DIMENSIONS OF INNOVATION POTENTIALS IN SMALL BUSINESS BASED ON MALCOLM BALDRIGE NATIONAL QUALITY AWARD RECIPIENTS

A Dissertation by

Hesham Hassan Mugharbil

Master of Science, Milwaukee School of Engineering, 2005
Bachelor of Science, Milwaukee School of Engineering, 2003

Submitted to the Department of Industrial and Manufacturing Engineering and the faculty of the Graduate School of Wichita State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy

December 2016
DIMENSIONS OF INNOVATION POTENTIALS IN SMALL BUSINESS BASED ON MALCOLM BALDRIGE NATIONAL QUALITY AWARD RECIPIENTS

The following faculty members have examined the final copy of this dissertation for form and content, and recommend that it be accepted in partial fulfillment of the requirement for the degree of Doctor of Philosophy, with a major in Industrial and Manufacturing Engineering.

____________________________________
Gamal S. Weheba, Committee Chair

____________________________________
Ramazan Asmatulu, Committee Member

____________________________________
Deepak Gupta, Committee Member

____________________________________
Krishna Krishnan, Committee Member

____________________________________
M. Edwin Sawan, Committee Member

Accepted for the College of Engineering

____________________________________
Royce Bowden, Dean

Accepted for the Graduate School

____________________________________
Dennis Livesay, Dean
DEDICATION

To my parents for all of their support and encouragement; to my dear wife for all of her support, patience, and sacrifices; to all of my precious children; and to all of my brothers and sisters
ACKNOWLEDGMENTS

I would like to express my highest appreciation and gratitude to my advisor, Dr. Gamal Weheba, for the continuous support of my PhD study and related research, for his patience, motivation, and immense knowledge. I also would like to thank my committee members, Dr. Edwin Sawan, Dr. Ramazan Asmatulu, Dr. Deepak Gupta, and Dr. Krishna Krishnan, for their support and feedback on this research.
ABSTRACT

Innovation is the driver for sustaining competitive advantage and growth. Innovation management is vital to small businesses, and requires clear plans, processes, and measures. This study examines key dimensions for innovation potential that can be utilized by small- and medium-sized enterprises (SMEs).

Based on an extensive literature review, eight dimensions pertaining to innovation potentials were identified. Each of the eight dimensions was assigned a set of symbols or codes. To ensure content validity, the codes were validated by utilizing the summary applications of 15 recipients of the Malcolm Baldrige National Quality Award (MBNQA). In addition, the application summaries were used to verify dimensionality.

Validated codes were the foundation for performing a computer-aided textual analysis (CATA) of 880 scholarly publications, the results of which were used to indicate the relative importance of each dimension. Also, principal component analysis (PCA) revealed the relative contribution of each dimension to the total variability and suggested two meta-dimensions: “idea generation” and “marketing capabilities.” These meta-dimensions offer a foundation for developing a methodology for evaluating the innovation process and quantifying the risks involved in new projects.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>LITERATURE REVIEW</td>
<td>3</td>
</tr>
<tr>
<td>2.1</td>
<td>Definitions of Innovation</td>
<td>3</td>
</tr>
<tr>
<td>2.2</td>
<td>Types of Innovation</td>
<td>4</td>
</tr>
<tr>
<td>2.3</td>
<td>Innovation in Small Business</td>
<td>5</td>
</tr>
<tr>
<td>2.4</td>
<td>Innovation Models and Factors</td>
<td>6</td>
</tr>
<tr>
<td>2.5</td>
<td>Malcolm Baldrige National Quality Award</td>
<td>14</td>
</tr>
<tr>
<td>2.5.1</td>
<td>Criteria for Performance Excellence</td>
<td>16</td>
</tr>
<tr>
<td>2.5.2</td>
<td>Award Recipients in Small Business</td>
<td>17</td>
</tr>
<tr>
<td>3.</td>
<td>RESEARCH GAP AND OBJECTIVES</td>
<td>28</td>
</tr>
<tr>
<td>3.1</td>
<td>Research Gap</td>
<td>28</td>
</tr>
<tr>
<td>3.2</td>
<td>Research Objectives</td>
<td>29</td>
</tr>
<tr>
<td>4.</td>
<td>RESEARCH METHODOLOGY</td>
<td>30</td>
</tr>
<tr>
<td>4.1</td>
<td>Initial Dimensions</td>
<td>30</td>
</tr>
<tr>
<td>4.2</td>
<td>Coding Scheme</td>
<td>33</td>
</tr>
<tr>
<td>4.3</td>
<td>Test for Validity</td>
<td>34</td>
</tr>
<tr>
<td>4.4</td>
<td>Summaries of MBNQA Recipient Applications</td>
<td>39</td>
</tr>
<tr>
<td>4.5</td>
<td>Dimensions of Innovation Potentials in Publications</td>
<td>43</td>
</tr>
<tr>
<td>5.</td>
<td>CONCLUSIONS AND FUTURE RESEARCH</td>
<td>51</td>
</tr>
<tr>
<td>5.1</td>
<td>Conclusions</td>
<td>51</td>
</tr>
<tr>
<td>5.2</td>
<td>Future Research</td>
<td>54</td>
</tr>
<tr>
<td>REFERENCES</td>
<td></td>
<td>56</td>
</tr>
<tr>
<td>APPENDIXES</td>
<td></td>
<td>62</td>
</tr>
<tr>
<td>A.</td>
<td>Content Validation Survey</td>
<td>63</td>
</tr>
<tr>
<td>B.</td>
<td>Research Publications References</td>
<td>67</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Manifest construct analysis</td>
<td>31</td>
</tr>
<tr>
<td>4.2</td>
<td>Example of utilizing online synonyms finder for “communication”</td>
<td>34</td>
</tr>
<tr>
<td>4.3</td>
<td>Example of NVivo search query process</td>
<td>35</td>
</tr>
<tr>
<td>4.4</td>
<td>Baldrige application summaries Pareto chart</td>
<td>40</td>
</tr>
<tr>
<td>4.5</td>
<td>MBNQA application summaries scree plot</td>
<td>42</td>
</tr>
<tr>
<td>4.6</td>
<td>PRISMA flow diagram</td>
<td>45</td>
</tr>
<tr>
<td>4.7</td>
<td>Publications Pareto chart</td>
<td>46</td>
</tr>
<tr>
<td>4.8</td>
<td>Publications’ scree plot</td>
<td>48</td>
</tr>
<tr>
<td>5.1</td>
<td>Innovation potentials paradigm</td>
<td>54</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Evolution of Innovation Process Models</td>
<td>7</td>
</tr>
<tr>
<td>2.2 Factors and Concepts for Model of Innovation</td>
<td>8</td>
</tr>
<tr>
<td>2.3 Practices for Company Innovation</td>
<td>9</td>
</tr>
<tr>
<td>2.4 Factors of Organizational Culture that Support Innovation</td>
<td>11</td>
</tr>
<tr>
<td>2.5 Innovation Capabilities</td>
<td>12</td>
</tr>
<tr>
<td>2.6 MBNQA Recipients in Small Business Category</td>
<td>18</td>
</tr>
<tr>
<td>4.1 Summary of Models and Factors of Innovation</td>
<td>32</td>
</tr>
<tr>
<td>4.2 Dimensions of Innovation Potentials in Small Business</td>
<td>33</td>
</tr>
<tr>
<td>4.3 Creativity Code Agreements and CVR</td>
<td>36</td>
</tr>
<tr>
<td>4.4 Development Code Frequencies</td>
<td>37</td>
</tr>
<tr>
<td>4.5 MBNQA Recipient Frequencies</td>
<td>37</td>
</tr>
<tr>
<td>4.6 Dimensions and Associated Codes</td>
<td>37</td>
</tr>
<tr>
<td>4.7 Initial Eigenvalues of MBNQA Summary Applications</td>
<td>41</td>
</tr>
<tr>
<td>4.8 Principal Component Analysis of MBNQA Summary Applications</td>
<td>43</td>
</tr>
<tr>
<td>4.9 Publications Search Boolean String</td>
<td>44</td>
</tr>
<tr>
<td>4.11 Initial Eigenvalues of Publications</td>
<td>47</td>
</tr>
<tr>
<td>4.12 Principal Component Analysis of Publications</td>
<td>49</td>
</tr>
<tr>
<td>5.1 Meta-Dimensions</td>
<td>52</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>AHP</td>
<td>Analytical Hierarchy Process</td>
</tr>
<tr>
<td>CATA</td>
<td>Computer-Aided Text Analysis</td>
</tr>
<tr>
<td>CVR</td>
<td>Content Validity Ratio</td>
</tr>
<tr>
<td>KMO</td>
<td>Kaiser-Meyer-Olkin</td>
</tr>
<tr>
<td>MBNQA</td>
<td>Malcolm Baldrige National Quality Award</td>
</tr>
<tr>
<td>NESTA</td>
<td>National Endowment for Science, Technology and the Arts</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PC</td>
<td>Principal Component</td>
</tr>
<tr>
<td>PCA</td>
<td>Principal Component Analysis</td>
</tr>
<tr>
<td>PIS</td>
<td>Performance Improvement System</td>
</tr>
<tr>
<td>PII</td>
<td>Potential Innovation Index</td>
</tr>
<tr>
<td>PRISMA</td>
<td>Preferred Reporting Items for Systematic Reviews and Meta-Analyses</td>
</tr>
<tr>
<td>SBA</td>
<td>Small Business Administration</td>
</tr>
<tr>
<td>SMEs</td>
<td>Small- and Medium-Sized Enterprises</td>
</tr>
<tr>
<td>SPP</td>
<td>Strategic Planning Process</td>
</tr>
<tr>
<td>WSU</td>
<td>Wichita State University</td>
</tr>
<tr>
<td>VOC</td>
<td>Voice of the Customer</td>
</tr>
</tbody>
</table>
Despite the fact that the United States (U.S.) is known for large corporations (Liu, Li, & Zhang, 2012), it has more than 28 million small businesses, which account for 99.7% of all employers nationally, according to the U.S. Small Business Administration (SBA, 2015).

Therefore, it is vital to investigate issues related to improving the success of these small businesses, which can also be referred to as small- and medium-sized enterprises (SMEs). One of these success elements is “innovation.” This study focuses on examining the factors that drive innovation’s potential for success, which can be utilized in the small business sector given its economic and social implications.

The initial dimensions of innovation potential were identified from the literature. Then those factors were validated through the application summaries of small business recipients of the Malcolm Baldrige National Quality Award (MBNQA). There is no evidence in the literature of innovation success factors associated with small businesses that received the MBNQA. Therefore, this research attempted to address such a gap in the literature. The motivation behind this study was based on the work of Usrey and Dooley (1996), who defined the dimensions of software quality through qualitative content analysis.

A preliminary publications’ search was conducted by accessing the library database at Wichita State University (WSU) and utilizing “SmartSearch” (WSU Libraries, 2016). The search query included the key word “innovation,” which had to be present in the publication title. Also, the terms “small business,” “SMEs,” and their derivatives had to be present in the abstract, and “factors,” “model,” “framework,” “dimensions,” or “constructs” had to be present in the publication text. The search was limited to full-text, peer-reviewed publications in English that
were published in the past sixteen years. Results yielded 1,200 publications, which were examined by evaluating the title and abstract of each to determine its relevance to this research.

The term “small business” is implied within the term small- and medium-sized enterprises; therefore, both terms were used interchangeably in this study. Results and conclusions were reached by utilizing qualitative content analysis and statistical methodologies.

Chapter 2 of this research presents a literature review concerning innovation models and factors that lead to success, and a description of the MBNQA. Chapter 3 discusses the gap in the cited literature and the research objectives. Chapter 4 discusses the research methodology and the dimensions of innovation potentials. Conclusions and future research are detailed in Chapter 5.
CHAPTER 2
LITERATURE REVIEW

The objective of this literature review was to identify studies related to factors that drive innovation success and that can be utilized in the small business sector. Various theories and models from the literature are discussed and analyzed.

The emphasis here is on discussing the process involved in product innovation, where the term “product” is used to cover both goods and services, as conferred by the Organisation for Economic Co-operation and Development (OECD) (2005). The innovation framework discussed in this research also applies to process, marketing, and organizational innovation. Moreover, the literature review attempts to identify innovation potentials from a broad-spectrum of innovation factors and dimensions.

Section 2.1 discusses the various definitions of innovation, and Section 2.2 discusses the various types of innovation. The small business sector and its significance are discussed in Section 2.3. Innovation models and factors are described in Section 2.4, and Section 2.5 discusses the MBNQA and its recipients.

2.1 Definitions of Innovation

There is a plethora of definitions for innovation by researchers, practitioners, and policymakers. The following definitions provide an indication of the subject matter.

Schumpeter (1934), who is regarded as the most influential early researcher on entrepreneurship and innovation’s impact on economic change, provided the earliest definition of innovation. He included five manifestations of innovation in this definition (Vyas, 2014):

1. Creation of new products or qualitative improvements in existing products.
2. Use of a new industrial processes.
3. New market openings.

4. Development of new raw-material sources or other new inputs.

5. New forms of industrial organizations

The United Kingdom’s National Endowment for Science, Technology and the Arts (NESTA) defined innovation as “change associated with the creation and adaptation of ideas that are new-to-world, new-to-nation/region, new-to-industry, or new-to-firm” (Patterson, Kerrin, & Gatto-Roissard, 2009). Tang (1998) asserted that innovation is “a process of raising and doing a project with the aim of commercializing or utilizing an innovative product, process, or service.” The OECD (2005) defined innovation comprehensively as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations.” The Baldrige Performance Excellence Program (2015) indicated that “innovation means making meaningful change to improve an organization’s products, services, programs, processes, operations, and business model, with the purpose of creating new value for stakeholders.”

2.2 Types of Innovation

According to the OECD (2005), there are four main types of innovation:

- **Product innovation**: The introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness, or other functional characteristics.

- **Process innovation**: The implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment, and/or software.
• Marketing innovation: The implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

• Organizational innovation: The implementation of a new organizational method in the firm’s business practices, workplace organization, or external relations (OECD, 2005).

2.3 Innovation in Small Business

Jones and Tilley (2003) stated that the definition of a small business in the U.S. and definition of a small business in Europe are entirely different. A firm in Europe is referred to as “small” if it has less than 50 employees, whereas in the U.S., a firm is referred to as “small” if it employs less than 500 people. Moreover, the Asia-Pacific Economic Cooperation (2003) defined small business as having less than 500 employees for manufacturing firms or less than $5 million in annual sales for non-manufacturing firms.

Yilin, Desheng, Luxiu, and Yuming (2010) asserted that the core value creation in SMEs stems from seeking new prospects through innovation and product development. Vyas (2014) argued that over the past 50 years, research has consistently shown a connection between innovation and business success. To support such an argument, he compiled a number of assessments from the literature that correlate business success with innovation as follows:

• High-growth companies get a higher percentage of sales from new products relative to competitors (O’Gorman, 1997)

• Innovation is a key element of business success (Nonaka & Takeuchi, 1995).

• Firms using innovation to differentiate their products from competitors are twice as profitable (Pavitt, 1991).
• Better business performance is related to the higher measures of innovation (Cavanagh & Clifford, 1983).

• Innovating firms have a lower probability of stagnant or declining employment in comparison to non-innovating firms (Frenz, Michie, & Oughton, 2003).

• Innovative businesses grow more than non-innovative businesses (Götzfried, Crowley, & Larsson, 2004).

Cobbenhagen (2000) argued that in order for a business to be competitive and profitable through new products or services, it needs to attain “innovation success,” not just innovation. He identified innovation success as “the economic exploitation of innovation by the introduction of new products and processes as well as the enhancement of services.” On the other hand, he asserted that innovation merely refers to “renewed products and services without necessarily obtaining economic returns.”

2.4 Innovation Models and Factors

In order to comprehend innovation models and factors, it is essential to understand innovation capability and measures. Saunila, Pekkola, and Ukko (2014) defined innovation capability as “consisting of the determinants influencing an organization’s ability to manage innovation.” In addition, they defined performance measurement as “quantifying the input, output, or level of activity of an event or process.” They also indicated that “the link between innovation capability and firm performance is significant in the presence of performance measurement. Performance measurement can thus be used as a tool for improving the performance of SMEs through innovation capability” (Saunila et al., 2014).

Innovation measurement has been based on metrics that were developed over the years through different scopes. According to Chobotová and Rylková (2014), these metrics were
divided into four generations, spanning from the 1950s until the 2000s. Hannola, Friman, and Niemimuukko (2013) referred to the aforementioned generations as “innovation process models” and included a fifth generation based on several other studies. Table 2.1 shows the fifth proposed generation added sequentially to the previous innovation process models.

### TABLE 2.1

**EVOLUTION OF INNOVATION PROCESS MODELS**

<table>
<thead>
<tr>
<th>Generation</th>
<th>Model</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>First (1950/1960s)</td>
<td>Technology push</td>
<td>Simple linear sequential model; emphasis on R&amp;D</td>
</tr>
<tr>
<td>Second (1970s)</td>
<td>Market pull</td>
<td>Simple linear sequential model; emphasis on marketing</td>
</tr>
<tr>
<td>Third (1980s)</td>
<td>Coupling model</td>
<td>Integration of R&amp;D and marketing</td>
</tr>
<tr>
<td>Fourth (1980/1990s)</td>
<td>Interactive model</td>
<td>Combinations of push and pull</td>
</tr>
<tr>
<td>Fifth (2000s)</td>
<td>Network model</td>
<td>Systems integration and extensive networking, continuous innovation</td>
</tr>
</tbody>
</table>

Source: Hannola et al. (2013)

Other researchers have asserted that the “systems integration and networking innovation process” theory is the most recent development in the 2000s, which was based on the fourth-generation process. This process focused on the need for continuous change. Conversely, various views in the literature debated the number of innovation generations. For example, Ortt and Duin (2008) argued that they only considered four generations in their research because they “believe that the alleged ‘fifth generation’ is merely an implementation of the fourth generation.” Tang (1998) proposed an earlier model, which was discovered during a review of the obtained publications, and was included due to its relevance. He conducted a literature review by analyzing innovation’s key theories. His analysis resulted in identifying six factors of innovation:

- Information and communication
- Behavior and integration
• Knowledge and skills
• Project raising and doing
• Guidance and support
• External environment

Table 2.2 illustrates the linkage of Tang’s identified factors to key concepts for the model of innovation.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information and Communication</td>
<td>Flow of information and technology, use of information technology, information as a source of knowledge and stimulus for innovation.</td>
</tr>
<tr>
<td>Behavior and Integration</td>
<td>Behavior traits, creative behaviors, motivation to innovate, team roles, cross-functional integration.</td>
</tr>
<tr>
<td>Knowledge and Skills</td>
<td>Creativity, intelligence, insights, bisociation, domain-related knowledge and skills, tacit and explicit knowledge, knowledge creation, learning and training.</td>
</tr>
<tr>
<td>Project Raising and Doing</td>
<td>Opportunity and problem finding, problem solving, product and process development stages, uncertainty reduction.</td>
</tr>
<tr>
<td>Guidance and Support</td>
<td>Organization’s mission, task, structure, strategy, resources, operation systems. Shared values, leadership style.</td>
</tr>
<tr>
<td>External Environment</td>
<td>Economic rules and innovation, national innovation system, industry structure, culture.</td>
</tr>
</tbody>
</table>


Corona-Armentats, Guimaraes, and Boly (2007) studied technological innovation within the manufacturing sector, proposing a model that aimed to better comprehend “management practices, the methodologies and the organizational schemes developed at one given moment in a company.” They asserted that the objective was to determine if this prospective is favorable for
innovation. Accordingly, they proposed a model for measuring a company’s innovative process capacity.

This model is “based on an innovative pilot model, which contains thirteen practices, developed in the laboratory by Boly (2004), and taking into account that innovation processes adopted by enterprises are specific” (Corona-Armentats et al., 2007). The 13 practices included factors such as conception, project follow-up, integrated strategy, portfolio management and others, as shown in Table 2.3. This methodology involved the Potential Innovation Index (PII), which was compared with two multiple criteria methods: Electre and the analytical hierarchy process (AHP). Results of the comparison showed that the different methods give similar global results. In a second phase, they classified companies based on the resulting PII, which was categorized based on certain predetermined index ranges. The classifications included referring to a company as proactive, preactive, reactive, or passive.

TABLE 2.3

PRACTICES FOR COMPANY INNOVATION

<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Tasks</td>
<td>Innovation actors must work to develop projects and technology evolution with design tasks.</td>
</tr>
<tr>
<td>Project Follow-Up</td>
<td>Each innovative project must involve a fundamental follow-up.</td>
</tr>
<tr>
<td>Integrated Strategy</td>
<td>Global supervision of new innovative projects (budget, deadline, etc.) must be led with an integration of the strategic dimension dictated by the management team.</td>
</tr>
<tr>
<td>Portfolio Management</td>
<td>Within the project’s portfolio, the direction ensures coherent management among different initiatives.</td>
</tr>
<tr>
<td>Feedback on Innovation Process</td>
<td>The management team and project managers must control and receive feedback on innovation processes in order to develop actor practices.</td>
</tr>
<tr>
<td>Suitable Organization</td>
<td>Suitable context and working conditions must be created in order to stimulate innovation.</td>
</tr>
</tbody>
</table>
TABLE 2.3 (continued)

<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competence Allocation</td>
<td>Clear steps toward necessary competence allocation to the innovation process must be developed.</td>
</tr>
<tr>
<td>Moral Support</td>
<td>Moral support must be given by the management team and the project managers to the innovation process participants.</td>
</tr>
<tr>
<td>Collective Learning</td>
<td>As projects progress, an environment of collective learning must exist for the actor.</td>
</tr>
<tr>
<td>Capitalization of Knowledge</td>
<td>An effort of capitalization of know-how and knowledge acquired during the former projects must be done for use in forthcoming projects.</td>
</tr>
<tr>
<td>Plan Survey Tasks</td>
<td>Survey tasks (technological, competitive, economic, managerial, intelligence) must be organized in order to open up the company to the environment.</td>
</tr>
<tr>
<td>Technological Networks</td>
<td>The management team must manage networks in which the firm is integrated.</td>
</tr>
<tr>
<td>Capitalization of New Ideas</td>
<td>New ideas from research, marketing, or those proposed by the employees must be continuously collected using creativity, in order for future projects to emerge.</td>
</tr>
</tbody>
</table>

Source: Corona-Armentats et al. (2007)

Hogan and Coote (2014) identified factors of organizational culture that support innovation. They asserted that “based on a review of research and relevant literature, the study examines the values, norms, and artifacts that the literature suggests motivate innovative behaviors.”

A number of factors were utilized for evaluating an innovation-oriented culture: success, openness and flexibility, internal communication, competence and professionalism, inter-functional cooperation, responsibility of employees, appreciation of employees, and risk-taking (Table 2.4). Such factors can be considered as innovation success factors based on their definitions and applications in a business environment.
### TABLE 2.4

**FACTORS OF ORGANIZATIONAL CULTURE THAT SUPPORT INNOVATION**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>The degree to which an organization values success and strives for the highest standards of performance, and values the provision of challenging goals and encouragement of employees to excel.</td>
</tr>
<tr>
<td>Openness and Flexibility</td>
<td>The degree to which an organization values openness and responsiveness to new ideas, and a flexible approach to solving problems.</td>
</tr>
<tr>
<td>Internal Communication</td>
<td>The degree to which an organization values open communication that facilitates information flows within an organization.</td>
</tr>
<tr>
<td>Competence and Professionalism</td>
<td>The degree to which an organization values knowledge and skills, and upholds the ideals and beliefs associated with a profession.</td>
</tr>
<tr>
<td>Inter-Functional Cooperation</td>
<td>The degree to which an organization values coordination and teamwork.</td>
</tr>
<tr>
<td>Responsibility</td>
<td>The degree to which an organization values employees’ proactiveness, initiative, autonomy, and responsibility for their work.</td>
</tr>
<tr>
<td>Appreciation</td>
<td>The degree to which an organization values, rewards and recognizes employees’ accomplishments.</td>
</tr>
<tr>
<td>Risk-Taking</td>
<td>The degree to which an organization values experimentation with new ideas and challenging the status quo.</td>
</tr>
</tbody>
</table>

Source: Hogan and Coote (2014)

Rahman, Doroodian, Kamarulzaman, and Muhamad (2015) proposed a model for “developing a reliable and valid scale for the measurement of innovation capability based on innovation activities and to assess its psychometric properties.” They proposed a concept termed “Sustainability of Overall Innovation Capability” (SUSTINOVAT) along with a model to measure the SUSTINOVAT construct. They explained, that “the SUSTINOVAT’s measurement model is a developed scale that measures the SUSTINOVAT construct based on evaluating the innovation activities and efforts of a firm rather than innovation inputs or outputs.” The results of their study put forward an “eight-dimensional (8D) scale of measuring the sustainability of
overall innovation capability construct” based on innovation activities. Their construct had eight factors (8D):

- Strategic management
- Supportive culture and structure
- Resource allocation
- Communication and networking
- Knowledge and technology management
- Idea management
- Project development
- Commercialization capabilities

Table 2.5 shows the factors and associated activities based on the findings of Rahman et al. (2015).

**TABLE 2.5**

**INNOVATION CAPABILITIES**

<table>
<thead>
<tr>
<th>Capability</th>
<th>Activity</th>
</tr>
</thead>
</table>
| Strategic Management             | Business vision
|                                  | Innovation strategy
|                                  | Innovation targets and search areas
<p>|                                  | Consistency between innovation strategy and firm’s activities.          |
| Supportive Culture and Structure | Supportive culture for innovation, creativity, and risk taking.          |
|                                  | Responsibility of top management for innovation and tolerance to changes and failures. |
|                                  | Encouraging open communication and efficient cross-linked communication. |
|                                  | Advocating differentiated, specialized, integrated and flexible structure. |</p>
<table>
<thead>
<tr>
<th>Capability</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Allocation</td>
<td>Human resource.</td>
</tr>
<tr>
<td></td>
<td>Financial resource.</td>
</tr>
<tr>
<td></td>
<td>Physical resource.</td>
</tr>
<tr>
<td></td>
<td>Slack resource.</td>
</tr>
<tr>
<td>Communication and Networking</td>
<td>Intimate communication with customers in all stages of the innovation process.</td>
</tr>
<tr>
<td></td>
<td>Attendance in national and international related exhibitions.</td>
</tr>
<tr>
<td></td>
<td>Membership and networking with industrial and professional associations.</td>
</tr>
<tr>
<td></td>
<td>Communication with competitors and national and international industrial service providers.</td>
</tr>
<tr>
<td>Knowledge and Technology Management</td>
<td>Informal R&amp;D and learning activities, internal technological efforts.</td>
</tr>
<tr>
<td></td>
<td>Knowledge and technology acquisition.</td>
</tr>
<tr>
<td></td>
<td>Knowledge and technology assimilation, adaptation &amp; transformation.</td>
</tr>
<tr>
<td></td>
<td>Technology trends monitoring and evaluation.</td>
</tr>
<tr>
<td></td>
<td>Integration of internal, external, tacit and explicit knowledge.</td>
</tr>
<tr>
<td>Idea Management</td>
<td>Use of different techniques of creativity and idea generation.</td>
</tr>
<tr>
<td></td>
<td>Acquisition of innovative ideas through networking and external relations.</td>
</tr>
<tr>
<td></td>
<td>Screening of ideas with the overall and innovation strategies of firms.</td>
</tr>
<tr>
<td></td>
<td>Screening of ideas by conducting multi-criteria feasibility study.</td>
</tr>
<tr>
<td>Project Development</td>
<td>Formation of cross-functional project teams.</td>
</tr>
<tr>
<td></td>
<td>Improvement of capabilities of designing, engineering, prototyping, and testing.</td>
</tr>
<tr>
<td></td>
<td>Use of a comprehensive system of innovation project management.</td>
</tr>
<tr>
<td></td>
<td>Adoption of high-tech tools and equipment.</td>
</tr>
<tr>
<td></td>
<td>Internal and external networking and cooperation.</td>
</tr>
<tr>
<td>Commercialization Capabilities</td>
<td>Market analysis and monitoring.</td>
</tr>
<tr>
<td></td>
<td>Proficiency of personnel/adequacy of facilities.</td>
</tr>
<tr>
<td></td>
<td>Adherence to a commercialization schedule and formal post-launch reviews.</td>
</tr>
<tr>
<td></td>
<td>Joint venturing and other financing methods.</td>
</tr>
<tr>
<td></td>
<td>Monitoring competitor.</td>
</tr>
</tbody>
</table>

Source: Rahman et al. (2015).
2.5 Malcolm Baldrige National Quality Award

According to the National Institute of Standards and Technology (NIST), the MBNQA was created in 1987 by Public Law 100-107. The NIST stated that: “Principal support for the program comes from the Foundation for the Malcolm Baldrige National Quality Award, established in 1988. The Award is named for Malcolm Baldrige, who served as Secretary of Commerce from 1981 until his death in 1987. His managerial excellence contributed to long-term improvement in efficiency and effectiveness of government.”

The Findings and Purposes section of Public Law 100-107 states the following:

1. The leadership of the United States in product and process quality has been challenged strongly (and sometimes successfully) by foreign competition, and our Nation’s productivity growth has improved less than our competitors' over the last two decades.

2. American business and industry are beginning to understand that poor quality costs companies as much as 20 percent of sales revenues nationally and that improved quality of goods and services goes hand in hand with improved productivity, lower costs, and increased profitability.

3. Strategic planning for quality and quality improvement programs, through a commitment to excellence in manufacturing and services, are becoming more and more essential to the well-being of our Nation's economy and our ability to compete effectively in the global marketplace.

4. Improved management understanding of the factory floor, worker involvement in quality, and greater emphasis on statistical process control can lead to dramatic improvements in the cost and quality of manufactured products.
5. The concept of quality improvement is directly applicable to small companies as well as large, to service industries as well as manufacturing, and to the public sector as well as private enterprise.

6. In order to be successful, quality improvement programs must be management-led and customer-oriented, and this may require fundamental changes in the way companies and agencies do business.

7. Several major industrial nations have successfully coupled rigorous private-sector quality audits with national awards giving special recognition to those enterprises the audits identify as the very best; and

8. A national quality award program of this kind in the United States would help improve quality and productivity by:
   o Helping to stimulate American companies to improve quality and productivity for the pride of recognition while obtaining a competitive edge through increased profits;
   o Recognizing the achievements of those companies that improve the quality of their goods and services and providing an example to others;
   o Establishing guidelines and criteria that can be used by business, industrial, governmental, and other organizations in evaluating their own quality improvement efforts; and
   o Providing specific guidance for other American organizations that wish to learn how to manage for high quality by making available detailed information on how winning organizations were able to change their cultures and achieve eminence (Public Law 100-107, 1987).
Feng (2005) discussed the correlation between innovation and quality as he argued that total quality management (TQM) demonstrates a positive relationship with a firm’s quality performance. Achieving quality is the main objective of TQM programs. However, such programs presently aim to reach further targets, such as organizational business excellence. Many aspects of the business excellence model are in line with creativity and innovation. Consequently, a positive relationship between TQM and innovation is expected.

2.5.1 Criteria for Performance Excellence

According to the Baldrige Performance Excellence Program (2015), the Criteria for Performance Excellence utilizes seven critical aspects of organizational management and performance:

- Leadership
- Strategy
- Customers
- Measurement, analysis, and knowledge management
- Workforce
- Operations
- Results

The MBNQA Criteria for Performance Excellence embrace certain core values. “These core values and concepts are the foundation for integrating key performance and operational requirements within a results-oriented framework that creates a basis for action, feedback, and ongoing success” (Baldrige Performance Excellence Program, 2015):

- Systems perspective
- Visionary leadership
• Customer-focused excellence
• Valuing people
• Organizational learning and agility
• Focus on success
• Managing for innovation
• Management by fact
• Societal responsibility
• Ethics and transparency
• Delivering value and results

2.5.2 Award Recipients in Small Business

Cazzell and Ulmer (2009) examined previous winners of the MBNQA in the manufacturing sector, and noted that “it is easy to see many common denominators that contributed to not only the successful operation of each company but the sustainable growth each company has achieved.” After studying these winners, they proclaimed that “it is evident why the award is highly coveted and why 1,100 applicants have previously strived for a chance to win the MBNQA, and why countless organizations have measured themselves against the award criteria and the benchmarks set by its recipients.”

According to the NIST website, there were 24 award recipients in the small business sector between 1988 and 2015. However, the NIST only released the application summaries of winners from 1999 onward, as shown in Table 2.6 (NIST, 2014).
TABLE 2.6

MBNQA RECIPIENTS IN SMALL BUSINESS CATEGORY

<table>
<thead>
<tr>
<th>Company</th>
<th>Award Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midway USA</td>
<td>2015</td>
</tr>
<tr>
<td>MESA</td>
<td>2012</td>
</tr>
<tr>
<td>Freese and Nichols, Inc.</td>
<td></td>
</tr>
<tr>
<td>K&amp;N Management</td>
<td>2010</td>
</tr>
<tr>
<td>Studer Group</td>
<td></td>
</tr>
<tr>
<td>Midway USA</td>
<td>2009</td>
</tr>
<tr>
<td>PRO-TEC Coating Company</td>
<td>2007</td>
</tr>
<tr>
<td>MESA</td>
<td>2006</td>
</tr>
<tr>
<td>Park Place Lexus</td>
<td>2005</td>
</tr>
<tr>
<td>Texas Nameplate Company, Inc.</td>
<td>2004</td>
</tr>
<tr>
<td>Stoner, Inc.</td>
<td>2003</td>
</tr>
<tr>
<td>Branch-Smith Printing Division</td>
<td>2002</td>
</tr>
<tr>
<td>Pal’s Sudden Service</td>
<td>2001</td>
</tr>
<tr>
<td>Los Alamos National Bank</td>
<td>2000</td>
</tr>
<tr>
<td>Cargill Kitchen Solutions</td>
<td>1999</td>
</tr>
</tbody>
</table>

Source: NIST (2014)

The 15 small business award recipients listed in Table 2.6 were involved in various innovation efforts that they defined in terms of innovation processes and measures, as evident in their application summaries. Some of these innovation activities for each business are mentioned here, denoted by business name and award year.

**Midway USA (2015):**

- An environment and culture for innovation and intelligent risk taking is created by senior leaders, who play a major role in such efforts. The firm’s culture includes agility, focus on success, managing for innovation, management by fact, delivering value and results,
and continuous improvement. The firm has formal calls for innovation and opportunity focus meetings.

- **Managing for innovation** is part of the firm’s culture. A key to stimulating innovation is the strategy to recruit, develop, and retain high-performing employees who share the firm’s values and align with the firm’s culture. The firm uses department key measures to assess innovation. The performance improvement system (PIS) is reviewed monthly at the company and department levels to identify and incorporate innovation into strategic planning.

- **Strategically important ideas** are developed, categorized, prioritized, and implemented. Innovation is developed through multiple methods. The firm has formal calls for innovation in meetings. Innovation is recorded in the PIS and reviewed and prioritized. The firm has more than 3,400 ideas captured in the firm’s PIS in various stages of consideration and implementation and, since 2011, has implemented more than 2,000 ideas.

- **Innovation and strategic planning processes** are achieved through assembly and transfer of knowledge, which is vital for the strategic planning process (SPP). Knowledge relevant to innovation and the SPP is collected from employees through the PIS and is used to improve and innovate systems. Ideas are categorized by the processes they impact.

- **Reinforcing intelligent risk to achieve innovation** through the firm’s leadership system, employees receive the information and tools needed to create, analyze, and propose ideas for intelligent risks to achieve innovation (NIST, 2014).
MESA (2012):

- **Key supplier relationships** are important to innovation because they help identify and define new products, services, and equipment.

- **Process improvement and innovation** initiatives are generated by management review, employee suggestions, customer/supplier feedback, and quality feedback reports.

- **Improvement and innovation opportunities** are identified through comparative and benchmark information that are then included as inputs. The relevant system analyzes the data and information provided by the knowledge management system, identifies opportunities for improvement and innovation, and deploys those improvements to the proper work systems.

- **Data and information** are collected to support voice-of-the-customer (VOC) processes. The data and information ultimately aids in identifying opportunities for improvement and innovation in products, services, and customer-access mechanisms.

- **Benchmarking the innovative work systems** is conducted with other high-performing organizations in designing new work systems (NIST, 2014).

Freese and Nichols, Inc. (2010):

- **Fostering innovation** is one of the most significant operational challenges for the firm. The firm has an innovation committee that develops methods to incorporate innovation across the company.

- **Innovative solutions** for projects are essentials, and employees are encouraged to find such solutions. A new innovation program is piloted in order to assign senior technical staff to coach project teams about innovation at key points of the project.
• **Innovation is emphasized** through recognition programs for professional and technical papers, presentations at conferences, and the company’s own annual innovation award.

• **Innovation through technology**, whereby a project team looks for such opportunities to reduce project cost or cycle time or to exceed client requirements by providing better value for the same cost, is advocated.

• **Promoting innovation** is accomplished by the lead team as they initiate an innovation program to improve the effectiveness of these efforts. The innovation team is charged with determining how to incorporate a more systematic approach to innovation into projects (NIST, 2014).

**K&N Management (2010):**

• **Innovation and business decision making** are supported by using real-time data, analyzing trends, conducting competitor and industry comparisons, comparing locations, and viewing comparisons from year to year.

• **A culture of excellence and innovation** is created by senior leaders and fostered through benchmarking best practices. The business innovatively designed a process that uses the same kitchen and front line used for barbecuing.

• **Approaches for identifying and innovating product offerings** are kept current, where the R&D director collects internal information related to how well the approaches worked during the last year, benchmarks best practices inside and outside the industry, and collects and analyzes data related to product sales mix.

• **Data mining techniques** are utilized to understand the interrelationships of the metrics that can help direct innovation and improvement initiatives (NIST, 2014).
Studer Group (2010):

- An innovative online program called tokens of appreciation is employed to recognize individual contributions of employees.
- The product or service innovation is screened using a strategic screening matrix to evaluate the likelihood of success against multiple dimensions. The most attractive opportunities are developed and brought to market.
- Innovation through the adoption of the Baldrige Criteria and other systematic processes, such as the SPP, three-year Rapid Enterprise Development™, and the firm’s innovation model.
- The innovation model is used to translate review findings from industry knowledge, customer listening methods, and evidence-based leadership into new products and services. Leaders drive innovation by empowering individuals and teams to seek out best practices and comparative data. In addition, innovation is embedded across departments through the bright ideas program (NIST, 2014).

Midway USA (2009):

- Innovation is measured by the ability to improve key processes and ultimately performance against company goals.
- As innovation ideas or new services become available, the business evaluates the ability to impact stakeholder. Innovation ideas are referred to the SPP for implementation as appropriate.
- Innovative ideas from each department are maintained in a list from employees, vendors, or customers that are used to innovate processes for designing, improving, and innovating
all processes. Senior leaders create opportunities for improvement, which are identified in meetings and the innovation process.

- **In support of managing for innovation**, the concept is incorporated into the SPP through innovation and knowledge sharing during meetings, and the two-way communication senior leaders team. Part of the innovation process is the CIP list, which senior leaders use to capture, maintain, and share innovation and improvement ideas from various sources.

- **Opportunities for innovation** are identified through customer and market information by using customer service survey and vendor management processes. Sources of innovation come from employees, feedback reports, and others. The business implements a significant number of CIP ideas to improve work systems and exceeds the Baldrige recipient benchmark’s percentage of innovation ideas implemented (NIST, 2014).

**Pro-Tec Coating Company (2007):**

- **Technical innovation** and product development is one of the company’s key success factors. Its strategic position as an “innovation leader in coated steel” is what sets the company apart from other suppliers.

- **Breakthrough innovation** is guided through actionable data, where the results of analysis of data may provide a measure for guidance of company strategic objectives or may provide insight into processes.

- **Innovating purposefully** is a method whereby senior leaders have established an environment for continuous improvement and associated learning, and they attribute the linkage between agility and innovation in developing new products and processes to the success and long-term viability of the company.
• **By capitalizing on the innovativeness** of core competency and of associates, the business is able to perform these processes with quality, accuracy, and efficiency while supporting the overall strategy of being an innovation leader (NIST, 2014).

**MESA (2006):**

• **Organizational innovation** is generally initiated by MESA; however, key suppliers are involved in supply chain performance and improvement. This company’s performance measurements are key drivers of decision-making and innovation. The results of performance analyses are translated into priorities for improvement and innovation through management review on a monthly and bi-annual schedule.

• **Tools for innovation** include the customer communications and satisfaction survey process, industry publications, conferences, training, seminars, and supplier input/survey (NIST, 2014).

**Park Place Lexus (2005):**

• **Managing for innovation** is one of the firm’s critical success factors for this year’s strategic plan, which will differentiate the company from competitors.

• **Innovation is rewarded** with personalized acknowledgement through recognition programs. Through each leader’s acceptance of new ideas, empowerment and innovation are ingrained in the culture. The firm conducts a monthly open forum for members to meet and discuss flexibility and ideas for innovation and evolving the corporate culture. Other approaches include suggestion boxes and the listening and learning process.

• **Breakthrough innovations** and continuous improvement are enhanced systematically through organizational excellence processes.
• **Measures of innovation** include: market share, cost of sales, and asset control.” (NIST, 2014).

**Texas Nameplate Company, Inc. (2003):**

• **Innovation and integration** are achieved by using the Baldrige criteria in combination with the business criteria, because the business continually looks for evidence of its own success in terms of sustainable growth.

• **Evidence of innovation**, daily refinement, and improved integration result from organizational-level analysis and sharing (NIST, 2014).

**Branch-Smith Printing Division (2002):**

• **An innovative excellence system** is the key mechanism to accomplish organizational focus on continuous improvement.

• **Innovation and continuous improvement** is encouraged by the company, and employees are motivated to engage through their own expectations and actively participate in performance improvement activities after receiving training in quality and problem solving (NIST, 2014).

**Pal’s Sudden Service (2001):**

• **Innovation is driven** through the product, service, and process introduction method. Senior leaders personally lead cross-functional teams through this systematic approach for developing new or modified products, services, or processes. This creates and reinforces an environment for participation, empowerment, and innovation.

• **Opportunities for innovation and needed improvements** are prioritized during management reviews by the senior leaders, in conjunction with the leadership team. The continuous improvement process is used to translate priorities/opportunities into plans.
• Measures of innovation include a balanced scorecard, which measures all the key business drivers (NIST, 2014).

Los Alamos National Bank (2000):

• Innovation and empowerment environments are established and reinforced by senior leaders within the context of the evaluation and measurement step in the leadership system.

• Improvement and innovations are prioritized based on organizational performance findings by senior leaders during monthly reviews, and during the budgeting and planning meeting process.

• The firm embraces innovation and has welcomed the opportunity to be a beta test site for several new technological innovations.

• Innovation is measured by new product usage, new technology, and new products and services (NIST, 2014).

Cargill Kitchen Solutions (1999):

• An environment for innovation in products and services is promoted by the leadership system through the use of the firm strategic business plan, annual business environment, annual operating plan, and weekly key indicator report.

• Innovative ideas are generated by customers and stakeholders, which are recorded into the product development process.

• Innovation is encouraged through a customer driven, rather than through a production driven, mindset.

• Innovation in operations focuses on optimizing processes to maximize yields and efficiencies, reducing variation, and creating value-added products that fulfill customer
requirements. Innovation in services provided by the firm also focuses on customer requirements and enhancing customer relationships (NIST, 2014).
CHAPTER 3

RESEARCH GAP AND OBJECTIVES

In this chapter, the research gap and objectives are discussed and defined based on the findings from the literature regarding dimensions for innovation potentials. Several models and factors were discussed in Chapter 2, which illustrated the variation in ideas in terms of what derives innovation success.

Tang (1998) identified six factors of innovation following his work in analyzing the key theories and contents of the related literature. Corona-Armentats et al. (2007) proposed an innovation measurement model, which incorporated an index of 13 innovation factors in order to evaluate management innovation practices. Hogan and Coote (2014) identified factors of organizational culture that support innovation. Such factors can be considered as drivers for innovation success based on their definitions and applications in business functions. Eight factors including their definitions and sub-practices were proposed by Rahman et al. (2015). Moreover, they proposed SUSTINOVAT, the concept of sustainability of overall innovation capability. They also developed a measurement model, “a developed scale that measures the SUSTINOVAT theory based on evaluating the innovation activities and efforts of a firm rather than innovation inputs or outputs.”

3.1 Research Gap

As shown previously, there is variability in innovation factors among the four models, in spite of the fact that studies by Hogan and Coote (2014), and Rahman et al. (2015) are specific to SMEs. Such variability indicates lack of consensus in the cited models on what constitutes innovation success. This is consistent with Bin Ali and Edison (2010) as they asserted that “there is no consensus as to what constitutes innovation within the same organization. Moreover,
innovation is a broader term and some aspects might be difficult to measure.” Likewise, Mir, Casadesús, and Petnji (2016) proclaimed that “there is no agreement on the variables that influence innovation capability, even though there were many different proposals.”

3.2 Research Objectives

Research efforts were established based on the idea that identifying the most important dimensions for innovation potentials would help small businesses understand the nature of innovation and increase the effectiveness of their efforts in seeking such endeavors. Hence, this research aims to study the dimensions for innovation potentials from the literature by validating them from research publications related to innovation. Consequently, the validated dimensions are studied through statistical analysis in order to identify the most significant dimensions for innovation potential.
CHAPTER 4
RESEARCH METHODOLOGY

This study applied qualitative analysis as the main research methodology. Flick (2009) defined qualitative research as “research interested in frequencies and distributions of issues, events or practices by collecting standardized data and using numbers and statistics for analyzing them.” The most appropriate type of qualitative analysis in this research was content analysis, or manifest construct analysis. Onwuegbuzie, Leech, and Collins (2012) indicated that content analysis consists of “systematically reducing source(s) to codes deductively or inductively, then counting the number of codes.” Such content analysis was conducted using NVivo 10, a computer-assisted text analysis (CATA) method.

The content comprised publications on innovation models and dimensions as well as the application summaries of 15 Baldrige award recipients in the small business sector. Statistical analysis utilizing Statgraphics Centurion XVII was employed to analyze the obtained data. The research methodology is illustrated in Figure 4.1. The remainder of this section describes the steps involved.

4.1 Initial Dimensions

The first step of the research methodology was to identify the 35 initial dimensions, which were acquired from the models described in Chapter 2. However, the dimensions in each model had some commonalities and some discrepancies, as summarized in Table 4.1. Redundant dimensions and dimensions unrelated to the innovation process were eliminated. For instance, one dimension by Corona-Armentats et al. (2007) was “Capitalization of Knowledge,” which was considered to be similar to what Rahman et al. (2015) referred to as “Knowledge and Technology Management.” Hence, the latter dimension was considered instead.
Figure 4.1. Manifest construct analysis
### TABLE 4.1

SUMMARY OF MODELS AND FACTORS OF INNOVATION

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Information and communication</td>
<td>• Design tasks</td>
<td>• Success</td>
<td>• Strategic management</td>
</tr>
<tr>
<td>• Behavior and integration</td>
<td>• Project follow-up</td>
<td>• Openness and flexibility</td>
<td>• Supportive culture</td>
</tr>
<tr>
<td>• Knowledge and skills</td>
<td>• Integrated strategy</td>
<td>• Internal communication</td>
<td>• Resource allocation</td>
</tr>
<tr>
<td>• Project raising and doing</td>
<td>• Portfolio management</td>
<td>• Competence &amp;and professionalism</td>
<td>• Communication and networking</td>
</tr>
<tr>
<td>• Guidance and support</td>
<td>• Feedback on innovation process</td>
<td>• Interfunctional cooperation</td>
<td>• Knowledge and technology management</td>
</tr>
<tr>
<td>• External environment</td>
<td>• Suitable organization</td>
<td>• Responsibility</td>
<td>• Idea management</td>
</tr>
<tr>
<td></td>
<td>• Competence allocation</td>
<td>• Appreciation</td>
<td>• Project development</td>
</tr>
<tr>
<td></td>
<td>• Moral support</td>
<td>• Risk-taking</td>
<td>• Commercialization</td>
</tr>
<tr>
<td></td>
<td>• Collective learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Capitalization of knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Plan survey tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Technological networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Capitalization of new ideas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The second step of forming the main dimensions for this study was to find a common name for combined dimensions. This measure was necessary because the methodology required single phrases to be used instead of word combinations in order to produce the “codes” for each dimension. Therefore, from the previous example, “Knowledge and Technology Management” was reduced to “Knowledge” as the main dimension. The word “Technology” was added as a code under “Knowledge.” These steps were applied to the other initial dimensions as well.
As shown in Table 4.2, the final set of dimensions was more relevant to what Rahman et al. (2015) proposed than the other models. Therefore, the resulting analysis of the chosen dimensions in this research were compared to his results in terms of significance and ranking. The newly formed dimensions and their definitions were compiled and referred to as “Dimensions of Innovation Potentials,” hereafter, signifying the groundwork for the coding scheme.

### TABLE 4.2

**DIMENSIONS OF INNOVATION POTENTIALS IN SMALL BUSINESS**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercialization</td>
<td>Converting ideas and new innovations into new marketable products (Azimi, Heydarpanahi, Mohammadi, &amp; Rezaei, 2013)</td>
</tr>
<tr>
<td>Communication</td>
<td>A symbolic interaction between organizations and their stakeholders dealing with new products, services, technologies, and ideas (Mast, 2011)</td>
</tr>
<tr>
<td>Creativity</td>
<td>Generating new and entirely original ideas (Patterson et al., 2009)</td>
</tr>
<tr>
<td>Development</td>
<td>Systematic applications of knowledge or understanding directed toward the production of useful materials, devices, and systems or methods to meet specific requirements (National Science Board, 2010)</td>
</tr>
<tr>
<td>Environment</td>
<td>The total surroundings, which have a direct or indirect bearing on the functioning of business or a set of external factors (Radomska, 2010)</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Information combined with experience, context, interpretation, and reflection (Davenport, De Long, &amp; Beers, 1998)</td>
</tr>
<tr>
<td>Management</td>
<td>Coordinated activities to direct and control an organization (Kostogryzov, Nistratov, &amp; Nistratov, 2012)</td>
</tr>
<tr>
<td>Resources</td>
<td>Refers to human, financial, physical, and slack assets (Rahman et al., 2015)</td>
</tr>
</tbody>
</table>

### 4.2 Coding Scheme

The second phase of the methodology involved a coding scheme, inspired by the work of Usrey and Dooley (1996), who utilized coding in developing dimensions of software quality. This coding scheme was used to assign symbols, or codes, for each dimension shown in Table 4.2. The source of the symbols was an online thesaurus or synonyms finder, as illustrated in Figure 4.2. In addition, the factor definitions contained some adjectives that were used as...
symbols. For instance, the dimension “creativity” in its definition had the words generate, original, and ideas, which were included as codes under “creativity.” As a result, each dimension produced a varying number of symbols. The author and his advisor considered the symbols most relevant to the area of innovation. By this point of the process, there were between six and thirteen codes per dimension.

4.3 Test for Validity

The codes from the previous step were validated through MBNQA recipients. This was based on information available in the application’s summary of each MBNQA recipient. Each winner was considered an expert for validating codes. The validation was conducted utilizing NVivo 10 software. All 15 applications were downloaded from the NIST websites and uploaded to the software. Subsequently, a text search query for each code was conducted on the
applications summaries of MBNQA recipients. The codes and their stem words for each dimension were searched in a separate query to obtain their availability and frequency in each summary application. Figure 4.3 illustrates the NVivo search query process.

Figure 4.3. Example of NVivo search query process

A content validation survey was created and completed for all 15 studied small businesses based on the textual analysis results. That survey is provided in Appendix A. Hence, any code that did not appear in any application was eliminated and replaced by another code from the previous step.

The results from codes pertaining to each dimension were extracted from the surveys and imported to an Excel file. The selection of the final codes was based on content validity ratio
(CVR). Lawshe (1975) asserted that content validity can be measured through the CVR, which measures the level of agreement among panellists, or survey takers. His formula is as follows:

\[ CVR = \frac{ne - \left(\frac{N}{2}\right)}{\left(\frac{N}{2}\right)} \]

where \( ne \) refers to the number of survey takers that indicate “agree,” and \( N \) is the total number of survey takers.

For this research, given that there were 15 applications, “a minimum CVR of 0.49 was required to satisfy the five percent level. Only those items with CVR values meeting this minimum were retained in the final form of the test” Lawshe (1975). The only exception to this rule was if the code that matched the dimension’s name had a CVR lower than the threshold. Then that code had to be included because it represented the actual dimension. For example, the dimension “Creativity” had the code “Creative,” which had a CVR of 0.33, and it was included in the list of codes as shown in Table 4.3. As can be seen, the CVR and total agreement of the 15 MBNQA applications, referred to as SB, or small business.

**TABLE 4.3**

<table>
<thead>
<tr>
<th>Code</th>
<th>SB1</th>
<th>SB2</th>
<th>SB3</th>
<th>SB4</th>
<th>SB5</th>
<th>SB6</th>
<th>SB7</th>
<th>SB8</th>
<th>SB9</th>
<th>SB10</th>
<th>SB11</th>
<th>SB12</th>
<th>SB13</th>
<th>SB14</th>
<th>SB15</th>
<th>Agreed</th>
<th>CVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>13</td>
<td>0.73</td>
</tr>
<tr>
<td>Creative</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>0.33</td>
</tr>
<tr>
<td>Design</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>1.00</td>
</tr>
<tr>
<td>Generation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>1.00</td>
</tr>
<tr>
<td>Innovativeness</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>1.00</td>
</tr>
<tr>
<td>Originality</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>12</td>
<td>0.60</td>
</tr>
</tbody>
</table>

The resulting symbols varied in numbers. Hence, the number of chosen symbols per innovation factor was set at five, in addition to the dimension’s name, which made the final count six codes. In case there were more than six codes with CVR = 1, which means 15
agreements, then the highest frequency was considered. Development code frequencies are shown in Table 4.4.

**TABLE 4.4**

DEVELOPMENT CODE FREQUENCIES

<table>
<thead>
<tr>
<th>Code</th>
<th>SB1</th>
<th>SB2</th>
<th>SB3</th>
<th>SB4</th>
<th>SB5</th>
<th>SB6</th>
<th>SB7</th>
<th>SB8</th>
<th>SB9</th>
<th>SB10</th>
<th>SB11</th>
<th>SB12</th>
<th>SB13</th>
<th>SB14</th>
<th>SB15</th>
<th>Freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advancement</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>13</td>
<td>6</td>
<td>18</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>81</td>
</tr>
<tr>
<td>Development</td>
<td>112</td>
<td>120</td>
<td>183</td>
<td>122</td>
<td>165</td>
<td>100</td>
<td>121</td>
<td>128</td>
<td>100</td>
<td>11</td>
<td>112</td>
<td>56</td>
<td>57</td>
<td>66</td>
<td>48</td>
<td>1501</td>
</tr>
<tr>
<td>Expansion</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>9</td>
<td>0</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Improvement</td>
<td>203</td>
<td>145</td>
<td>189</td>
<td>156</td>
<td>179</td>
<td>205</td>
<td>114</td>
<td>146</td>
<td>143</td>
<td>12</td>
<td>216</td>
<td>155</td>
<td>148</td>
<td>95</td>
<td>68</td>
<td>2174</td>
</tr>
<tr>
<td>Increase</td>
<td>43</td>
<td>40</td>
<td>4</td>
<td>42</td>
<td>36</td>
<td>15</td>
<td>31</td>
<td>35</td>
<td>3</td>
<td>45</td>
<td>18</td>
<td>8</td>
<td>27</td>
<td>13</td>
<td>390</td>
<td></td>
</tr>
<tr>
<td>Progression</td>
<td>15</td>
<td>9</td>
<td>8</td>
<td>14</td>
<td>34</td>
<td>35</td>
<td>14</td>
<td>21</td>
<td>23</td>
<td>3</td>
<td>11</td>
<td>24</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>241</td>
</tr>
</tbody>
</table>

The detailed frequencies for each MBNQA recipient are shown in Table 4.5. Each small business is listed by number under the column “SB,” where the latest award recipient is listed first, and so on. The final list of codes used in the textual analysis is shown in Table 4.6. These codes were used in conducting the textual analysis in the subsequent steps.

**TABLE 4.5**

MBNQA RECIPIENT FREQUENCIES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>504</td>
<td>380</td>
<td>252</td>
<td>219</td>
<td>282</td>
<td>99</td>
<td>198</td>
<td>153</td>
</tr>
<tr>
<td>2</td>
<td>277</td>
<td>309</td>
<td>211</td>
<td>184</td>
<td>243</td>
<td>114</td>
<td>119</td>
<td>78</td>
</tr>
<tr>
<td>3</td>
<td>585</td>
<td>425</td>
<td>239</td>
<td>230</td>
<td>288</td>
<td>319</td>
<td>158</td>
<td>209</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>306</td>
<td>156</td>
<td>199</td>
<td>95</td>
<td>84</td>
<td>173</td>
<td>196</td>
</tr>
<tr>
<td>5</td>
<td>375</td>
<td>436</td>
<td>335</td>
<td>278</td>
<td>79</td>
<td>212</td>
<td>146</td>
<td>138</td>
</tr>
<tr>
<td>6</td>
<td>356</td>
<td>390</td>
<td>232</td>
<td>194</td>
<td>169</td>
<td>110</td>
<td>128</td>
<td>157</td>
</tr>
<tr>
<td>7</td>
<td>347</td>
<td>283</td>
<td>178</td>
<td>190</td>
<td>121</td>
<td>129</td>
<td>121</td>
<td>101</td>
</tr>
<tr>
<td>8</td>
<td>367</td>
<td>333</td>
<td>222</td>
<td>261</td>
<td>155</td>
<td>109</td>
<td>97</td>
<td>61</td>
</tr>
</tbody>
</table>
### TABLE 4.5 (continued)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>390</td>
<td>313</td>
<td>286</td>
<td>249</td>
<td>145</td>
<td>139</td>
<td>112</td>
<td>102</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>29</td>
<td>42</td>
<td>16</td>
<td>26</td>
<td>27</td>
<td>39</td>
<td>17</td>
</tr>
<tr>
<td>11</td>
<td>300</td>
<td>395</td>
<td>192</td>
<td>252</td>
<td>143</td>
<td>107</td>
<td>110</td>
<td>103</td>
</tr>
<tr>
<td>12</td>
<td>225</td>
<td>266</td>
<td>177</td>
<td>161</td>
<td>134</td>
<td>101</td>
<td>93</td>
<td>73</td>
</tr>
<tr>
<td>13</td>
<td>163</td>
<td>230</td>
<td>95</td>
<td>88</td>
<td>111</td>
<td>113</td>
<td>63</td>
<td>99</td>
</tr>
<tr>
<td>14</td>
<td>313</td>
<td>211</td>
<td>134</td>
<td>137</td>
<td>183</td>
<td>68</td>
<td>55</td>
<td>92</td>
</tr>
<tr>
<td>15</td>
<td>128</td>
<td>139</td>
<td>59</td>
<td>69</td>
<td>49</td>
<td>45</td>
<td>45</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>4910</td>
<td>4445</td>
<td>2810</td>
<td>2727</td>
<td>2223</td>
<td>1776</td>
<td>1657</td>
<td>1610</td>
</tr>
</tbody>
</table>

### TABLE 4.6
DIMENSIONS AND ASSOCIATED CODES

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Code</th>
<th>Dimension</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercialization</td>
<td>Market</td>
<td>Environment</td>
<td>Environment</td>
</tr>
<tr>
<td></td>
<td>Profit</td>
<td>Culture</td>
<td>Culture</td>
</tr>
<tr>
<td></td>
<td>Distribute</td>
<td>Integrate</td>
<td>Integrate</td>
</tr>
<tr>
<td></td>
<td>Capitalize</td>
<td>Responsible</td>
<td>Responsible</td>
</tr>
<tr>
<td></td>
<td>Execution</td>
<td>Structure</td>
<td>Structure</td>
</tr>
<tr>
<td></td>
<td>Commercialize</td>
<td>Flexible</td>
<td>Flexible</td>
</tr>
<tr>
<td>Communication</td>
<td>Communicating</td>
<td>Knowledge</td>
<td>Knowledge</td>
</tr>
<tr>
<td></td>
<td>Reporting</td>
<td>Information</td>
<td>Information</td>
</tr>
<tr>
<td></td>
<td>Feedback</td>
<td>Knowledge</td>
<td>Knowledge</td>
</tr>
<tr>
<td></td>
<td>Contacting</td>
<td>Technology</td>
<td>Technology</td>
</tr>
<tr>
<td></td>
<td>Discussing</td>
<td>Education</td>
<td>Education</td>
</tr>
<tr>
<td></td>
<td>Interacting</td>
<td>Experience</td>
<td>Experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflection</td>
<td>Reflection</td>
</tr>
</tbody>
</table>
### 4.4 Summaries of MBNQA Recipient Applications

The 15 MBNQA recipient application summaries were available in a form of pdf files from the previous validation step. The eight innovation dimension frequencies from the 15 application summaries were analyzed through textual analysis. Accordingly, all identified innovation dimensions and their codes were searched in the full text of the applications summaries using NVivo 10 software.

To conduct the search, all documents were uploaded into the software, and then a word frequency query for the desired words and their stems was performed to determine the frequency of manifestation for each factor and its symbols.

Principal component analysis (PCA) was used as the main statistical methodology to extract three factors for analysis. A 15-by-8 table was created representing the 15 application summaries, where the sums of frequencies for each application are denoted in rows and the studied innovation potential dimensions are denoted in columns.

To check the sampling adequacy of the frequencies from the 15 applications, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was conducted, where the KMO should be
at least 0.60 (Kaiser, 1974). Hence, the KMO measure was 0.60 for the Baldrige application summaries, indicating that the PCA should be able to efficiently extract common factors.

The resulting Pareto chart based on MBNQA application summaries, as shown in Figure 4.4., revealed that the most frequent innovation dimension was Management, accounting for 22.16% of the total count. Development was next with the second highest frequency of 20.06% of the total count. Knowledge and Communication had frequencies of 12.68% and 12.31%, respectively. Commercialization, Resources, Environment, and Creativity resulted in frequencies of 10.03%, 8.02%, 7.48%, and 7.27% of the total count, respectively. It can be seen that Management, Development, Knowledge, Communication, and Commercialization account for 77.24% of the total count.

![Figure 4.4. Baldrige application summaries Pareto chart](image)

The result of the Pareto analysis for the Baldrige application summaries showing the highest frequencies being the Management and Development dimensions and accounting for approximately 42% of the total frequencies can be attributed to the fact that the Baldrige Criteria
for Performance Excellence focuses on management and its practices. For example, some of the core competencies of the criteria include visionary leadership, managing for innovation, and management by fact. Moreover, within those criteria, there is a focus on development in terms of employees, partners, technology, and overall business development.

The studied summary applications corresponded to those criteria areas in terms of describing business activities and answering questions related to management and development practices. Other dimensions illustrated frequencies that accounted for between 12.68% and 7.27% of the total frequencies. Interestingly, the Creativity had the lowest frequency, although one of the seven core values of the Baldrige Criteria of Performance Excellence is managing for innovation, which has always been part of the core values since its inception.

The purpose of the analysis was to obtain a small number of factors to account for most variability in the eight dimensions. Results from the Baldrige application summaries are shown in Table 4.7, indicating that only the first factor should be extracted based on the eigenvalue. The Management component accounts for 72.88% of the variability in the original data.

### TABLE 4.7

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>Percentage of Variance</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.83</td>
<td>72.88</td>
<td>72.88</td>
</tr>
<tr>
<td>2</td>
<td>0.75</td>
<td>9.40</td>
<td>82.28</td>
</tr>
<tr>
<td>3</td>
<td>0.55</td>
<td>6.94</td>
<td>89.22</td>
</tr>
<tr>
<td>4</td>
<td>0.51</td>
<td>6.37</td>
<td>95.59</td>
</tr>
<tr>
<td>5</td>
<td>0.14</td>
<td>1.78</td>
<td>97.37</td>
</tr>
<tr>
<td>6</td>
<td>0.13</td>
<td>1.66</td>
<td>99.03</td>
</tr>
<tr>
<td>7</td>
<td>0.07</td>
<td>0.89</td>
<td>99.92</td>
</tr>
<tr>
<td>8</td>
<td>0.01</td>
<td>0.08</td>
<td>100.00</td>
</tr>
</tbody>
</table>
From the analysis, a scree plot was generated based on eigenvalues, as shown in Figure 4.5. As can be seen, only principal component 1 should be retained, given that it is over the threshold of 1. Also, the break after the component indicates that the remaining components that appear after the break would be considered insignificant.

![Figure 4.5. MBNQA application summaries scree plot](image)

Consequently, all dimensions fall within the first factor, which is Management. Table 4.8 shows the factor loadings for each dimension. These dimensions are listed from the most important to the least important, based on their factor loadings. It can be seen from the previous results that Management had the highest frequency in the Baldrige summaries, although, it ranked second in terms of significance based on the PCA. The third highest frequency was Knowledge, but it appeared further down the rank of significance. Communication, the fourth ranking frequency shown previously in the Pareto analysis was also fourth ranking in the PCA’s significance rank. Hence, Communication does not appear to be of major significance for small businesses.
The dimension Commercialization, the fifth ranking frequency, appeared as the last factor in terms of significance to small businesses. This result could be due to less emphasis on commercialization and marketing efforts in the studied small businesses. Also, Resources ranked sixth in the frequencies and seventh in terms of PCA significance, thus indicating that management does not consider resources management very significant. Conversely, Environment was the seventh ranking dimension in the frequencies, but it ranked third in terms of PCA significance. This result might show that small businesses consider the working environment, culture, and structure to be important innovation factors.

It can be seen that Creativity had the lowest frequency according to the previously discussed Pareto analysis, and ranked sixth in significance. This result can be attributed to the fact that the application summaries do not focus merely on innovation but also include other management practices and functions.

4.5 Dimensions of Innovation Potentials in Publications

This research involved obtaining research publications related to the dimensions of innovation potentials. A search was conducted by accessing a scholarly search engine through
the library at WSU and utilizing “SmartSearch.” Several databases were searched by the search engine, which included: Business Source Complete, Academic OneFile, Expanded Academic ASAP, General OneFile, ScienceDirect, Business Insights: Essentials, and JSTOR Journals (WSU Libraries, 2016).

The search query included the key words “innovation,” which had to be present in the publication titles, and the terms “small business,” “SMEs” and their derivatives had to be present in the abstract. Also, the terms “factors,” “model,” “framework,” “dimensions,” or “constructs” had to be present in the publication text. The full Boolean string used is shown in Table 4.9.

**TABLE 4.9**

**PUBLICATIONS SEARCH BOOLEAN STRING**

```
TI Innovat* AND TX (construct* OR framework* OR model* OR dimension*) AND AB ("small business*" OR "SME*" OR "small firm*" OR "small enterprise*" OR "small and medium sized enterprises" OR “small to mid-sized organization*” OR "small-medium sized organization*" OR "small-medium sized organisation*" OR "small to mid-sized organisation*" “small organization*” OR “small organisation*” OR SMB* OR “Small-to-Medium Business*” OR “small company*”)
```

The search was limited to full-text, peer-reviewed publications in English that were published in the last sixteen years. Results yielded 1,200 publications. They were examined by following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method in order to determine their relevance to this research (Moher, Liberati, Tetzlaff, & Altman, 2009). The steps following the PRISMA method are illustrated in Figure 4.6. The final tally was 880 research publications, all of which were included in this research. A list of research publication references may be found in Appendix B.
The results of each dimension analysis were extracted in order to sort and analyze them using principal component analysis. Jackson (2005) asserted that PCA is a “multivariate
technique in which a number of related variables are transformed to a smaller set of uncorrelated variables.” Hence, the 880 publications formed an 880-by-8 table, where the sum of the frequencies for each item was denoted in rows and the studied innovation potential dimensions was denoted in columns. The KMO measure was 0.76 for the publications, indicating that the PCA should be able to efficiently extract common factors.

A Pareto chart shown in Figure 4.7 illustrates the ranking of the publication based on their frequencies. The most frequent innovation dimension was Creativity, which accounted for 34.4% of the total frequencies, followed by Knowledge with 16.2% and Management with 14.8%. Development had a frequency of 10.8%, followed by Commercialization with a frequency of 8.0%. Environment and Resources had the same frequencies of approximately 6.0%. The final dimension was Communication, accounting for 4.0% as the lowest frequency of the eight dimensions. It can be seen that the dimensions Creativity, Knowledge, Management, and Development explain 76.20% of the total count.

Figure 4.7. Publications Pareto chart
From the Pareto analysis of the publications, it was perceived that Creativity’s frequency was more than twice the frequencies of Knowledge and Management combined. This was predictable, given the fact that one of the main search terms for the publications in the databases was “innovation,” which was a symbol within the dimension Creativity. The second and third ranking dimensions, Knowledge and Management, had very close frequencies, thus showing that both had similar importance. On the other hand, the other dimensions had varying differences of frequency, except for Communication, which had a prominently low frequency level, accounting for only 4% of the total frequencies. This could be explained by the fact that employees that are involved in innovation and creativity are mostly segregated, due to the nature of their work. Hence, their communication with other employees or with external parties is not substantial.

As mentioned previously, PCA data were examined to identify the most significant correlations between the eight potential dimensions of innovation. Results of the PCA are illustrated in Table 4.10. As can be seen, Creativity and Knowledge were over the eigenvalue threshold of 1. Hence, these two principal components (PCs) explain 43.62% of the total variation in the data.

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>Percentage of Variance</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.41</td>
<td>30.10</td>
<td>30.10</td>
</tr>
<tr>
<td>2</td>
<td>1.06</td>
<td>13.30</td>
<td>43.40</td>
</tr>
<tr>
<td>3</td>
<td>0.95</td>
<td>11.90</td>
<td>55.40</td>
</tr>
<tr>
<td>4</td>
<td>0.88</td>
<td>11.0</td>
<td>66.40</td>
</tr>
<tr>
<td>5</td>
<td>0.77</td>
<td>9.70</td>
<td>76.10</td>
</tr>
<tr>
<td>6</td>
<td>0.70</td>
<td>8.80</td>
<td>84.80</td>
</tr>
<tr>
<td>7</td>
<td>0.67</td>
<td>8.50</td>
<td>93.30</td>
</tr>
<tr>
<td>8</td>
<td>0.53</td>
<td>6.70</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Given that only eigenvalues equal to or greater than 1 are considered, the first two PCs were extracted, as shown in Table 4.10. It can be seen that Creativity, Management, Development, Environment, and Resources made a significant contribution to the first PC. In addition, Knowledge, Commercialization, and Communication made a significant contribution to the second PC.

These PCA results are illustrated in the scree plot shown in Figure 4.8. The plot shows two significant principal components based on their eigenvalues. There is a break after the first two components, indicating that the remaining components would be considered insignificant.

![Figure 4.8. Publications’ Scree Plot](image)

Table 4.11 illustrates the dimensions and their significance ranked relative to each principal component. Based on the resulting PCA, dimensions in first PC were referred to as “Idea Generation.” On the other hand, dimensions in the second PC were referred to as “Marketing Capabilities.” It can be observed from the previously described Pareto chart that the highest frequency in the publications came from Creativity, which shows a significant
contribution to the first principal component, ranking second among the others. This should not be surprising due to the fact that the search for the publications was specific to innovation and creativity subjects.

The second highest PCA frequency in the publications data was Knowledge, which did not appear in the first principal component, but made a significant contribution to the second principal component. Management was the first ranking frequency, and it appeared as the first principal component and was revealed to be the most significant dimension of all. Development was the fourth ranking frequency in the publications, and the PCA corresponded to such a ranking.

TABLE 4.11

PRINCIPAL COMPONENT ANALYSIS OF PUBLICATIONS

<table>
<thead>
<tr>
<th>Dimension</th>
<th>PC1</th>
<th>PC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creativity</td>
<td>0.406</td>
<td>0.166</td>
</tr>
<tr>
<td>Knowledge</td>
<td>0.326</td>
<td>-0.534</td>
</tr>
<tr>
<td>Management</td>
<td>0.449</td>
<td>0.154</td>
</tr>
<tr>
<td>Development</td>
<td>0.398</td>
<td>-0.020</td>
</tr>
<tr>
<td>Commercialization</td>
<td>0.204</td>
<td>0.643</td>
</tr>
<tr>
<td>Environment</td>
<td>0.360</td>
<td>0.188</td>
</tr>
<tr>
<td>Resources</td>
<td>0.298</td>
<td>-0.004</td>
</tr>
<tr>
<td>Communication</td>
<td>0.330</td>
<td>-0.463</td>
</tr>
</tbody>
</table>

The dimension Commercialization was the fifth ranking frequency and was the most significant factor in the second principal component. This result could be due to the fact that commercialization and marketing efforts in the publications are considered top priorities in innovation efforts.
The sixth ranking dimension based on frequency in the publications was Environment, which appeared in the first principal component and ranked as fifth. This result reveals that researchers consider the working environment (i.e. culture and structure) to be one of the important factors for innovation efforts.

The Resources dimension was seventh in frequency rank with the lowest significance in the first principal component, where Communication was eighth in frequency rank with the lowest significance in the second principal component. These results indicate that the publications view those dimensions as less significant than the other dimensions.
CHAPTER 5
CONCLUSIONS AND FUTURE RESEARCH

This chapter highlights the research efforts, provides conclusions, and discusses areas where continuous research efforts are needed.

5.1 Conclusions

This research was aimed at identifying the most important dimensions for innovation potential, in an effort to help small businesses improve their innovation processes. Also, research efforts were aimed at clarifying the relative importance of each dimension.

Eight dimensions were extracted from previous studies: Management, Development, Knowledge, Communication, Commercialization, Resources, Environment, and Creativity. The research started by validating codes and verifying dimensionality of the constructs based on 15 application summaries from recipients of the Malcom Baldrige National Quality Award. Resulting codes were used to perform content analysis of 880 scholarly publications. Publication selection was performed by following PRISMA guidelines to ensure repeatability of the research findings.

Based on results of the textual analysis of 880 scholarly publications, it can be concluded that innovation potentials in SMEs can be determined based on the eight dimensions considered in this research. There are significant differences between perceptions of the MBNQA recipients and cited publications in terms of the emphasis placed on each dimension. These dimensions appeared to have different rankings in the two data sets.

Results from the principal component analysis based on the publications suggested two meta-dimensions: “idea generation” and “marketing capabilities,” as shown in Table 5.1.
The author proposes definitions for these two meta-dimensions:

- **Idea Generation**: This refers to management’s ability to create a supportive environment and provide sufficient resources to assist in the development of creative ideas into new products and processes.

- **Marketing Capabilities**: This refers to the abilities of organizations to commercialize and market new products based on knowledge of market trends and communication with their stakeholders.

The Idea Generation meta-dimension is supported by Poorkavoos, Duan, Edwards, and Ramanathan (2016), who argued that certain internal capabilities are vital because they stimulate innovation performance, including innovation strategy, human resource management, and creativity/idea management. As indicated, management is proven to be a vital component of idea generation, which is supported by Baldridge and Burnham (1975), who affirmed that “management orientation appears to play an important role in determining and supporting the firm’s decision to adopt and/or generate innovations regardless of its size.” The research finding showed that environment and culture are essential for the idea-generation process. This was
supported by Buckler (1997), who stated that “a supportive culture can further drive value
creation and encourage innovative ways of representing problems and searching for solutions.”

The proposed Marketing Capabilities meta-dimension and its factors are to a large extent
supported by Biazzo, Garengo, and Bernardi (2013), who discussed a similar dimension, referred
to as “market intelligence” and defined as “those activities that analyze the demand and supply,
and the environment in which these are embedded.” Moreover, the purpose of market
intelligence is to acquire the necessary knowledge of three areas: market segmentation, customer
motivations, and competitors. Also, the literature supports the idea that knowledge is an integral
part of the marketing capabilities. Hence, Evangelista, Sandven, Sirilli, and Smith (1998)
proclaimed that “knowledge of the market is part of the overall strategic innovation process.”
The findings in this dissertation that commercialization is a factor in marketing capabilities was
supported by Havlícek, Thalassinos, and Berezkinova (2013), who asserted that
“commercialization is based on careful preparation contained in the marketing plan that is based
on marketing research.”

The analysis of the publications suggested that the Management dimension makes the
highest contribution to Idea Generation, which agrees with Rahman et al. (2015). However,
Rahman et al. (2015) assigned Creativity, the seventh rank among the eight dimensions, to Idea
Generation. This research indicated that Creativity is the second most important dimension for
innovation potential.

The proposed meta-dimensions offer a foundation for developing a methodology for
evaluating the innovation process and quantifying the risks involved in new projects. It is
recommended that SMEs develop two different measures to evaluate their performance relative
to the two dimensions. Separate assessments would help identify the firm’s weaknesses and guide managerial actions, as shown in Figure 5.1.

![Figure 5.1. Innovation Potentials Paradigm](image)

**5.2 Future Research**

The identified dimensions for innovation in this research define the potential for innovation in small businesses based on the published research. The eight dimensions considered in this research should be viewed as the minimum number of dimensions required to evaluate innovation in small- and medium-sized firms. Research efforts should continue to identify other dimensions based on published research and best practices. In addition, several opportunities for future research are described as follows:

- **Innovation Potentials in Large Corporations**: Future research in this area would utilize a similar procedure targeting publications associated with large corporations. Such research would allow for a better understanding of the impact of the firm’s size and its innovation potentials.
• **Potential Innovation Indices**: Further research could produce indices for each dimension of innovation potential based on benchmarking. Such indices may be used to evaluate the innovation process and allow businesses to assess their strength and weaknesses.

• **Self-Assessment Tool**: This research would be aimed at the development of an instrument that can be customized for and used by different firms to evaluate their performance. Similar to Baldrige self-assessment tools, such instruments may provide ways to evaluate activities and determine how well an organization is meeting its innovation goals and objectives.


REFERENCES (continued)


REFERENCES (continued)


REFERENCES (continued)


REFERENCES (continued)

APPENDIXES
APPENDIX A
CONTENT VALIDATION SURVEY

Company Name: ____________________    MBNQA Year:   _________________________

(1) COMMERCIALIZATION
Definition: “Commercialization involves converting ideas and new innovations into new marketable products.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capitalize</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Commercialize</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Convert</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Distribute</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Enterprise</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Execution</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Exploit</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Market</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Profit</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Realize</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Venture</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

(2) COMMUNICATION
Definition: “Communication involves two-way or symbolic interactions between organizations and their stakeholders dealing with new products, services, technologies, and ideas.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicating</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Connecting</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Contacting</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Conversation</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Discussing</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Disseminate</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Exchanging</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Feedback</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Interacting</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Networking</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Reporting</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Transmitting</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
APPENDIX A (continued)

(3) DEVELOPMENT
Definition: “Systematic applications of knowledge or understanding directed toward the production of useful materials, devices, and systems or methods to meet specific requirements.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advancement</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Augmentation</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Boost</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Buildup</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Evolvement</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Expansion</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Improvement</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Increase</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Progression</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Unfold</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

(4) CREATIVITY
Definition: “Creativity involves generating new and entirely original ideas.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Creative</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Design</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Generation</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Imaginativeness</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ingenuity</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Innovativeness</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Intelligence</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Inventiveness</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Originality</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Talent</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Thinking</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
(5) ENVIRONMENT
Definition: “The total surroundings, which have a direct or indirect bearing on the functioning of business or a set of external factors.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditions</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Culture</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Environment</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Flexible</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Integrate</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Openness</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Responsible</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Setting</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Situation</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Specialized</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Structure</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Surroundings</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Tolerate</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

(6) KNOWLEDGE
Definition: “Knowledge refers to information combined with experience, context, interpretation and reflection.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Context</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Education</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Experience</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Expertise</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Information</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Interpretation</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Proficiency</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Reflection</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Technology</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
(7) MANAGEMENT
Definition: “Management refers to coordinated activities to direct and control an organization.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Care</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Control</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Coordinate</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Decide</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Direct</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Monitor</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Oversight</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Strategy</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Supervision</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Support</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Vision</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

(8) RESOURCES
Definition: “Resources refer to human, financial, physical, and slack resources.”

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Budget</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Capital</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Equipment</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Income</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Laboratories</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Machines</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Property</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Reserves</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Revenue</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Staff</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Supplies</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Technicians</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
APPENDIX B

RESEARCH PUBLICATIONS REFERENCES


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


Entrepreneurship and innovation in a cultural framework: The success of entrepreneurship among 2nd generation south Asians in the UK, returnees to mainland China and Ukrainian business owners depends on operating within particular cultural value systems. (2011). *Strategic Direction, 27*(6), 29-31


APPENDIX B (continued)


APPENDIX B (continued)


87


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)

Hadjimanolis, A. (1999). Barriers to innovation for SMEs in a small less developed country (Cyprus). *Technovation, 19*(9), 561-570.


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


Sharma N. Management of innovation: The case of IT and pharmaceutical SMEs. *IUP Journal of Knowledge Management, 14*(2), 60-76.


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


APPENDIX B (continued)


