A Critical Review of the Measurement of Organization Innovativeness

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Abstract

The role of organizational innovativeness, or innovative capability, in attaining competitive advantage has been widely discussed. Many researchers have developed the measures for organizational innovativeness. This article reviews the measurement of this construct and recommends the further improvement. Related literature retrieved from several databases was reviewed in terms of reliability, content validity, and construct validity using a checklist based on the guideline of Devellis. An extensive literature review identified a total of nine scales on the construct. Three showed very limited psychometric information. More psychometric information was provided by six scales i.e., the organizational innovativeness scale, the innovation propensity scale, the measurement of firm innovativeness, the strategy-making and changes, the measuring innovativeness of organization and the cultural measurement. Overall six scales with more psychometric information are reliable, but more information is needed on their content validity and construct validity. Four of six scales are multi-dimensional, the other two scales are uni-dimensional. The organizational innovative scale by Wang and Ahmed has more psychometric information than other scales. This scale has 20 items measuring five dimensions (product, process, market, behavior, and strategy of innovativeness. The reviewed scales are in the early stage. The development of new scales or improvement of the existing ones by theory-driven study is urgently needed.

Keywords: Organizational innovativeness, measurement, critical review
Background

Innovation has been studied from many perspectives in several fields including marketing, management, sociology, economics, psychology, and engineering. The results of these studies have led to the development of two distinct innovativeness concepts. The first concept focuses on consumer innovativeness. The second focuses on firm innovativeness (Knowles, 2007). Firm or organizational innovativeness was defined by Wang and Ahmed (2004) as “an organization’s overall innovative capability of introducing new products to the market, or opening up new products to the markets, through combining strategic orientation with innovative behavior and process”. Innovativeness or ability to innovate is as one of the determinants for organization to survive and succeed (Barney & Clark, 2007; Doyle, 1998). However, there is a few empirical studies in development and validation of scale for this construct. The literatures addressed that its measurement needed improvement (Avlonitis, Kouremenos, & Tzokas, 1994; Capon, Farley, Lehmann, & Hulbert, 1992; Hurley & Hult, 1998; Miller & Friesen, 1983; North & Smallbone, 2000).

Many measures of the construct were ad hoc measures not conforming to systematic procedures for scale development. Moreover, many scales adopted a certain perspective, such as product innovativeness (Danneels & Kleinschmidt, 2001; Sethi, Smith, & Park, 2001) instead of overall innovative capability. Diverse approaches for measurement were employed such as those based on firm’s current technology, self-evaluation, R&D funding, number of new products and intellectual property (Knowles, 2007). These diversities led to confusion in innovation research, making it difficult to compare findings across studies or leading to biased conclusions (Cooper, 1998; Subramanian & Nilakanta, 1996; Tushman & Anderson, 1986; Zaltman, Duncan, & Holbek, 1973). Additional, all measurements were in the initial stage of development and required further research. The above reasons explain why organizational innovativeness literature often does not arrive at consensus over many issues. Valid and reliable measure is a prerequisite for conducting any valid.

Objectives

To review and evaluate the measurements of this construct in terms of their advantages and disadvantages.

Research Methodology
Article Retrieval

There were five steps in the identification of relevant articles as followed:

Step 1 Searching: This research employed several electronic databases to perform the search including ABI, ProQuest, ProQuest dissertation, APS, Business Source, Complete, H.W. Wilson, Sprinkle link, Emeral, Science Direct and Scopus. Keywords employed in the search included “innovativeness”, “innovation” and “innovati*” both in the field of title and abstract in the area of business and management. No time limited except those limits imposed by the individual databases. This search retrieved a total of 298,987 articles.

Step 2 Identification of relevant research: the researchers filtered the search results using the following criteria 1) include only articles on general management, finance, accounting taxation and law, operations, human resource management, and marketing; 2) being published in scholarly journals, dissertation and theses; 3) being research articles, dissertation and literature review; 4) Written in English and being peer reviewed 5) relevant to innovation, organizational behavior and marketing. This procedure retrieved a total of 1905 articles.

Step 3 Selection of studies: The procedure intended to check whether the studies deliberated the measurement of innovation and organizational innovativeness. However, if a decision could not be made from titles or abstract, the introduction, methodology and conclusion of the articles were assessed. 1,821 articles were excluded for not meeting above requirement. 84 remaining articles were included.

Step 4 Quality assessment: the selected articles were independently rated by the first 2 authors on whether they were related to innovativeness measurement with self-report approach. We excluded those based on other data collection methods such as R&D funding. Two raters discussed on the articles with different opinions to reach the agreement. 60 studies were identified as relevant to the measurement of innovativeness. 9 did not clearly state the methodology and were also excluded. Another 15 were excluded because we could not access the full articles. Finally, 36 studies involving 9 scales with self-evaluation method were included in the review.
Critical Appraisal the Instruments

The critical appraisal was guided by a checklist that drew on the work of DeVellis (2003). The checklist detailed the criteria on reliability, content validity and construct validity. Two authors then independently assessed 9 scales according to the criteria.

Findings

Nine scales of organizational innovativeness met the inclusion criteria of the study. Their dimensions were listed in table 1. Table 2 summarizes psychometric information of all nine scales.

Table 1: Dimension of innovativeness scale

<table>
<thead>
<tr>
<th>Author</th>
<th>Number of study</th>
<th>Product</th>
<th>Market</th>
<th>Process</th>
<th>Behavior</th>
<th>Strategic</th>
<th>Business system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avlonitis, et al. (1994)</td>
<td>2</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Miller and Friesen (1983)</td>
<td>1</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Knowles (2007)</td>
<td>5</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>North and Smallbone (2000)</td>
<td>1</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Rainey (1995)</td>
<td>1</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Hurley and Hult (1998)</td>
<td>10</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Capon, et al. (1992)</td>
<td>3</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Dobní (2008)</td>
<td>1</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Psychometric properties of the reviewed scales

<table>
<thead>
<tr>
<th>Instrument</th>
<th>No. of item (Dimension)</th>
<th>Target</th>
<th>Content validity</th>
<th>Construct validity</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wang and Ahmed (2004)</td>
<td>20 (5)</td>
<td>Any Companies</td>
<td>yes</td>
<td>correlation, CFA</td>
<td>Alpha=0.87-0.63</td>
</tr>
<tr>
<td>Hurley and Hult (1998)</td>
<td>5 (1)</td>
<td>Any organization</td>
<td>yes</td>
<td>correlation, CFA</td>
<td>Alpha= 0.82</td>
</tr>
<tr>
<td>Knowles (2007)</td>
<td>15 (3)</td>
<td>softwood sawmill company</td>
<td>yes</td>
<td>correlation, CFA</td>
<td>Alpha= 0.94</td>
</tr>
<tr>
<td>Miller and Friesen (1983)</td>
<td>5(3)</td>
<td>Any companies</td>
<td>yes</td>
<td>correlation</td>
<td>Alpha=0.76-0.90</td>
</tr>
<tr>
<td>Avlonitis, et al. (1994)</td>
<td>11(4)</td>
<td>Manufacturing companies</td>
<td>yes</td>
<td>EFA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Table 2: Psychometric properties of the reviewed scales

<table>
<thead>
<tr>
<th>Instrument</th>
<th>No. of item (Dimension)</th>
<th>Target</th>
<th>Content validity</th>
<th>Construct validity</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainey (1995)</td>
<td>11(2)</td>
<td>Employers</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>North and Smallbone (2000)</td>
<td>5(4)</td>
<td>SMEs</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Capon, et al. (1992)</td>
<td>27(2)</td>
<td>Manufacturers</td>
<td>no</td>
<td>no</td>
<td>Alpha=0.74</td>
</tr>
<tr>
<td>Dobni (2008)</td>
<td>9(1)</td>
<td>service industry</td>
<td>yes</td>
<td>EFA</td>
<td>Alpha= 0.71</td>
</tr>
</tbody>
</table>

The Organizational Innovativeness Scale by Wang and Ahmed (2004)

The scale by Wang and Ahmed is the most well validated instrument of organizational innovativeness. They defined the construct as “organization’s overall innovative capability of introducing new product to the market, or opening up new markets, through combining strategic orientation with innovative behavior and process”.

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The scale consisted of 20 items on seven points Likert scale from 1=strongly disagree to 7=strongly agree. Cronbach’s Alpha ranged from 0.63-0.87 across 5 dimensions. The scale showed a good fit to the data with RMSEA=0.052 and CFI=0.949. Advantages of this scale are its comprehensiveness in measuring innovativeness covering the dimensions in product, process, market and underlying elements of innovation outcomes, i.e. behavioral and strategic innovative orientation. It is quite popular among researchers in the field because it is relatively short and easy for use in a large sample. However, the scale is in the early stage of development. The findings provided a basic framework and a direction for future research, in which they recommended among other things, the expansion of construct items.

**The Cultural measurement by Hurley and Hult (1998)**

Hurley and Hult (1998) used innovativeness as one of the independent variables to explain innovative capacity. The measure consists of five items on five point scale ranging from 1 (not descriptive) to 5 (very descriptive). The content of the measure focuses on organizational cultures that emphasize learning development, and participative decision making. Therefore, the scale was similar to behavioral dimension of innovativeness.

The scale is reliable with Cronbach alpha 0.82. The scale along with the other 4 scales was subjected to a confirmatory factor analysis. The model fitted well to the data with DELTA=0.94 and RNI= 0.94. This scale was quite popular in the field because it is short and easy for use in a large sample. However, the scale measures only one dimension of innovativeness that is behaviorally based.

**Innovativeness of Organization by Avlonitis, et al. (1994)**

The scale by Avlonitis, et al. (1994) consisted of 11 items developed for Greek manufacturing industry in the project called “Project Innovastrat”. There were five dimensions underlying the scale including technological innovation challenges, manifested strategic innovation intentions, product innovativeness, innovativeness of core machinery and innovative leadership. The data in the study were split randomly into halves and submitted to exploratory factor analysis. The five factors remained stable suggesting that the results were not the result of chance.
The advantage of this measurement is that it provides an appropriate framework for the assessment of the various aspects of innovativeness such as technological innovativeness and behavioral innovativeness. This measurement is alternative approach for the better understanding of a multidimensional concept of innovativeness of organization.

Even though, the researchers took effort to ensure content validity and used exploratory factor analysis to examine construct validity. However, the authors did not report Cronbach Alpha.

**Firm Innovativeness by Knowles, et al. (2007)**

The scale is one of the well validated instruments. The creators conceptualized innovativeness in a similar way to that of Wang and Ahmed’s but used three dimensions instead of five, by merging three dimensions (behavioral, strategic and market innovativeness) into business systems innovativeness.

Knowles et al. first developed the original 25 items based on definition of innovativeness which was the propensity to create new products, new manufacturing processes or new business systems, the propensity to adopt new product, the propensity to adopt new manufacturing processes or new business system. This items were on a five point Likert scale with 1= strongly disagree and 5= strongly agree.

The first stage of testing showed a good reliability. However, the result showed that the propensity to create and adopt scale was attempting to measure too many dimensions of innovativeness. The aspects of innovativeness as reduced from six to three which is product, process and business system. The final version of scale was composed of 15 items measuring three aspect of innovativeness with Cronbach’s Alpha 0.94 for the whole scale.

However, sample sizes (n= 87 for stage I and 109 in stage II) in the studies did not meet the recommended minimum size (200 response or 10 response per item) for using confirmatory factor analysis. This small size may have an effect on the fit of the models. Modification of the scale is also required for the use in the other type of respondents outside softwood sawmilling industries. This scale needs further refinement.

**The Strategy-making and Changes by Miller and Friesen (1983)**
The development of this scale was based on the concept of strategy-making. Strategy-making refers to two broad dimensions: analysis and innovation. The innovation dimension includes new product and service, seeking unusual and novel solution, method of production and risk taking by key executive. The measurement consists of five items on a seven point scale ranging from "has decreased very much" (1) to “has increased very much” (7).

The scale was tested in Chief Executive Officer (CEOs) of 50 firms. The scale was reliable with Cronbach alpha 0.76-0.79. Construct validity was demonstrated by the scale’s correlation with other variables which was consistent to a theoretical prediction. This scale is quite short and easy to use. The scale needed a revision and focused on specific dimensions of innovation such as product and service, process, behavior and risk taking.


The researchers developed questionnaires with five innovation dimensions, namely: 1) product and services 2) market development 3) marketing method 4) production processes and 5) the technology used in administration. Items were generated using data from telephone interview and face-to-face interview with managers from 16 sectors in remote rural areas in England.

Later, data from 330 SMEs were collected by using the scale. The authors tried to measure the overall innovativeness of firms by producing an index of total innovative activity. The authors classified total index scores into three groups based on the upper and lower quartiles i.e., ‘highly active innovator’ (above the upper quartile or an index score of 6 or more) ‘moderately active innovator’ (comprising the two middle quartiles, or index score of 3-5) and ‘low level of innovation’ (below lower quartile or index score of 0-2). However, the researchers did not present enough information on construct validity and reliability.

**The Innovation Propensity Scale by Dobni (2008)**

This measurement was based on the concept of innovation and culture. Innovative culture has been defined as a multi-dimensional context which includes the intention to be innovative, the infrastructure to support innovation, operational level behaviors necessary to influence a market and value orientation, and environment to
implement innovation. However, innovative propensity is one of seven factors in the innovation culture. The scale consists of nine items on a seven point Likert scale ranging from (1) strongly disagree to (7) strongly agree.

This scale is uni-dimensional scale emphasizing behavioral innovativeness. The scale was tested in 282 employees in financial service industry. The scale was reliable with Cronbach alpha 0.71. Construct validity was demonstrated by showing a strong correlation among the seven factors representing the innovation index.

The Measurement of Innovation by Capon, et al. (1992)

Capon, et al. (1992) derived 27 questions on corporate environment, corporate strategy, and formal and informal organization in four groups of 113 Fortune 500 manufacturers that approached innovation quite differently. The representatives of 113 large U.S. manufacturers were interviewed by three MBA students who worked full time as interviewers on the project. They were trained and managed by a market research company. Cronbach Alpha of the scale was 0.74. However the author did not report the information on content and construct validity.


Rainey’s study is the review of research and theories relevant to innovative attitudes and behavior among public and private sector employees. He used the term “organization’s change resistance” instead of innovation attitudes. His measure consists of eleven items which summarized from the literature. Sample questions are “1a. if we do not constantly strive to improve our products and services, our competition will get ahead of us” and “1b. what percentage of your organization’s total budget come from governmental appropriations?”

Rainey’s scale is considered a specific measure because the content focuses on government reform such as government authorities and political influences, public scrutiny, bureaucratic structure and configuration, personnel red tape. This measurement has no information on its reliability and constructs validity. Moreover, the measurement is quite long and difficult to use. The scale has not been used in any study.

Discussions
The authors do not support to use of uni-dimensional scale of innovation and assessing change resistance scale. Their information on reliability and validity is very limited. However, assessing change resistance scale is useful and suitable for reforming organization. Conversely, this scale is too specific and limit in its narrow target and content.

Among nine reviewed measurements, 7 are multi-dimension scale and two (The innovation propensity and The cultural measurement) are uni-dimensional scale. Many instruments were created by data-driven strategy. The researchers directly created items from literature review without having a clear organizing framework or theories in mind, and went on using exploratory data analysis to group the items into various factors. Six instruments (1. The organizational innovativeness scale 2. The innovation propensity scale 3. The measurement of firm innovativeness 4. The strategy-making and changes 5. The measuring innovativeness of organization and 6. The cultural measurement) have more information on psychometric properties. However, they all are still in the early stage.

The measurement of firm innovativeness shows satisfactory psychometric properties on measuring three innovativeness dimensions. However, its limitation is length (15 items), small sample size (n=109) on scale development which might affect fit of the measurement model. This scale also has cross loadings in many items.

The organizational innovativeness scale by Wang and Ahmed (2004) has more psychometric properties compared to the other. However, it has some problems with cross loadings and low square multiple correlations. The researchers did not remove some items because it would decrease reliability. The scale by Wang and Ahmed is recommended. It provides an overview of multi-dimensional characterization of product, strategy, behavior, process, and market innovativeness. The scale also includes questions specific to professions or setting of interest (managers, employee etc.) to offer a more complete picture of organizational innovativeness.

**Recommendations**

The review shows that organizational innovativeness scale plays an important role in measuring firm or organizational innovativeness because of its better psychometric properties compared to the other scales and its comprehensive dimensions. This article encourages the researchers to use existing theoretical
framework in developing new scale, improving the existing scale or advancing the research in this area. Further research on measurement of factorial validity and feasibility and improvement of existing measures by theory-driven studies are required.

References


