public. Moreover, these indices are recognized internationally as reliable national competitiveness indices therefore ensuring the validity of the NQCI. The WEF publishes the Global Competitiveness Report (GCR), an annual report that factors constituting a national economy so as to help ensure sustainable economic growth and long-term prosperity. Since 2005, the forum has issued the Global Competitiveness Index (GCI), a comprehensive index that measures countries' national competitiveness. These reports include the countries' microeconomic and macroeconomic data (Schwab, 2009).

The GCI consists of about 110 indicators spread out in 12 pillars in three areas, as shown in Figure 1. It is being complied for nearly 130 countries. Some pillars are related to the critical factors for quality competitiveness and global quality trends that were mentioned earlier in this paper. Examples of the pillars are: business sophistication, related to global management; innovation, related to interoperation between sectors/industries and the response to environmental changes; good market efficiency, labor market efficiency, financial market sophistication and technological readiness, all factors affect quality improvement, such as competitors, suppliers, customers, the work force, the government, technology, and the financial market; and infrastructure, the foundation on which competitiveness-related activities take place. The excellence of GCI is particularly noted in the microeconomic issues (Lall, 2001).

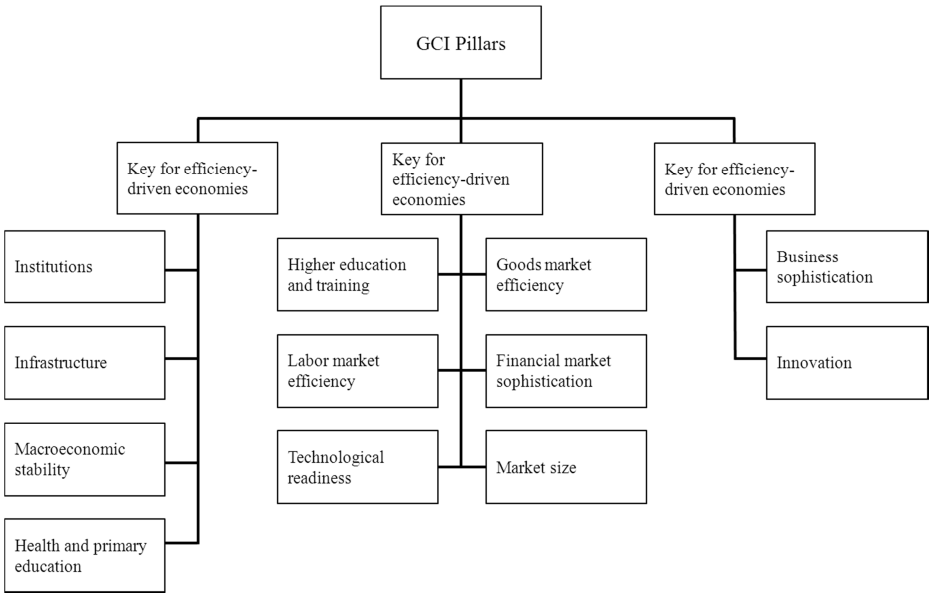

Figure 1 – The 12 pillars of competitiveness

The IMD publishes the World Competitiveness Yearbook (WCY), an annual report that analyses how the environment of some 58 countries affects the creation and maintenance of their respective degrees of corporate competitiveness. It also determines the ranking of the countries according to the analysis. The WCY consists of some 330 indicators in 20 pillars in four areas, as shown in Figure 2. The WCY presents criteria associated with the quality competitiveness factors and global quality trends. The criteria are the technological infrastructure and the scientific infrastructure, providing input sources to ensure continuous quality improvement; and health and the environment, indicating the direction of quality improvement in terms of energy and environmental conservation. They also include the labour market, allowing the measurement of internal parties' competitiveness; management practices, showing a company's sustainable capabilities and its leaders' quality policies; and basic infrastructure and finance, indicating the level of factors behind quality improvement.

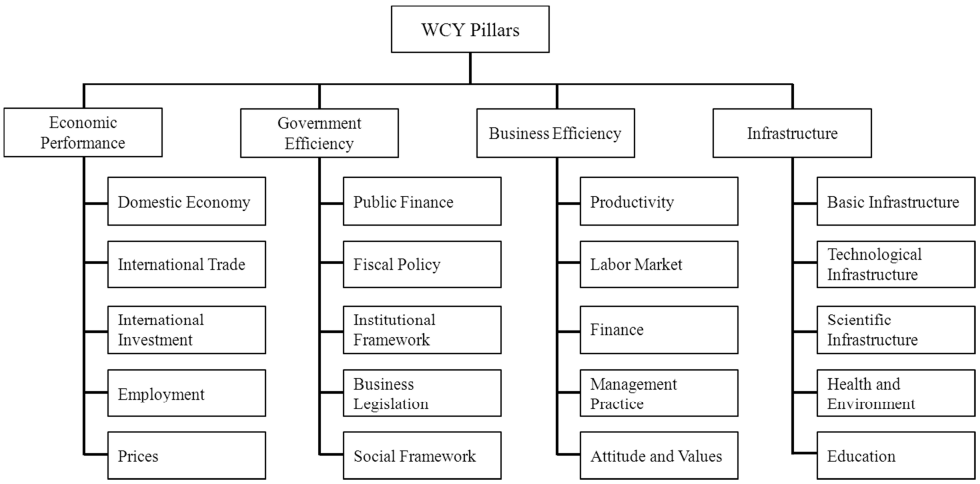

Figure 2 – Four pillars of competitiveness

The GCI and WCY factors/criteria, however, are not without shortcomings. The GCI materials rely heavily on data gathered from surveys and have a complicated weighted value system when it comes to technology, public agencies, and the macroeconomic environment. The WCY, on the other hand, introduces a greater variety of competitiveness evaluation factors compared to the GCI. However, its system comprises only four pillars and uses a simple totalling technique, which weakens its theoretical foundation. Furthermore, the WCY materials have problems such as frequent changes in its evaluation model and a lack of consistency in its partnered investigation agencies. Therefore, it appears necessary to take the strengths of the GCI and WCY factors/indicators and combine them effectively to offset the shortcomings.

3.2 Selection of indicators

First, based on five critical factors for quality competitiveness and four global quality trends, 25 indicators were selected from the WEF materials, as shown in Table 3.

Table 3 – Indicators Selected from the WEF Materials

Index	Pillar	Indicators	Criteria	
			Critical factor for quality competitiveness	**Global trend**
W1	Institution	Ethical behaviour of firms	Leadership for quality	
W2	Infrastructure	Quality of overall infrastructure	Continuous improvement	Global management
W3	Higher education and training	Quality of the educational system	Support from the internal work force	
W4	Goods market efficiency	Intensity of local competition	Relationship with the external environment	
W5		Degree of customer orientation	Customer orientation	Individual values
W6		Buyer sophistication	Relationship with the external environment	
W7	Labour market efficiency	Cooperation in labour-employer relations	Support from the internal work force	
W8		Hiring and firing practices	Support from the internal work force	
W9	Financial market sophistication	Financial market sophistication	Relationship with the external environment	
W10		Venture capital availability	Relationship with the external environment	
W11	Technological readiness	Availability of latest technologies		Global management
W12		Firm-level technology absorption		Technological innovation
W13	Business sophistication	Local supplier quantity	Relationship with the external environment	
W14		Local supplier quality	Relationship with the external environment	
W15		Nature of competitive advantage		Global management
W16		Control of international distribution	Relationship with the external environment	Global management

Index	Pillar	Indicators	Criteria	
			Critical factor for quality competitiveness	Global trend
W17		Production process sophistication		Global management
W18		Extent of marketing	Relationship with the external environment	Global management
W19	Innovation	Capacity for innovation	Continuous improvement	Technological innovation
W20		Quality of scientific research institutions		Technological innovation
W21		Company spending on R&D		Technological innovation
W22		University-industry collaboration in R&D	Relationship with the external environment	Technological innovation
W23		Government procurement of advanced tech products	Relationship with the external environment	
W24		Availability of scientists and engineers	Relationship with the external environment	
W25		Utility patents		Technological innovation

Next, using the IMD's factors, several indicators were chosen from the aforementioned six pillars. Some indicators were also selected from the pillars of 'economic performance' and 'government efficiency' based on five critical factors for quality competitiveness and four global quality trends. Table 4 lists the final 26 indicators selected

Table 4 – Indicators Selected from the IMD Materials

Index	Pillar	Indicators	Criteria	
			Critical factor for quality competitiveness	Global trend
I1	Management Practice	Ethical practices	Leadership for quality	
I2	Basic Infrastructure	Distribution infrastructure		Global management
I3		Energy infrastructure		Environmental and energy crises
I4	Education	Educational system	Support from the internal work force	

Index	Pillar	Indicators	Criteria	
			Critical factor for quality competitiveness	Global trend
I5	Scientific Infrastructure	Science degrees		Technological innovation
I6	Management Practice	Customer satisfaction	Customer orientation	
I7	Labour Market	Labour relations	Support from the internal work force	
I8	Business Legislation	Labour regulations	Support from the internal work force	
I9	Finance	Banking and financial services	Relationship with the external environment	
I10		Venture capital	Relationship with the external environment	
I11	Management Practice	Adaptability of companies	Leadership for quality	
I12	Scientific Infrastructure	Innovative capacity		Technological innovation
I13		Business expenditure on R&D ($)		Technological innovation
I14		Business expenditure on R&D (% of GDP)		Technological innovation
I15		Knowledge transfer	Support from the internal work force	Global management
I16		Number of patents in force		Technological innovation
I17	Labour Market	Employee training	Support from the internal work force	
I18	Management Practice	Social responsibility	Leadership for quality	
I19	Technological Infrastructure Innovation	Development and application of technology	Continuous improvement	Technological innovation
I20		Communications technology		Global management
I21		Qualified engineers		Technological innovation
I22		Funding for technological development		Technological innovation
I23	Health and Environment	Green technologies		Environmental and energy crises

Index	Pillar	Indicators	Criteria	
			Critical factor for quality competitiveness	Global trend
I24		Sustainable development	Continuous improvement	
I25		Pollution problems		Environmental and energy crises
I26		Environmental laws		Environmental and energy crises

Of the total of 51 indicators selected from the WEF and the IMD, those that overlap in meaning were combined, resulting in a total of 35 indicators for the NQCI. They were labelled afresh to suit the purpose of this study as long as the new designations remain in line with the existing terminology (See Table 5).

Table 5 – Creating NQCI Indicators Using WEF and IMD Materials

NQCI Indicator	WEF Indicator	IMD Indicator	Meaning of NQCI Indicator
N1	W1	I1	Corporate ethics
N2	W2	I2, I3	Basic infrastructure
N3	W3	I4	Education system
N4	W4		Strength of competitiveness in domestic market
N5	W5	I6	Degree of customer orientation
N6	W6		Buyer maturity
N7	W7	I7	Labor relations
N8	W8	I8	Hiring flexibility
N9	W9	I9	Financial maturity
N10	W10	I10	Venture capitalism
N11	W11		New technology availability
N12	W12	I11	Capabilities to accept technology
N13	W13		Size of subcontractors
N14	W14		Quality of subcontractors
N15	W15		Unique competitiveness
N16	W16		Global logistics management
N17	W17		Production process maturity
N18	W18		Marketing expertise
N19	W19	I12	Innovation capability

NQCI Indicator	WEF Indicator	IMD Indicator	Meaning of NQCI Indicator
N20	W20		Level of competency in science & engineering research institutes
N21	W21	I13, I14	Investment in R&D
N22	W22	I15	Industry-academia collaboration and technology transfers
N23	W23		Governmental purchases of cutting-edge products
N24	W24	I5	Availability of science & technology personnel
N25	W25	I16	Patents
N26		I17	Development of human resources
N27		I18	Corporate social responsibility
N28		I19	Telecommunications technology
N29		I20	Capability to develop and utilize technology
N30		I21	Technological assets
N31		I22	Proficiency of technical work force
N32		I23	Green technology
N33		I24	Capability for sustainable development
N34		I25	Capability to mitigate pollution
N35		I26	Business-friendly environmental regulations

3.3 Statistical verification

In this study, the 58 countries evaluated by the IMD were subjected to a statistical analysis. All 58 countries were included in the 130 countries evaluated by the WEF. Thus, they were deemed appropriate for this study, which utilizes both WEF and IMD data. Factor analysis was conducted to explore potential indicators/factors that could explain the correlation between the evaluation items. Based on the analysis, weighted values were established to calculate the NQCI value.

Creating indicators

In the descriptive statistics conducted for this study, the indicators selected from the WEF and IMD were used as the indicators for devising the NQCI. Because the WEF uses a seven-point scale while the IMD uses a 10-point scale, the data were first standardized by using descriptive statistics and the mean values acquired from the standardization were used as new indicators values. Considering that the final quality competitiveness indices have values ranging between 0 and 100, the indicators were converted, starting from the data preparation, so that the values would be between 0 and 100. This process simplified identifying a country's standing in terms of national quality competitiveness.

Factor analysis and distance matrix

In this study, factor analysis was conducted as a test preceding the cluster analysis that later grouped the selected indicators into sub-groups with similar properties. Principal factor method by a year was used for factor analysis with the combined indicators. When considering with an Eigen value greater than 1 and a cumulative value ranging between 0.7 and 0.9, '5' was deemed appropriate for the number of factors.

Using the results of factor analysis, the factor loading was obtained; from the factor loading matrix, the distance matrix between the indicators was obtained using the values representing the same factors. This distance matrix was used as the input data for the cluster analysis.

Cluster analysis

Cluster analysis is a technique used to categorize indicators with a variety of properties into homogeneous groups based on their similarities (Scott and Knott, 1974). This method can be assigned to clusters that are composed of similarly characterized indicators. This study utilized a hierarchical cluster analysis, Ward's minimum variance method (Ward Jr, 1963). As shown in Figure 3, when semi-partial R^2 values set 0.1 as a criteria for categorization, the 35 indicators are categorized into four clusters. Because indicator N9 from Cluster 1 has been excluded from the survey items since 2010, this study uses the 34 indicators for the analysis excluding N9.

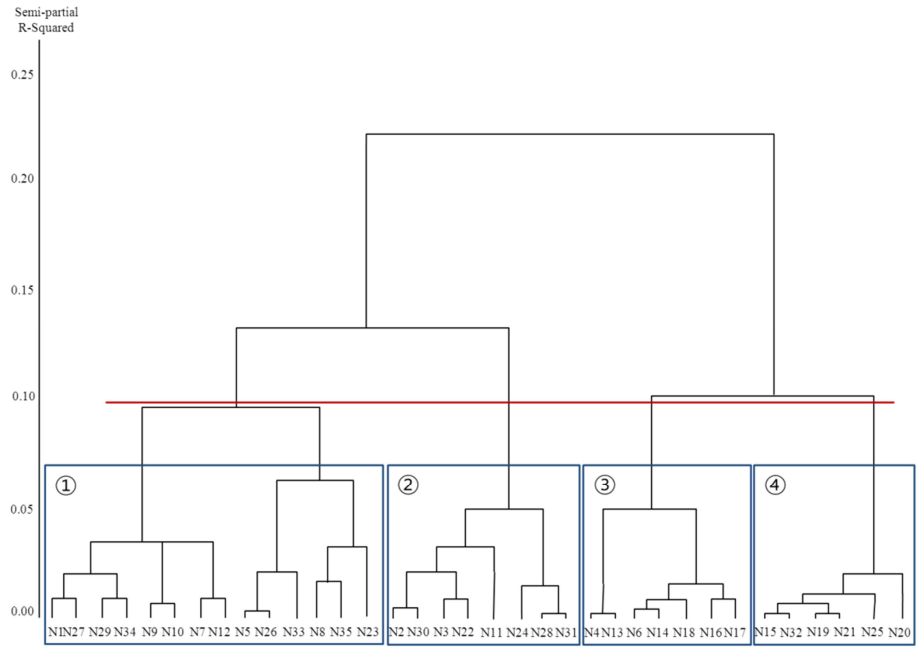

Figure 3 – Cluster analysis results using Ward's method

Identification of four quality-competitiveness capabilities

Based on the cluster analysis results (Table 6), an expert consensus method was used to draw four perspectives of quality competitiveness that were believed to best represent each cluster. The perspectives are sustainable capability, basic infrastructure capability, primary activity capability, and innovation capability.

Table 6 – Four Clusters and their Indicators (Indicators)

Cluster	Indicators	
C1. Sustainable Capability	N1 (Corporate ethics)	N26 (Human resources development)
	N5 (Degree of customer orientation)	N27 (Corporate social responsibility)
	N7 (Labour relations)	N29 (Capability to develop and utilize technology)
	N8 (Hiring flexibility)	N33 (Capability for sustainable development)
	N10 (Venture capitalism)	N34 (Capability to mitigate pollution)
	N12 (Capabilities to accept technology)	N35 (Business-friendly regulations)
	N23 (Governmental purchases of cutting-edge products)	
C2. Basic Infrastructure Capability	N2 (Basic infrastructure)	N24 (Availability of science & technology personnel)
	N3 (Education system)	N28 (Telecommunications technology)
	N11 (New technology availability)	N30 (Technological assets)
	N22 (Industry-academia collaboration and technology transfers)	N31 (Proficiency of technical work force)
C3. Primary Activity Capability	N4 (Strength of competitiveness in domestic market)	N14 (Quality of subcontractors)
	N6 (Buyer maturity)	N16 (Global logistics management)
	N13 (Size of subcontractors)	N17 (Production process maturity)
		N18 (Marketing expertise)
C4. Innovation Capability	N15 (Unique competitiveness)	N21 (Technological assets)
	N19 (Innovation)	N25 (Patents)
	N20 (Level of competency in science & engineering research institutes)	N32 (Green technology)

First, sustainable capability is operationally defined as a company's competency to pursue sustainability while taking into account economic, environmental, and social issues and achieving a balance. Second, basic infrastructure capability is defined operationally as a company's degree of utilization of the basic components (e.g., education/training, technology, human resources) that are indispensable for their quality control. Third, the operational definition of

primary activity capability is a company's capability to engage in activities that contribute to the creation of added value in products and services that can be transferred directly to customers. This type of capability includes inbound logistics, operations, outbound logistics, marketing and sales, and services. Lastly, innovation capability is defined as how a company develops and manages the factors such as unique competitiveness, investment in R&D, patent ownership, and green technology that can help facilitate its innovation.

3.4 Identification of a quality competitiveness index

After ensuring the validity of the four perspectives and the selected indicators, the NQCI value was calculated for this study. Principal component analysis (PCA) was carried out to identify the single element that best describes four new indicators (i.e., C1, C2, C3, and C4) which represent the clusters. This was done by obtaining the average value of the indicators in each cluster.

- C1 (Sustainable Capability) = (X1 + X5 + X7 + X8 + X10 + X12 + X23 + X26+ X27 + X29 + X33 + X34 + X35)/13
- C2 (Basic Infrastructure Capability) = (X2 + X3 + X11 + X22 + X24 + X28 + X30+ X31)/8
- C3 (Primary Activity Capability) = (X4 + X6 + X13 + X14 + X16 + X17 + X18)/7
- C4 (Innovation Capability) = (X15 + X19 + X20 + X21 + X25 + X32)/6

As in the earlier factor analysis, '1' was deemed appropriate as the number for the principal component when using criteria with an Eigen value greater than 1 and a cumulative value ranging from 0.7 to 0.9. Thus, the Eigenvector of the first principal component was used as the weighted value for calculating the NQCI value for each year (Table 7). Using the average of the year-specific weighted values, the final weighted value was calculated.

Table 7 – Weighted Value obtained through the Principal Component Analysis

Year	C1	C2	C3	C4
2005	0.4969	0.4989	0.5065	0.4976
2007	0.4890	0.5068	0.5000	0.5040
2008	0.4908	0.5118	0.4970	0.5002
2009	0.4962	0.5102	0.4960	0.4975
2010	0.4964	0.5051	0.4918	0.5065
Weighted Value	0.4939	0.5065	0.4983	0.5012

To ensure that the NQCI has a value between 0 and 100, the weighted value was divided by 2 and then rounded off to four decimal places. The adjusted weighted value is as follows:

- The NQCI = 0.247×C1 + 0.253×C2 + 0.249×C3 + 0.251×C4

4 THE EMPIRICAL ANALYSIS OF THE NQCI

To conduct an empirical analysis of the NQCI, a total of 18 countries were selected from the 58 target countries mentioned earlier. For this selection, G20 member states were used as the reference, except for the EU, which is not a country, and Saudi Arabia, which is not included in the IMD's 58 countries (Table 8). The NQCI was applied to the 18 countries for each year concerned.

Table 8 – The NQCI and Ranking of 18 Countries (by Year)

Country	NQCI					NQCI Ranking				
	2005	2007	2008	2009	2010	2005	2007	2008	2009	2010
Argentina	49	49	48	48	49	53	56	57	56	51
Australia	67	68	68	67	66	22	22	21	22	24
Brazil	54	55	56	57	56	42	43	42	36	38
Canada	72	72	71	70	71	13	15	15	14	12
China	53	55	57	57	58	46	44	36	34	33
France	71	71	71	69	69	14	18	14	16	17
Germany	76	77	75	75	75	6	7	8	7	5
India	62	62	61	61	59	27	25	29	28	31
Indonesia	49	57	56	55	57	54	40	41	41	37
Italy	55	56	56	55	56	40	41	39	42	41
Japan	79	79	77	78	78	3	2	3	2	2
Korea, Rep	68	74	68	67	67	20	11	18	19	22
Mexico	49	52	50	51	49	55	50	53	51	53
Russian Federation	51	52	53	51	48	50	51	52	52	56
South Africa	58	57	57	56	55	31	39	38	38	42
Turkey	56	57	55	56	56	38	38	44	40	39
United Kingdom	70	71	69	69	69	17	19	19	18	18
United States	82	78	79	77	75	1	3	2	5	6

In this study, the results of applying the NQCI to the countries were used to identify the differentiations between high and low ranked groups. Based on these

analyses, our results not only provide an implication for quality policies at the national level to the referenced 18 countries but also to other nations. Based on Table 8, primary activity capability and innovation capability have a relatively higher influence on national quality competitiveness for countries ranked higher in the NQCI. This indicates that the higher-ranked countries need active corporate efforts as well as governmental quality policies and intervention. For example, the government has supported the establishment of the inter-business networks to create industrial clusters that help increase the efficiency of primary corporate activities.

For the countries that ranked lower in the NQCI, it is important that the government plays a central role in strengthening quality competitiveness and implementing the industrial modernization steps. This fact could be confirmed by comparing two lower ranked countries, China and Russian Federation.

In China the government has begun an national effort to strictly manage quality by establishing a governmental institutions such as the General Administration of Quality Supervision and the Inspection and Quarantine of the People's Republic of China (Pompeo, 2007). Consequently, China improved its NQCI standing from being 46th in 2005 to 33rd in 2010.

Whereas, Russian Federation relied only on the energy sector, such as, oil, natural gas, metals and timber, and neglected to improve their competitiveness in its manufacturing and service sectors (Ahrend, 2004; Mills, Dukeov and Fey, 2007). As a result, Russian Federation slid in rank from 50th in 2005 to 56th in 2010.

Next, national competitiveness rankings were compared with rankings in the NQCI. For easy comparison, countries included in both NQCI and IMD were compared.

The results show that the majority of the countries are ranked similarly in both indices during 2005 to 2010, except for 2006. The Spearman rank correlation coefficient was calculated between the indices of all 18 countries for each year concerned. The values obtained were 0.896 (2005 year), 0.806 (2007 year), 0.879 (2008 year), 0.922 (2009 year), and 0.888 (2010 year), showing a high statistical correlation which represents a mutually compensating relationship. Therefore, improvement of NQCI is closely related to improvement of national competitiveness.

5 CONCLUSION

This study developed a competitive index specializes in national quality. An attempt to devise this type of index has never been tried elsewhere. This index provides a theoretical value by statistically investigating the validity and reliability of the data. These findings also help government to establish a more concrete quality policies through quantified indices.

First, this study categorized the factors considered for quality competitiveness into four different perspectives using statistical techniques. Policy makers will be able to initiate new policy projects by apprehending the pros and cons of quality competitiveness using these perspectives. Second, in the process of applying the NQCI, we have discovered a difference in quality policies between high ranked and low ranked countries. Therefore, it indicates that a country willing to improve national quality should benchmark quality policies of countries at a similar level. Lastly, through analysing the correlation between NQCI and national competitiveness from IMD, NQCI was found to be an important factor that guides to higher national competitiveness.

The limitations of this study include a lack of consistency in evidence, as demonstrated in the results. That is to say, the evidence failed to show consistently that the NQCI is capable of operating as an early indicator of countries' national competitiveness. This is attributable to the fact that the NQCI was "borrowed" from existing indices to ensure obtainability instead of developing new index. For the same reason, the application of and comparison via the NQCI is limited to the target countries of the WEF and IMD. Therefore, future research may need to ensure that the NQCI leads national competitiveness indices by rearranging existing indices, by adjusting the weighted values, or by conducting research on the development of new index.

ACKNOWLEGEMENT

This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2012-2012S1A3A2033474).

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