A Comparative Study of National Culture and Innovation: Effects of Cultural Dimensions on Traditional Innovation and Online Innovation

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Abstract
This study extends previous research on the relationship between Hofstede’s cultural values and innovation by focusing on role of national culture in explaining online innovation. We adopted Hofstede’s national culture dimensions to compare different national online innovation rates. The results show that individualism has a significant positive association with both traditional innovation and online innovation. As expected, power distance has a strong negative influence on both traditional innovation and online innovation. Uncertainty avoidance has no significant association with traditional innovation while it has a significant association with online innovation. Masculinity did not have significant association with both traditional innovation and online innovation. Lastly, long-term orientation has positive significant association with both traditional innovation and online innovation. The study supports the findings of the earlier studies [38, 46, 47] that investigated the two cultural dimensions (i.e., individualism and power distance) as factors that influence national innovativeness. However, an interesting finding is that uncertainty avoidance has a significant positive relationship with online innovation. Discussions including interpretations and contributions of findings are presented along with future plan to complete this study.

1. Introduction

Human life has been always improved through innovation. In today’s highly competitive global economy, innovation is a subject of great importance because it stimulates sustainable growth of businesses and national economy. The fundamental driving force behind any innovation is the human factor. For example, individuals’ creative and critical thinking and their appetite for taking risks and thinking entrepreneurially are critical capabilities to encourage innovation. Innovation is spurred by having favorable conditions whereby individuals and collective groups including teams, communities, and even nations are open to new approaches [11].

At the national level, we observe that some nations take the lead in innovative capability over others. A major factor for this disparity of innovation process is the quality of human factor linked to the innovation activities carried out in these nations. In this study, we look at the collective human factor at the national level as a collective value perception of individuals of the nation, which distinguishes the members of one group or category of people from others (i.e., national culture). One of widely accepted definitions of culture describes it as shared beliefs and values established on core assumptions and manifested in artifacts and creations [40]. As such culture constantly dictates who we are and what we do, individually as well as collectively.

Technology is no exception. How we create, use and manage technologies for innovation is influenced by different cultural values held by different individuals, organizations and even nations. The importance of culture in IT research and practices has long been recognized but this research faces various challenges conceptually and methodologically and the knowledge resulting from this work is sparse and fragmented [35]. On the other hand, the need for cross-cultural studies that take into account in the context of technology is ever increasing with rapidly advancing technologies – particularly the Internet – that are making geopolitical boundaries more blurry and less relevant. People of different cultures in different nations of different cultures are ever more connected and engaged in various aspects of innovation enabled by various online technologies. With the global community connected, these technologies may spawn creative and innovative ideas that would not have been possible previously. However, the way these technologies are adopted and used is not homogeneous across the global community and such disparity has been recognized and studied as “digital divide.”

Even if these technologies are equally and readily available, the innovative outcomes resulting from the use of these technologies may not be equally
distributed. Even before the age of the Internet, researchers have looked into this disparity in innovative outputs by measuring and comparing the numbers of trademarks and patents registered across nations and cultures (e.g. [38, 46, 47]). This study follows up on the earlier studies by focusing on role of national culture in explaining the general trend of innovativeness of a society in terms of traditional innovation and online innovation. We adopted Hofstede’s national culture dimensions to compare different nations in their cultural inclinations and the Global Innovation Index (GII) to assess online innovation among nations of different cultures.

In order to compare nations’ innovative capabilities, we adopted and applied the five dimensions of Hofstede’s national culture: (1) Individualism vs. Collectivism, (2) Power distance, (3) Masculinity vs. Femininity, (4) Uncertainty avoidance, and (5) Long-term orientation. Despite some criticism, Hofstede’s concept of national culture has been widely adopted in numerous studies, including those related to technologies. We analyzed the online innovation measures across the five national culture dimensions to answer the question “Are there cross-cultural variations in online innovation?”

In the remainder of this paper, section 2 reviews relevant literature and background theory; section 3 proposes a research model to address the relationships between national cultures and national level online innovation; section 4 explains the method used in the study to test the proposed model, and section 5 shows preliminary findings of the study; and the last section discusses the meaning of the findings and unanswered questions that need to be further studied.

2. Literature and Theoretical Background

2.1. Cultural Values

Hofstede’s cultural value model is one of the most comprehensive studies in cross cultural research. The model consists of five dimensions of national culture empirically tested based on a large-scale global survey: (1) Power distance, (2) Individualism, (3) Masculinity, (4) Uncertainty avoidance, and (5) Long-term orientation.

Power distance refers to the degree to which the less powerful members of a society accept and expect that power is distributed unequally. People in a country with a high power distance more readily accept a hierarchical order in which everybody has a place. On the other hand, people in societies with a low power distance strive to equalize the distribution of power and demand justification for inequalities of power. Individualism can be defined as a preference for a loosely-knit social framework. People in individualistic societies are expected to take care of only themselves and their immediate families. In contrast, people in collectivistic societies can expect their relatives or members of a particular in-group to look after them in exchange for unquestioning loyalty. Masculinity refers to preference for achievement, heroism, assertiveness and material rewards for success. People in masculine societies are more competitive. Its opposite, femininity, represents preference for cooperation, modesty, caring for the weak and quality of life. The uncertainty avoidance dimension refers to degree to which the members of a society feel uncomfortable with uncertainty and ambiguity. People in a country with high uncertainty avoidance tend to shun ambiguous states by maintaining rigid codes of belief and behavior and are intolerant of unorthodox behavior and ideas. On the other hand, people in weak uncertainty avoidance societies tend to maintain a more relaxed attitude in which practice counts more than principles. Long-term orientation is the fifth dimension of Hofstede’s cultural value model. This dimension was added after the original four to try to distinguish the differences in thinking between the East and West. Long-term orientation includes persistence, ordering relationships by status and observing this order, thrift, and having a sense of shame.

2.2. Cultural Values and Innovation

Hofstede’s cultural value model has been adopted in many research areas. However, only a few have attempted to use his value model to explain innovation variations in innovation across nations. Shane [46, 47] pioneered the comparative study of national innovativeness based on Hofstede’s cultural values by investigating the link between the four cultural values and the numbers of patents, using the latter as a measure for national innovativeness. The studies suggest that societies with high individualism are more innovative even after controlling for wealth. Later studies extended Shane’s work by developing more comprehensive framework of national culture and innovation [38, 51].

From the review of prior research, we identified several determinants of innovation along Hofstede’s five cultural dimensions (see Table 1). Five factors including hierarchy, communication, centralization of power, control over subordinates, and resistance to change of power were found to be related to power distance. With regard to individualism, three factors including freedom, outward orientation and independence were found. Tolerant of uncertainty was found to be possibly related to uncertainty avoidance.
cultural dimension. Reward and recognition for performance, emphasis of training and improvement as determinants of innovation were found to be related to masculinity cultural dimension. Lastly, three factors that expected to be related to long-term orientation were continuous knowledge acquisition, open toward innovation and long term incentive.

Research suggests that innovative activities are associated with high rate of failures and take a long time to succeed (e.g., [1, 17, 23]). Innovation is often viewed as a key determinant of long-term profits that require significant investment in money and time to materialize [4, 15]. Research also suggests a positive relationship between long-term orientation and openness for change [27] that increases the likelihood of idea creation and innovative outputs [32, 49].

<table>
<thead>
<tr>
<th>Table 1. The Relationship between Cultural Value and Traditional Innovation</th>
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</thead>
<tbody>
<tr>
<td>Cultural Values</td>
</tr>
<tr>
<td>Power Distance</td>
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<td></td>
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<tr>
<td>Individualism</td>
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<tr>
<td>Uncertainty Avoidance</td>
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<tr>
<td>Masculinity</td>
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<tr>
<td>Masculinity</td>
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<tr>
<td>Long-term Orientation</td>
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</table>

2.3. Traditional Innovation and Online Innovation

The purpose of this paper is to examine whether the results of earlier studies on national culture and innovation such as Shane [46, 47] are still valid in today’s technology-driven environment. Furthermore, the study investigates if and how recent technological developments may have impacted national innovativeness. During the past several decades since the publication of these studies, digital technologies, particularly the Internet, have fundamentally transformed the way we live, communicate and conduct business. These technologies have allowed individuals, communities and even countries to generate, collaborate and produce innovative ideas and products with no or fewer barriers. Researchers have recognized this phenomenon as “digital innovation” and studied its nature and implications for individuals and societies [60]. They argue that two major characteristics of digital technologies – i.e., programmability and homogenization – lead to innovation unbounded by traditional and physical constraints [61]. For example, digital convergence has blurred the boundaries among traditionally distinct technologies such as phones, TV and computers and created a new breed of technology like smartphone. As digital technologies evolve, they become more complex, dynamic and sophisticated and it becomes difficult to define what digital innovation is, not to mention to understand how it affects individuals and societies. While it is almost impossible to observe and measure what constitutes digital innovation, there is a certain aspect of digital innovation that we can more easily observe and analyze. Today people are constantly engaged in activities with and through digital technologies such as browsing and searching the web, sharing information in various formats – text, audio, video and graphic in social media, conducting commercial transactions, among many others. These activities – which we call online activities – are visible manifestations of digital innovation and serve as surrogates for assessing digital innovation for the study.

Thus we distinguish and contrast in our study the innovation made possible by these digital technologies as observable by online activities – indicators of online innovation – to the innovation that has been traditionally observed and studied at the national level. We have surveyed the relevant literature and compiled a list of measures used to assess two types of innovation as shown in Table 2.
Table 2. Measurement of Innovation at the National Level

<table>
<thead>
<tr>
<th>Innovation Measurement</th>
<th>Comparison of Measurement</th>
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<tbody>
<tr>
<td><strong>Traditional Innovation</strong></td>
<td></td>
</tr>
<tr>
<td>Patent [10, 12, 41, 42, 46, 50, 51]</td>
<td>Traditional innovation was measured by outputs of traditional innovative or inventive activities</td>
</tr>
<tr>
<td>Trademark [10, 12, 47, 50]</td>
<td>GI categorized traditional innovation measurement as knowledge and technology outputs</td>
</tr>
<tr>
<td>Scientific publications [10, 12, 51]</td>
<td></td>
</tr>
<tr>
<td>Export of high-tech products [50]</td>
<td></td>
</tr>
<tr>
<td><strong>Online Innovation [11]</strong></td>
<td></td>
</tr>
<tr>
<td>Generic top-level domains</td>
<td>Online innovation in this study was measured by outputs of online innovative activities</td>
</tr>
<tr>
<td>Country-code top-level domains</td>
<td></td>
</tr>
<tr>
<td>Wikipedia monthly edits</td>
<td></td>
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<tr>
<td>Video uploads on YouTube</td>
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<td>Government’s online service</td>
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<tr>
<td>Online e-participation</td>
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</tbody>
</table>

We identified and adopted such measures as patents, trademarks, scientific publications and export of high-tech products as variables that capture traditional innovation at the national level. In the absence of a clear definition and measurement of online innovation at the national level, we adopted the measures used in the Global Innovation Index (GII). The Global Innovation Index (GII) is an annual report on a wide range of constructs and variables associated with innovation published as a collaboration of several educational institutions and international agencies (Cornell University, INSEAD, and WIPO, 2014). It reports the results of surveys of 143 economies on 81 innovation indicators. While its validity as a research tool has not been fully tested, it provides a rare and valuable opportunity to look into various factors that affect innovation capabilities across a large number of nations. The report addresses the competitiveness of these nations for two particular output categories – (1) Knowledge and technology outputs and (2) Creative outputs. While all of these output data present opportunities for a wide range of cross-cultural studies, we were particularly interested in the online creativity construct used to measure creative output level. While other creative outputs reported in the GII – intangible assets, creative goods and services – represent culturally influenced innovative artifacts, we focus on online innovation as it is unique to the digital context.

3. Research Model and Hypothesis

3.1. Research Model

In order to compare nations’ levels of online innovation, we adopted and applied the five dimensions of Hofstede’s national culture: (1) Individualism vs. Collectivism, (2) Power distance, (3) Masculinity vs. Femininity, (4) Uncertainty avoidance and (5) Long-term orientation. To operationalize the concept of online innovation, we adopted five indicators as proposed by the Global Innovation Index (GII): (1) Generic top-level domains (TLDs), (2) Country-code TLDs, (3) Government’s online service, (4) Online e-participation, (5) Average number of video uploads to YouTube and (6) Wikipedia monthly edits [11]. Figure 1 depicts the proposed research model.

![Figure 1. Proposed Research Model](image)

3.2. Hypothesis Development

We set forth hypotheses connecting Hofstede’s cultural values and online innovation as measured in GII. The concepts of autonomy, independence, and freedom are often associated with individualism and regarded as an important impetus for innovative ideas [29, 46, 47]. People need freedom to realize the potential of their ideas with their personal conviction [39]. In addition, freedom to work on areas of personal and professional interest is a critical condition for creative scientists to succeed [54]. Another important factor to spur innovation is a cosmopolitan orientation of the societies which is one of aspects of
individualism [21, 31]. Outward orientation is another important factor for innovation given the fact that about 60% of the technical ideas originate from external sources [55]. It is also important for innovators to stay current and in touch with latest developments on a global scale. Research shows that the ability of a scientist to connect internationally has a significant bearing on his/her innovative capacity [9]. In a collectivistic society, people are more likely to avoid confrontation and more reluctant to freely express ideas [38]. Thus, people in individualistic nations are in a better position to gather the information necessary for innovation and develop their innovative ideas than those in collectivistic countries. Thus, the following hypothesis is postulated:

**Proposition 1: Individualism will be positively related to innovation.**

- **Hypothesis 1a:** Individualism will be positively related to traditional innovation.
- **Hypothesis 1b:** Individualism will be positively related to online innovation.

Shane [47] suggests several factors associated with Hofstede’s [21] power distance index that discourage innovation. In his study, vertical communication style, power centralization, control over subordinates, and resistance to change of power redistribution were used to examine the link between power distance and innovation. Researchers have shown that free communication crossing different levels of hierarchy stimulates innovation [2, 29, 34]. People in a high power distance society tend to expect their leaders to guide their thoughts and actions. They are reluctant to express disagreements and challenge their superiors. They are deprived of opportunities to think for themselves and to use imagination [38]. On the other hand, a low power distance society is more conducive to independent, imaginative and innovative thoughts and activities [22]. People in high power distance countries tend to favor centralized decision making while innovation was spurred by decentralized authority [2, 21, 25, 26]. Studies have shown that rigid control over subordinates that is common in high power distance countries tend to hinder the flexibility necessary for innovation [21, 56]. Innovation, in turn, tends to redistribute the power and spur social mobility [30]. People in a high power distance society are more reluctant to accept the redistribution of power [21]. Based on this reasoning, we set forth the following hypothesis:

**Proposition 2: Power distance will be negatively related to innovation.**

- **Hypothesis 2a:** Power distance will be negatively related to traditional innovation.
- **Hypothesis 2b:** Power distance will be negatively related to online innovation.

Changes are an inevitable outcome of innovation and people in a high uncertainty avoidance society tend to shun changes and consequently suppress innovative ideas [21]. However, the findings of Shane’s study [46] indicate that uncertainty avoidance has a complex relationship with innovation. While uncertainty avoidance was negatively related to trademarks, one of the measures for innovation used in the study; no significant relationship was found with patents, another innovation measure. Innovative entrepreneurs are an important source of innovation [44, 38] and cultures that avoid uncertainty are likely to suppress the emergence of these innovative entrepreneurs. Thus we set forth the following hypothesis:

**Proposition 3: Uncertainty avoidance will be negatively related to innovation.**

- **Hypothesis 3a:** Uncertainty avoidance will be negatively related to traditional innovation.
- **Hypothesis 3b:** Uncertainty avoidance will be negatively related to online innovation.

Individual achievements and rewards are stressed in masculine societies whereas quality of life and relationship are emphasized in feminine societies [21]. Research has shown that people are more likely to be encouraged to be innovative for recognition and a sense of accomplishment [16, 37]. However, earlier studies [46, 47] failed to note any significant connection between masculinity and innovation. Other studies such as Rinne et al. [38] did not even consider masculinity in these studies. Nevertheless, we included masculinity in our study as it may be relevant in the context of online activities. We speculated that people in a feminine society are more likely to share personal information, pictures and messages and join online groups. In turn, these activities fuel innovative thoughts and actions that may not have been possible otherwise. Thus, we proposed the following hypothesis:

**Proposition 4: Masculinity will be negatively related to innovation.**

- **Hypothesis 4a:** Masculinity will be negatively related to traditional innovation.
- **Hypothesis 4b:** Masculinity will be negatively related to online innovation.
Research shows that innovative activities take long time and require substantial investment to generate the intended benefits (e.g., [1, 23]). Studies also suggest a positive relationship between long-term orientation and openness for change [27] that increases the likelihood of idea creation and innovative outputs [32, 48]. People in long term orientated societies are more likely to have persistent and thrifty attributes with a sense of shame [21, 22], which are more conducive to innovation than those in short term orientated cultures.

**Proposition 5: Long-term orientation will be positively related to innovation.**
- **Hypothesis 5a:** Long-term orientation will be positively related to traditional innovation.
- **Hypothesis 5b:** Long-term orientation will be positively related to online innovation.

### 4. Research Methodology

#### 4.1. Data Collection

Because the level of analysis of this study is the nation, we have searched for national-level data to validate the proposed research model and hypotheses. Considering the fact that there is no single data source that contains all the data required for this study, we collected data from various sources and combined them to make a suitable data set for hypothesis testing.

On the cultural side, we used Hofstede’s dimensions of national culture. On the innovation side, we used the INSEAD Global Innovation Index 2014 [11]. After examining the common data points across the reports used, we reached a set of data from 93 countries for analysis. All the data sources used in this study are considered reliable and have been widely used in past academic research.

The use of secondary data in this research offers advantages such as the capacity to analyze large-scale data from multiple countries and ease of reproducibility. Using secondary data restricts our capabilities to using only the variables listed in the data sources, but it is one of the best practices done in many research areas and previous research papers. We believe that our sample represents the target population well because it contains a diverse range of countries in terms of technological and economic development including developed, developing, and underdeveloped countries.

### 4.2. Construct Measurement

To measure the cultural dimensions, we used Hofstede’s national culture dimensions. These include individualism/collectivism, power distance, uncertainty avoidance, and long-term orientation. Since Hofstede reports a single number for each dimension in each country, these five constructs are measured as single-item ones.

The online innovation data was extracted from INSEAD Global Innovation Index 2014 [11] and considered as formative measures. We used five online creative outputs from the innovation scale for each country’s population aged 15 through 69 years. The five indicators used are: (1) the normalized generic top-level domains (TLDs) such as biz, info, org, net, and com; (2) country-code TLDs, (3) government’s online service, (4) online e-participation, and (5) average monthly video uploads on YouTube. A generic top-level domain (gTLD) is one of the categories of top-level domains (TLD) maintained by the Internet Assigned Numbers Authority (IANA). Generic TLDs can be unrestricted (com, info, net, and org) or restricted (biz, name, and pro). Of these, the five generic domains were included such as biz, info, org, net, and com. Generic domains .name and .pro and sponsored domain (arpa, aero, asia, cat, coop, edu, gov, int, jobs, mil, museum, tel, travel, and xxx were not included. Country code TLDs are two-letter domains especially designated for a particular economy, country, or autonomous territory. This index represents the total number of registered domains. Government’s online service index was used to assess each country’s national website presence, including the national central portals, e-service portals, and e-participation portals as well as the websites of related ministries of education, labor, social services, health, finance, and environment, as applicable. Online e-participation focuses on the use of the Internet to facilitate the provision of information by governments to citizen, interaction with stakeholders, and engagement in decision-making processes. The number of video uploads on YouTube counts all video upload events by users. We did not include control variables such as income and population as Shane did because GII indicators did special treatment in the computation to be comparable across countries by scaling through division by gross domestic product (GDP) in current US dollars, purchasing power parity (PPPS GDP), population, total exports, and so on. Following previous studies (e.g. [10, 12, 47, 50]), the traditional innovation is measured by the numbers of trademarks and patents registered across nations. Table 3 summarizes mean values, standard deviations and correlations between constructs.
Table 3. Mean value and Correlations

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Mean (S.E.)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. IDV</td>
<td>69.20 (21.15)</td>
<td>SC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. POD</td>
<td>63.20 (21.15)</td>
<td>-.665</td>
<td>SC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. UAI</td>
<td>63.71 (22.03)</td>
<td>-.137</td>
<td>1.26</td>
<td>SC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. MAS</td>
<td>47.70 (18.77)</td>
<td>.041</td>
<td>.107</td>
<td>.023</td>
<td>SC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. LTO</td>
<td>44.91 (23.38)</td>
<td>-.013</td>
<td>.024</td>
<td>.027</td>
<td>SC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Traditional Innovation</td>
<td>20.17 (17.07)</td>
<td>.315</td>
<td>-.256</td>
<td>-.003</td>
<td>.041</td>
<td>368</td>
<td>FC</td>
<td></td>
</tr>
<tr>
<td>7. Online Innovation</td>
<td>30.46 (20.08)</td>
<td>.622</td>
<td>-.549</td>
<td>-.010</td>
<td>.028</td>
<td>.201</td>
<td>.376</td>
<td>FC</td>
</tr>
</tbody>
</table>

Note: the means and standard Error (S.E.) of the constructs were computed by taking the means of the measurement items. SC: Single-item construct, FC: Formative construct.

5. Data Analysis and Preliminary Results

We used the SmartPLS version 2.0.M3, a variance-based partial least square technique to explain dependent constructs. PLS is a second-generation statistical methodology that takes an exploratory approach to develop theories or a confirmatory (i.e., hypothesis-testing) approach to the analysis of causal relationships among latent variables. We choose PLS methodology, because the sample size is relatively small, the data are non-normally distributed with many missing values, and formatively measured constructs are part of the structural model.

To validate two formative constructs, we conduct collinearity test among formative indicators using the variance inflation factor (VIF) and outer weights significance and relevance test. Table 4 summarizes the results of the tests. We remove Government’s online service for the test of structure model because the VIF value of the measure is higher than 5, indicating a potential collinearity problem [18]. Looking at the significance levels of formative indicators, the results show that all formative indicators are significant except Wikipedia monthly edits.

Table 4. Variance Inflation Factor and Outer Weights Testing Results

<table>
<thead>
<tr>
<th>Formative Constructs</th>
<th>Formative Indicators</th>
<th>VIF</th>
<th>Outer Weights</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Innovation</td>
<td>Trademark</td>
<td>1.023</td>
<td>0.017</td>
<td>1.867***</td>
</tr>
<tr>
<td></td>
<td>Patent</td>
<td>1.023</td>
<td>0.045</td>
<td>12.881***</td>
</tr>
<tr>
<td>Online Innovation</td>
<td>gTLDs</td>
<td>1.979</td>
<td>0.018</td>
<td>3.976***</td>
</tr>
<tr>
<td></td>
<td>Country-code TLDs</td>
<td>2.753</td>
<td>0.027</td>
<td>5.607***</td>
</tr>
<tr>
<td></td>
<td>Government’s online service</td>
<td>9.366</td>
<td>-0.019</td>
<td>3.827***</td>
</tr>
<tr>
<td></td>
<td>Online e-participation</td>
<td>1.619</td>
<td>0.004</td>
<td>4.468***</td>
</tr>
<tr>
<td></td>
<td>Average video uploads on YouTube per month</td>
<td>2.818</td>
<td>0.011</td>
<td>1.673**</td>
</tr>
<tr>
<td></td>
<td>Wikipedia monthly edits</td>
<td>1.140</td>
<td>0.002</td>
<td>0.771***</td>
</tr>
</tbody>
</table>

Note: NS = not significant, ** p < 0.05, *** p < 0.01

Figure 2 summarizes the structure model testing results, which indicate that individualism has a strong positive association with both online innovation (β = 0.45, p < 0.01) and traditional innovation (β = 0.18, p < 0.05, supporting hypothesis 1. Power distance has a strong negative influence on both online innovation (β = -0.26, p < 0.01) and traditional innovation (β = -0.14, p < 0.05), supporting hypothesis 2. Uncertainty avoidance shows a significant association with online innovation (β = 0.13, p < 0.05), but no significant association with traditional innovation. However unlike our expectation, the relationship between uncertainty avoidance and online innovation is positive. This unexpected finding calls for further examination and discussion. We provide our discussion in the following section. Lastly, we found that masculinity is not significantly associated with both traditional innovation (β = 0.03, p > 0.05) and online innovation (β = -0.02, p > 0.05); Thus, H4 is not supported. Lastly, long-term orientation shows a significant association with both traditional innovation (β = 0.35, p < 0.01) and online innovation (β = 0.18, p < 0.01) supporting hypothesis 5.

The squared multiple correlation (R2) is a common indicator showing the integrated effect size for predicted endogenous constructs. The R2 values of traditional innovation and online innovation from national cultural dimensions are 0.221 and 0.497, indicating that the model accounts for about 22% and 50% of the variance, respectively. According to Cohen (1988)’s recommendation, the conventional R2 values of .01, .09, and .25 indicate small, medium, and large effects. Thus, Individualism, Power distance, Uncertainty avoidance and Masculinity have a large combined effect on online innovation.

Figure 2. Results
6. Discussion

This study examined the relationship between national cultural values and national online innovation. Previous research mainly focused on the link between Hofstede’s cultural values and traditional innovation outcomes like trademarks and patents. Even through recent studies [38] extended previous research by including more comprehensive measures of national innovation, it is the first attempt to examine the link between cultural dimensions and online innovation in national level to the best of our knowledge. This study extended the relationship between Hofstede’s cultural values and online innovation by including measurement of online national innovation from the GII.

The results from this study can be summarized as follows. First, individualism has a significant positive association with both traditional innovation and online innovation. As expected, power distance has a strong negative influence on both traditional innovation and online innovation. Uncertainty avoidance has no significant association with traditional innovation while it has a significant association with online innovation. Masculinity did not have significant association with either traditional innovation or online innovation. Lastly, long-term orientation had a positive significant association with both traditional and online innovation. Our study supports the findings of the earlier studies [38, 46, 47] that investigated the two cultural dimensions (i.e., individualism and power distance) as factors that influence national innovativeness.

It was expected and reaffirmed that countries with high degrees of individualism stress autonomy, independent, and freedom and ultimately high levels of innovativeness. The study also confirmed that people in high power distance nations display lower innovation rates than those in low power distance nations in the context of innovative online innovation. With regard to uncertainty avoidance, however, the results show an interesting pattern that is different from previous studies based on more traditional innovation measures such as trademarks and patents. Shane [46] showed that there is no significant relationship between uncertainty avoidance and national innovativeness as measured by the number of patents. A later study [47] contradicted the earlier study with a significant, negative connection between uncertainty avoidance and innovation. Recently, Rinne et al. [38] suggested that uncertainty avoidance has no significant connection to innovation. Surprisingly, the results from our study indicate that uncertainty avoidance has a significant positive relationship with online innovation, but no significant relationship to traditional innovation.

We could not directly compare the results with those of Shane and Rinne et al. studies because previous research did not include long-term orientation dimension. The results from this study show that long-term orientation has positive significant association with both traditional innovation and online innovation.

Some results from this study were noteworthy. First, overall, the results from the current study generally supported the findings of the earlier studies [38, 46, 47], but they show different degrees in the context to which these five cultural dimensions influence national innovativeness. In three cultural dimensions, including individualism, power distance, and uncertainty avoidance, the degree of impact of culture on online innovation was greater than on traditional innovation (traditional innovation = 0.18 < online innovation = 0.44 for individualism; traditional innovation = -0.14 < online innovation = -0.26 for power distance; traditional innovation = 0.03 < online innovation = 0.10 for uncertainty avoidance). This means that a culture with individualism, high power distance, and high uncertainty avoidance in the online context may have a more important role in facilitating online innovation compared to its influence on traditional innovation. In contrast, a culture with long-term orientation in the online context may have a less important role in facilitating online innovation compared to its influence on traditional innovation.

Second, we anticipated that the sign of uncertainty avoidance and online innovation would be negative if at all. To our surprise, it turned out positive. We may speculate two possible explanations for this unexpected result. First, this may be a manifestation of the desire for control by the people in high uncertainty avoidance society as alluded to by Hofstede [22]. Uncertainty avoidance may not be a straightforward predictor for innovation; it can both hinder and spur innovation as suggested by Rinne et al. [38]. It is possible that people with strong desire for control in high uncertainty avoidance societies may be better positioned to devise innovative ideas and develop innovative products and services that require attention to detail and discipline to carry out innovative tasks [38].

Third, we speculate that the difference may reside in the context in which studies were conducted – i.e., traditional measures of innovation vs. modern online innovation. In the traditional context, people in high uncertainty avoidance countries are less likely to accept uncertainty, changes and new ideas [21]. However, the digital context may present a different environment for people living in high uncertainty avoidance societies who may think and act differently than they would in a traditional environment.

Much work should be done given that this is a preliminary study of online innovation. More
sophisticated definitions and measurements for online innovation need to be explored given that there is a wide range of varying definitions of innovation. Further research should distinguish and define different types of innovation. In addition, more sophisticated research models should be developed to explain why culture in the online context seems to play a more important role in facilitating innovation than it does in facilitating tradition innovation.

Further studies are needed to explain these contradictory findings and to fully understand the role of culture and extent to which it influences various aspects of national innovation. Future studies may benefit from adopting other national cultural value models such as Schwartz, World Value Survey Model, and GLOBE to examine the linkage of innovation to cultural values. Future studies should also take advantage of national level data sets collected and published by various international organizations. As these data accumulate over time, there should be longitudinal, cross-cultural studies that analyze and compare various aspects of innovation among nations.

7. References


