Innovation as a heuristic to excellence: A study in Indian context

THESIS SYNOPSIS

By

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Introduction
In the context of economic stagnation in the developed countries and the grim struggle for economic growth and social change in the developing world there has been growing interest in modes of vigorous, innovative entrepreneurial management (Khandwalla, 1987). This has resulted in organizations increasingly looking to create practices that nurture innovation and taps creativity of their employees. The research community is also increasingly focusing on the various aspects of innovation resulting in a sustained increase in the literature on innovation and its related aspects. Innovation, more now than ever, clearly tops the value chain in product and service lifecycles (Katragadda, 2009).

The relationship between innovation and excellence has been noticed by scholars and management practitioners since long. It has been found that the innovative entrepreneurship stimulates economic growth (Schumpeter, 1934) as it leads to effective combination of various factors of production (Schumpeter 1950). Peters and Waterman (1982) has identified 8 key features of excellence in the U.S. companies one of which is the commitment to innovation and dynamic growth. Innovative organizations are more profitable, grow faster, create more jobs and are more productive than their non-innovative competitors, even in mature industries (Franco, 1989; Capone et al., 1992; Baldwin & DaPont, 1993).

Rationale of the study
The present study is set in business organization context and aims to study the role of innovation in bringing business excellence. A large amount of research literature is available on nature of innovation in relation to organizational excellence but studies on ‘innovation as a heuristic’ is lacking. A growing body of researches (e.g., Kahneman, 2002; Gladwell, 2005; Gigerenzer & Gaissmaier, 2011) suggest the dominance system 1 (intuitive-heuristic) thinking processes in decision making, on the other hand, innovation has become an imperative for business success and adaptation (Altshuller, 1999; Khandwalla, 2006). So, its important to study the exact nature of innovation as a part of system 1 thinking process. The present research pursues this idea and tries to find the answer. Further, the old paradigm on system 1 thinking processes have received heuristics with negative connotation which, according to it, lead to faulty or biased conclusions while decision making (Kahneman, 2002) but the current research takes view that heuristics are mind’s adaptive mechanism (Gigerenzer, 2000; Gigerenzer & Brighton, 2009) can be helpful in attaining and sustaining business excellence.
Considering ‘innovation as a heuristic to excellence’, the current research throws light on adaptive value of innovation for entrepreneurs and managers working under resource constrained and increasingly uncertain environment.

Further, factorial study of innovation heuristic are lacking (Johannessen, Olsen, Lumpkin, 2001; Aranda & Molina-Fernández, 2002), and the present study tries to identify the major factors underlying innovation-heuristic through factor analysis method. A need was felt to explore the business model through which innovation, heuristic thinking and excellence interact with each other. The present study seriously tries to explore this model for the current sample by using structural equation modeling (SEM) technique.

**Objectives of the study:**

The current research has three major objectives:

1) To study whether innovation heuristic has a significant correlation with business excellence;

The first basic objective of the present research was to see whether there is any significant relation between innovation heuristics and organizational excellence. The proposition made regarding this objective is as follows:

*Proposition 1*: Innovation-as-a-heuristic is related to organizational excellence.

More precisely, this proposition can be formulated in terms of following hypothesis:

*Hypothesis 1a*: There is a significant correlation between search & adapt heuristic and business excellence.

*Hypothesis 1b*: There is a significant correlation between fast & frugal heuristic and business excellence.

*Hypothesis 1c*: There is a significant correlation between heuristic intelligence and business excellence.

2) To explore the factors underlying innovation heuristic through factor analysis method;

The second major objective of the current research was to identify factors underlying innovation heuristic\(^1\) through factor analytic method.

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\(^1\)In this thesis, the phrase innovation heuristic is same as innovation-as-a-heuristic. These phrases have been used synonymously. Innovation heuristic refers to general model containing all items of the innovation-as-a-heuristic questionnaire.
3) To explore the structural business model through which innovation heuristic and excellence interact with each other by using structural equation modeling (SEM) technique.

The third, and final objective of the research was to identify the structural model through which the two innovation heuristics\(^2\) and business excellence interact with each other.

\(^2\) After the factor analysis two broad factors underlying innovation heuristic emerged, i.e. innovation as a search & adapt heuristic, and innovation as fast & frugal heuristic. After this the phrase innovation heuristic means these two heuristics.
REVIEW OF LITERATURE

Innovation in Indian context: The case of Indovation

According to Vedic Indian perspective the essential human nature is divine or *Sat-Chit- Ananda* (The Existence Absolute- The Knowledge Absolute- The Bliss Absolute) which subsumes in itself a continuous process of creation, maintenance and destruction. This ancient view has further been elaborated in modern sense by Prof. Vijay Govindarajan in his ‘Three box thinking Model’ which he developed to facilitate strategic thinking in organizations. According to this model the central task of an organization’s leaders is to balance managing the present with creating the future (Govindarajan, 2006). The Box 1 thinking refers to managing the present while Box 2 and 3 relate to creation of future by adopting an innovative approach at all levels, see the figure 2.1 on next page.

According to Govindarajan (2006) many organizations restrict their strategic thinking to Box 1. This tendency has been particularly acute in the past two to three years, as most leaders have emphasized reducing costs and improving margins in their current businesses. But strategy cannot be just about what an organization needs to do to secure profits for the next year. Strategy must encompass Box 2 and Box 3. It must be about what a company needs to do to sustain leadership for the next ten years. In fact, the central task of an organization’s leaders is to balance managing the present with creating the future. According to him the examples of successful Box 2 and Box 3 initiatives are Dell’s direct model in the PC industry, Wal-Mart’s transformation of the discount retailing industry, Apple’s introduction of iPod, etc.

Further Govindarajan (2006) has metaphorically used his Three Boxes as corresponding to three main Hindu deities (the “Hindu Trimurti”): *Vishnu*, the god of preservation; *Shiva*, the god of destruction; and *Brahma*, the god of creation. For Govindarajan (2006) “the correspondence between the three boxes and the three Hindu gods is clear. Vishnu/Box 1 = preserving or managing the present; Shiva/Box 2 = destroying or selectively abandoning the past; and Brahma/Box 3 = creating the future. He further maintains that according to Hindu philosophy, creation-preservation-destruction is a continuous cycle without a beginning or an end. The three gods play an equally important role in creating and maintaining all forms of life.

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3 Indovation is a word coined by G. Katragadda (2009) which stands for Indian Innovation.
Another important model of innovation discussing the nature of innovation in Indian context is the ‘invisible model of innovation’ (Kumar & Puranam, 2012), according to which although there is substantial amount of innovation coming from India but most of it remain invisible to end users of customers around the world. According to the model, there are four major types of innovation coming from India: one, globally segmented innovation mainly led by major MNCs that have set of innovation and R & D centers in India; two, outsourcing innovation by major Indian companies (working especially in the technology sector) offered as innovation on demand to support the new product development for the consumers of the developed countries; three, process innovation coming from and injection of intelligence where highly qualified staff doing routine jobs has invented newer and better processes of completing the task; four, management innovation of the global delivery model by reintegrating the globally distributed work coming from different geographies and cultures in a innovative way.

According to Entrepreneurship in India Report (2008) published by National Knowledge Commission “innovation has emerged as one of the drivers of India’s economic growth, and is a factor in increasing competitiveness, profitability and market share as well as reduced costs. ..The ‘Innovation Intensity’ (i.e. the percentage of revenue derived from products or services which are less than three years old) has increased for large firms as well as SMEs in India. The strategic prioritization of innovation has
also intensified since economic liberalization. Moreover, an interesting finding is that SMEs register a greater increase in ‘Innovation Intensity’ than large firms. This could also indicate that smaller, decentralized, creative and experimentation-oriented organizations could be the torch-bearers of large-scale ‘disruptive innovation’ in the country” (p. 53).

According to the Innovation in India Report published by National Knowledge Commission (2007), in the growth of the Indian economy, Innovation is emerging as a key driver, although this may neither be apparent nor readily visible. According to the report:

- 17% of the large firms rank Innovation as the top strategic priority and 75% rank it among the top 3 priorities.
- All the large firms agree (of which 81% strongly agree) that Innovation has gained importance as being critical to growth and competitiveness since the start of economic liberalization in India.
- All the large firms agree (of which nearly half strongly agree) that they cannot survive and grow without investment in Innovation.
- An overwhelming 96% of large firms see Innovation spending increasing over the next 3-5 years.

Khandwalla (1992) considers creative excellence a major type of organizational excellence among the 6 types of organizational excellence (Competitive, Rejuvenatory, Institutionalized, Creative, missionary, and Versatile) outlined by him. The chief trait of creative organizational excellence is the commitment to pioneering, innovation, experimentation, discovery and dynamic change. Such organizations are in a constant state of flux, shedding or modifying current activities, practices, and products and adopting new ones. A culture of creativity and innovation prevails in such organizations sometimes coupled with the desire to dazzle the world with breathtaking ideas.
METHODOLOGY

Research Design
The current research follows a quantitative research methodology based on the principles of positivistic paradigm of scientific research. The study adopts an objective approach for studying the variables of interest. However, the some variables studied in the research have been of latent type which have been computed with the help of two questionnaire. The subjects were asked to self-report their beliefs and opinions on the items of the questionnaire and the obtained data was later analyzed to meet the stated objectives of research. Li (2006) has cited Neuman (1997) and Rundle-Thiele (2005), according to whom, self administered questionnaire surveys can be deemed appropriate for measuring self-reported beliefs and behaviors. The constructs of the study, for e.g., innovation-as-a-heuristic and organizational excellence are basically perceptual in nature which subjects have reported based on their perception of these constructs, which can appropriately be measured by self-report measures (Schmitt, 1994; Spector, 1994).

Further, the study follows a correlational research design which attempts to explore the nature of relationship between innovation-as-a-heuristic variable and organizational excellence. Correlational research design have been regarded as a major and widely used research design in scientific research (Isaac and Michael, 1977; Fraenkel and Wallen, 1990). It is especially useful when the researcher is interested in finding the relationship between two variables as this design helps in assessing the degree and direction relationship between two variables. Further, structural equation modeling was carried out to test the causal relationship among variables (Rippy, 2001).

Variables measured in the research
The two major types of variables studied in the current research were innovation-as-a heuristic variable and business excellence. A casual relation was hypothesized between the two variables where innovation-as-a-heuristic was conceptualized as independent variable and organizational excellence as the dependent variable. However, a major objective of the present research was to explore the structural relationship between innovation heuristic and organizational excellence. The following kind of structural relationship was hypothesized (see figure below) between variables which was later tested through structural equation modeling. In the proposed model a linear causative relationship was hypothesized from the two identified heuristics, i.e., search & adapt heuristic, and fast & frugal
heuristic, to heuristic intelligence variable. Again, a linear causative path was hypothesized from heuristic intelligence variable to the dependent variable, i.e. business excellence.

Figure The hypothesized structural relationship among variables

**Procedure**

The objective of the research paved the way for the procedure. Once the objectives were finalized the first task was to identify the sample and develop the measurement tools. The sample (N=203) characteristics and other details of sampling procedure is discussed in the following section in this chapter. One measurement tool, i.e. innovation-as-a-heuristic questionnaire, was developed and its psychometric properties were established before including it for data collection. The second measurement tool was Excel questionnaire which was adopted from Sharma et al. (1992). The details of these measurement tools are further discussed in this chapter in ‘Measurement Tools’ section. Once tools were ready they were administered on sample and data was collected. The collected data was analyzed by using SPSS 16.0 and Amos 18.0. The obtained results are discussed in discussion chapter, and finally, the future implications and limitations of the current study has been deliberated in the closing sections of the thesis.

**Sample Size**

The sample size of the current sample is 203. Li (2006) has cited a review of studies indicating what should be the appropriate sample size for a scientific research study. According to him “for SEM studies, a sample size of about 200 is typically considered as adequate for small to medium structural
equation models (Boomsma 1983; Loehlin 1992; Ullman 2001). Other accepted rules of thumb include 5 cases per estimated parameter (Bentler and Chou 1987), or 15 cases (Research Consulting 2001; Stevens 1996) per measured variable” (p. 112). So, keeping in mind the objective of the study and number of variables studied a sample size of 203 appears adequate, and wherever it has been necessary, appropriate tests for measuring sampling adequacy has been computed; for e.g., before doing principal component analysis (to identify the major factors underlying innovation heuristic) Kaiser-Meyer-Olkin test (Kaiser, 1970, 1974) of sampling adequacy was carried out. The sample consisted of both males (N= 79), consisting of 38.9 % of the sample, and females (N=124) consisting of 60.6% of the sample, as shown in the figure 3.2. Since, the study didn’t aim to make any gender based comparisons so no attempt was made to balance the gender ratio in the sample.

Measurement Tools
The two questionnaires were used in the study for measuring two constructs, i.e., ‘innovation as a heuristic’ and organizational excellence. These tools are discussed below along with their psychometric properties.

Innovation-as-a-heuristic questionnaire:
- The major aim of current research was to measure innovation as a managerial heuristic. Due to non-availability of any direct measure on this topic innovation as a heuristic questionnaire was developed by Taking 19 innovation related heuristics (out of total 186 heuristics that were being used by managers and entrepreneurs in various business related decisions) given by Prof. Mathew J. Manimala (1992), IIM-Banglore, after discussion with experts. These heuristics, Manimala (1992) found that, were frequently used by Indian managers and entrepreneurs as a rule-of-thumb guiding the management decisions involved in the start-up and management of a new venture. According to Manimala (1992) the “data on innovativeness and use of heuristics were collected from 138 published undisguised cases on entrepreneurs, using the case-survey method that involved the content analysis of these cases and quantification of the above variables. Case data thus collected were verified against the field data collected from a comparable group of 26 ventures” (p. 477 ). These innovation related heuristics were arranged in a format of 7 – point Likert type rating scale where 1 denoted ‘strongly disagree’ and 7 denoted ‘strongly agree’.
- 8 items were generated based on Prof. Gerd Gigerenzer’s idea of fast and frugal heuristics (Gigerenzer, Todd, & the ABC Research Group, 1999; Gigerenzer, 2000; Gigerenzer, 2002) as
it was hypothesized that innovation brings fast, frugal, and drastic changes in performance and other competitive domains of business. Many researchers have corroborated about the ability of innovation in bringing non-linear, drastic or disruptive changes in business by improving performance, beating competition, creating new markets and establishing market leadership (Schumpeter, 1934; Kim & Mauborgne, 2005; Khandwalla, 2006). These innovation related heuristics were arranged in a format of 7 – point Likert type rating scale where 1 denoted ‘strongly disagree’ and 7 denoted ‘strongly agree’.

- The questionnaire was administered to the sample (N=203) and reliability analysis was carried out. Reliability of total scale was found to be .963 (Cronbach’s Alpha = .963).

The innovation as a heuristic scale is based on the research in Indian organizations (Manimala, 1992) so it is likely to offer the accurate measure of the extent to which managers/entrepreneurs perceive innovation as a heuristic excellence. However, since the scale has been constructed specifically to meet the objectives of current research, so in future the use of this scale may warrant more revisions leading to the more mature assessment of the innovation as a heuristic.

*Measure of Organizational Excellence*

To measure organizational excellence the EXCEL Scale (Sharma et al., 1990a) was used which is a 16 item scale designed to operationalize and measure 8 attributes of excellence as espoused by Peters & Waterman (1982) in their book ‘In search of Excellence’. Sandbakken (2004) has cited various researches which report the Cronbach’s Alpha reliability coefficient for the Excel scale as .89/.90 (Sharma et al., 1990a), .92 (Caruana et al., 1995; Sandbakken, 2002). Apart from this, 5 indicators of organizations performance were further added after discussion with experts. On these indicators subjects were required to indicate their responses on a 7- point Likert type scale where 1 denoted strongly disagree and 7 denotes strongly agree. The total excellence score was computed by adding the total scores of subjects on Excel scale and the 5 indicators of organizational performance.
RESULTS

Descriptive Results

The results of descriptive statistics for various variables are shown in the table below. The variables that were directly measured are age, gender, work experience, innovation as a heuristic and excellence. The variables search and adapt heuristic, fast and frugal heuristic and heuristic intelligence have been computed.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>203</td>
<td>23.92</td>
<td>4.219</td>
<td>5.960</td>
<td>.340</td>
</tr>
<tr>
<td>Work experience</td>
<td>203</td>
<td>2.05</td>
<td>1.586</td>
<td>4.078</td>
<td>22.473</td>
</tr>
<tr>
<td>Search &amp; Adapt Heuristic</td>
<td>203</td>
<td>89.09</td>
<td>19.556</td>
<td>-1.392</td>
<td>1.476</td>
</tr>
<tr>
<td>Fast &amp; Frugal Heuristic</td>
<td>203</td>
<td>37.26</td>
<td>7.825</td>
<td>-1.435</td>
<td>2.329</td>
</tr>
<tr>
<td>Heuristic Intelligence</td>
<td>203</td>
<td>126.34</td>
<td>25.853</td>
<td>-1.497</td>
<td>2.064</td>
</tr>
<tr>
<td>Innovation as a heuristic</td>
<td>203</td>
<td>141.95</td>
<td>29.237</td>
<td>-1.509</td>
<td>2.144</td>
</tr>
<tr>
<td>Excellence</td>
<td>203</td>
<td>108.96</td>
<td>21.232</td>
<td>-1.337</td>
<td>1.431</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>203</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although biographical variables like age, gender, and work experience were not required for further analysis but there descriptive statistics have been presented to offer a complete picture of the sample characteristics. Age and gender compositions have already been discussed in the methodology chapter (under sample characteristics) so here only a brief discussion will follow on them after which the descriptive characteristics of remaining variables will be discussed. The total sample size included in analysis was 203 of which 79 (39.3 %) were males, and 124 (60.6 %) were females. Looking at this we can say that females are a bit overrepresented as compared to males in the sample but gender based comparison was not part of any of the three main objectives (see Chapter 1 Introduction, for the detailed overview of objectives) of the current research, so the current sample was accepted for further analysis. The mean age of sample is 23.92 (S.D. = 4.219) with the average work experience of 2.05 years. The mean scores and standard deviations of other variables are also shown in the table above.
Another descriptive statistics measured were skewness and kurtosis. These two are the measures of symmetry, or more precisely asymmetry, of the distribution. Skewness refers to the extent to which a distribution departs from the symmetricity (Simpson & Kafka, 1971) or normal distribution. The range of skewness value varies from -3 to +3 (Lomax, 2001). A positively skewed distribution will have positive skewness value, and the value of mean will be greater than median which in turn will be greater than mode (i.e. mean > median > mode), while a negatively skewed distribution will have negative skewness value, and the value of mean will be less than median which in turn will be less than mode (i.e. mean < median < mode). A symmetric distribution, such as a normal distribution, has a skewness of 0. Kurtosis, on the other hand shows the “peakedness” of distribution (Lomax, 2001). A distribution range from flat (platykurtic) shape to a slender, narrow or highly peaked (leptokurtic) shape. In between the these two types lie the bell-shaped normal distribution curve (mesokurtic).

According to Field (2009), z-scores can also be computed by dividing the skewness and kurtosis scores with standard errors and their significance levels can be checked at the desired level. According to him an absolute value greater than 1.96 is significant at \( p < .05 \), above 2.58 is significant at \( p < .01 \), and absolute values above about 3.29 are significant at \( p < .001 \). However, “large samples will give rise to small standard errors and so when sample sizes are big, significant values arise from even small deviations from normality. In case of large samples (i.e., 200 or more) it is more important to look at the shape of the distribution visually and to look at the value of the skewness and kurtosis statistics rather than calculate their significance” (p.139). Hence, z-scores were not computed further. Again, Field (2009) has given a threshold value of 3.29 for these measures and if the values of variables under scrutiny are below this threshold we can proceed with further analysis. In present case the variables that were included in the analysis to test hypothesis, i.e. search and adapt heuristic, fast and frugal heuristic, heuristic intelligence, innovation as a heuristic and business excellence, all has values below 2.58, and thus we can proceed with the further analysis.

**Principal Component Analysis (PCA)**

A principal component analysis (PCA) was carried out on the 27 items of Innovation as a heuristic questionnaire (based on Manimala, 1992; Gigerenzer, 2000; Gigerenzer, 2002) with oblique rotation (direct oblimin). The Bartlett’s test of sphericity \( \chi^2 (351) = 3917.096, p < .001 \), indicated that correlations between items were sufficiently large for conducting PCA. An initial analysis was run to obtain eigen values for each component in the data. It was found that two components had eigen
values over Kaiser’s criterion of 1 and in combination explained 57.63 % of the variance. Given the KMO test of sampling adequacy for the two groups, and the convergence of the scree plot and Kaiser’s criterion the two components having eigen values 13.88 and 1.67 respectively were retained in the final analysis. Further, to observe the internal consistency of these two factors Chronbach’s Alpha was computed which came out to be $\alpha = .90$ and $\alpha = .95$. These components were names as search & adapt heuristic (SAH), and fast and frugal heuristic (FFH). For a detailed discussion on factor naming and related explanation see the discussion chapter.

Table  **Summary of principal component analysis (N = 203)**

<table>
<thead>
<tr>
<th>SN</th>
<th>Symbol</th>
<th>Item</th>
<th>Rotated Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hi9</td>
<td>Be flexible in one’s ideas and plans.</td>
<td>.897</td>
</tr>
<tr>
<td>2</td>
<td>Hi2</td>
<td>Ideas are the most important resource. Look for them everywhere .</td>
<td>.885</td>
</tr>
<tr>
<td>3</td>
<td>Hi3</td>
<td>Look for new (product) ideas among personal contacts (friends, hobby clubs, professional associations, customer complaints, previous job contacts, etc.).</td>
<td>.866</td>
</tr>
<tr>
<td>4</td>
<td>Hi14</td>
<td>Never stop searching for new ideas and opportunities.</td>
<td>.863</td>
</tr>
<tr>
<td>5</td>
<td>Hi16</td>
<td>Introduce new products, modify existing products, and/or change strategies periodically.</td>
<td>.813</td>
</tr>
<tr>
<td>6</td>
<td>Hi4</td>
<td>Look for new (product) ideas among technological developments abroad especially among new, rare, or specialized products developed abroad.</td>
<td>.774</td>
</tr>
<tr>
<td>7</td>
<td>Hi11</td>
<td>Never be constrained by rigid plans and the narrow visions. Act according to opportunities.</td>
<td>.763</td>
</tr>
<tr>
<td>8</td>
<td>Hi17</td>
<td>Keep the organization fresh and dynamic by periodically inducting young people into it who have new ideas and the drive to implement them.</td>
<td>.710</td>
</tr>
<tr>
<td>9</td>
<td>Hi5</td>
<td>Look for new (product) ideas among one’s own vision of the future, special talents, and innovative research findings, or among the special skills of one’s associates and staff.</td>
<td>.698</td>
</tr>
<tr>
<td>10</td>
<td>Hi10</td>
<td>Do not get stuck to one idea. Be prepared to leave it at the slightest indication of failure, and develop new ideas.</td>
<td>.694</td>
</tr>
<tr>
<td>11</td>
<td>Hi18</td>
<td>Launch new products on a trial basis, receive feedback, and slowly widen the market.</td>
<td>.671</td>
</tr>
</tbody>
</table>
| 12 | Hi1    | Be a pioneer in the choice of products. Avoid highly competitive, low
Never set any geographical limits to one’s search for ideas and opportunities.

Look for new (product) ideas in the general environment (existing practices and changes in the legal, political, religious, social, and cultural domains).

Never be complacent about successes, but keep on striving for excellence through new ideas (Do not repeat success strategies until they fail).

Look for new (product) ideas among the components, substitutes, complements, neglected ranges, supply gaps, deficiencies, and inadequacies of existing products.

Treat personal problems/handicaps/mishaps as indications to change one’s line of thinking/occupation.

Innovation is driving the market toward smaller but more efficient products/services. The evolution of smart phones, tablets and nano-cars is case in point.

The best innovative product/service in a domain is one that accomplish the domain specific task in minimum number of steps and maximum simplicity.

Product/service improvisation means identifying and eliminating all unnecessary steps in design and use.

A faster way to challenge and involve employees to give them time to explore new ideas/products on their own.

When I make changes in my product I focus on how fast & simple it will become for customers while adopting it.

Innovation is the quickest way to create an uncontested market and beat competition.

I welcome all new ideas but ideas which are fast and frugal in bringing returns are likely to be funded and supported first than those which promise only long term benefits.

<table>
<thead>
<tr>
<th>Eigen Value</th>
<th>13.88</th>
<th>1.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of variance</td>
<td>51.44</td>
<td>6.19</td>
</tr>
<tr>
<td>Cronbach’s Alpha</td>
<td>.90</td>
<td>.95</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
Items with factor loading < .4 have been suppressed.
Factors with Eigen value < 1 & explaining less than 5% variance have been omitted.
Correlational Analysis

To study whether innovation heuristic has a significant correlation with business excellence, a correlation analysis was carried out among variables whose results are summarized in the table 4.4 below. The two extracted factors were correlated with total excellence scores and it was found that:

1) The Pearson’s correlation coefficient between ‘Search & Adapt Heuristic’ and ‘Business Excellence’ scores is \( r = .78 \) (p < .01); and

2) The Pearson’s correlation coefficient between ‘Fast & Frugal Heuristic’ and ‘Business Excellence’ scores is \( r = .65 \) (p < .01); and

Table Correlations between extracted components and total excellence scores

<table>
<thead>
<tr>
<th>Search &amp; Adapt Heuristic</th>
<th>Fast &amp; Frugal Heuristic</th>
<th>Heuristic Intelligence</th>
<th>Business Excellence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search &amp; Adapt Heuristic</td>
<td>1</td>
<td>.734**</td>
<td>.979**</td>
</tr>
<tr>
<td>Fast &amp; Frugal Heuristic</td>
<td>1</td>
<td>.858**</td>
<td>.647**</td>
</tr>
<tr>
<td>Heuristic Intelligence</td>
<td>1</td>
<td>.787**</td>
<td></td>
</tr>
<tr>
<td>Business Excellence</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)

3) The Pearson’s correlation coefficient between ‘Heuristic Intelligence’ and ‘Business Excellence’ scores is \( r = .79 \) (p < .01).

Structural Equation Modeling

To explore the structural model through which innovation heuristic and excellence interact with each other, structural equation modeling (SEM) was carried out using AMOS 18.0. SEM is essentially a combination of exploratory factor analysis and multiple regression analyses (Ullman 2001) techniques which is used for testing and estimation of the causal relationship among variables within a proposed model. The model tested in the current research consisted of observing the structural relationship among two exogenous variables i.e., search & adapt heuristic and fast & frugal heuristic, one latent
variable i.e. heuristic intelligence, and one endogenous variable i.e. business excellence (for a detailed description of the variables please refer to the methodology chapter). Keeping in mind the problem associated with the multivariate normality and continuity of the data bootstrap method was used (West et al., 1995; Yung & Bentler, 1996; Zhu, 1997).

Mediation Analysis
Further, To check whether the heuristic intelligence has any mediating effect between exogenous variables (Search & Adapt Heuristic, and, Fast & Frugal Heuristic) and Endogenous variables (Business Excellence) mediation analysis through Bootstrap Method was carried out. The result shows that path from both heuristics (i.e., Search & Adapt Heuristic, and Fast & Frugal Heuristic) to latent variable (i.e., Heuristic Intelligence) is significant. Path from Search & Adapt Heuristic to endogenous variable (i.e., Business Excellence) is significant (p < .05), this means mediation effect of Heuristic Intelligence between Search & Adapt Heuristic and Business Excellence is partial (i.e., partial mediation). Further, path from Fast & Frugal Heuristic to endogenous variable (i.e., Business Excellence) is not significant (p – value = .276), this means mediation effect of Heuristic Intelligence between Fast & Frugal heuristic and Business Excellence is Full.

The SEM output & estimates
The output terms the current model as the recursive model. A recursive model is one that specifies direction of cause from one direction only (Byrne, 2010), which is true for the proposed model which is shown below:

![Diagram](image.png)

Figure  The proposed model with output values after confirmatory analysis
The table 4.7 below shows the various estimates for the path diagram for the hypothesized model. The higher the value of estimate, the more variation it explains in the dependent variable.
**Table Regression weights of various paths in proposed model**

<table>
<thead>
<tr>
<th>Path</th>
<th>Estimate</th>
<th>S.E.</th>
<th>C.R.</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heuristic Intelligence ---&gt; Search &amp; Adapt Heuristic</td>
<td>1.099</td>
<td>.012</td>
<td>94.727</td>
<td>***</td>
</tr>
<tr>
<td>Heuristic Intelligence ---&gt; Fast &amp; Frugal Heuristic</td>
<td>1.208</td>
<td>.029</td>
<td>41.644</td>
<td>***</td>
</tr>
<tr>
<td>Business Excellence ---&gt; Heuristic Intelligence</td>
<td>.568</td>
<td>.032</td>
<td>17.862</td>
<td>***</td>
</tr>
</tbody>
</table>

Looking at p values we can say all the paths in hypothesized model is significant.

**Indices of Model Fit**

The proposed model was tested using AMOS 18.0 and various indices of model fit were observed. The indices of fit that were used for testing the model along with their obtained and desired values are shown in the table 4.10 on the following page. All the indices except RMSEA show good model fit. A detailed interpretation of these indices have been offered in the discussion chapter. In acknowledgement of multivariate non-normality Bollen – Stine bootstrap values have been observed for the Chi-square test of model fit. The major indices of model fit along with their obtained and accepted range of values are shown in the table below:

**Table A summary of Indices of fit for the proposed model**

<table>
<thead>
<tr>
<th>Index</th>
<th>Obtained value</th>
<th>Accepted range of values for model fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$</td>
<td>5.446</td>
<td>$\chi^2$ is not significant (p = .066, $p_{\text{Bollen - Stine}} = .094$), so we accept null hypothesis, i.e., Ho: There is no significant difference (p_{Bollen - Stine} = .094)</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>.066</td>
<td></td>
</tr>
</tbody>
</table>
covariance matrix and population covariance matrix. hence the default model is acceptable.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$/df ratio</td>
<td>2.723</td>
<td>1 to 3</td>
</tr>
<tr>
<td>GFI (Goodness-of-fit Index)</td>
<td>.987</td>
<td>≥ .95</td>
</tr>
<tr>
<td>AGFI (Adjusted Goodness-of-fit Index)</td>
<td>.934</td>
<td>≥ .95</td>
</tr>
<tr>
<td>PGFI (Parsimony Goodness of Fit Index)</td>
<td>.193</td>
<td>&lt; .5, should be less than .5</td>
</tr>
<tr>
<td>SRMR (Standardized Root Mean square Residual)</td>
<td>.011</td>
<td>0 (perfect fit) to 1 (unfit)</td>
</tr>
<tr>
<td>NFI (Normed Fit Index)</td>
<td>.996</td>
<td>≥ .95</td>
</tr>
<tr>
<td>TLI (Tucker – Lewis Index)</td>
<td>.993</td>
<td>≥ .95</td>
</tr>
<tr>
<td>CFI (Comparative Fit Index)</td>
<td>.998</td>
<td>≥ .95</td>
</tr>
<tr>
<td>RMSEA (Root Mean Square Error of Approximation)</td>
<td>.092</td>
<td>.00 to .1</td>
</tr>
</tbody>
</table>
RESULTS

- Innovation-as-a heuristic variable has a significant correlation with business excellence.
  - There is a significant correlation between search & adapt heuristic and business excellence.
  - There is a significant correlation between fast & frugal heuristic and business excellence.
  - There is a significant correlation between heuristic intelligence and business excellence.

- A Principal Component Analysis (PCA) showed that the two major factors underlying innovation heuristic are ‘search-and-adapt heuristic’ (SAH), and ‘fast-and-frugal heuristic’ (FFH) which jointly explained 57.63 % of the variance. ‘Search-and-adapt heuristic’ explains 51.44 % ($\alpha = .90$) of variance, while ‘fast-and-frugal heuristic’ explains 6.19 % ($\alpha = .95$) of variance.

- The proposed structural equation model wherein the effect of ‘search-and-adapt heuristic’, and ‘fast-and-frugal heuristic’ are mediated through the ‘heuristic intelligence’ variable was found to be fit.
LIMITATIONS OF THE STUDY

- The sample size of 200 consist mostly MBA students whose ratings are based on how they perceive innovation as a heuristic to excellence not on their actual behavior. However, according to Rogers (1983) perception is important aspect of innovation as an idea to be innovative it must be perceived so by a large number of people.

- There are comparatively large number of items on innovation as a ‘search-and-adapt heuristic’ (n = 17) as compared to innovation as a ‘fast-and-frugal heuristic’ (n = 7) on innovation as a heuristic scale which may skew the results in its favor.

- The two major multivariate techniques used in the current research (i.e., PCA & SEM) may bring in their own strengthening and limitationary influence to the research outcomes.

- Finally, a major limiting factor could be that innovation in Indian context is an emergent concept (Kumar & Puranam, 2011) which may give rise to many alternate theoretical propositions (Tiwari, & Herstatt, 2012). There could be alternative models which may show an equal or better fit indices as there is no single best way through variables may casually related to each other especially when they are studied under presumed environmental uncertainties and limited choices faced by entrepreneurs and managers.
IMPLICATIONS OF THE STUDY

The present study is a sincere attempt to study the nature of relationship between innovation and excellence within the framework of bounded rationality paradigm. The study could have both theoretical and practical implication. Theoretically, the study posits two new factors, i.e. SAH & FFH, underlying innovation heuristic and their joint influence measured as heuristic intelligence. These variables may require further assessment and validation along with measuring their instrumentality in bringing business excellence through other independent researches.

The idea of heuristic intelligence may be received critically among the researchers and academicians but the intelligent use of heuristics is gradually finding a place among the researchers of intelligence in the form of intelligence of intuition, gut or unconscious mind (e.g., Simon, 1987; Loftus & Klinger, 1992; Gladwell, 2005; Gigerenzer, 2007; Kaufman, 2011). To what extent heuristic intelligence relates with other types of intelligence, for e.g. practical intelligence (Sternberg, 1988, 1999), will warrant another study and a detailed study exploring formally the ability of a person to use heuristics for arriving at successful solutions along with the underlying sub-factors (i.e., heuristic intelligence) will be of strong heuristic value per se.

On practical side, the one implication of study could be that it may help managers and entrepreneurs to beat the rationality burnout caused by a heavy emphasis placed on to appear rational while making decisions. However, this issue has long been explored under the bounded rationality and behavioral economics research. The seemingly non-rational-heuristic approach to decision making is itself a rational behavior in a world of constraints and uncertainty. The two identified factors, i.e. SAH & FFH, may nudge the budding entrepreneurs and managers to exercise these heuristics in their various behaviors like decision making, product designing, process improvement, redesigning consumer experiences, selecting a new employee, creating future strategies to adapt and achieve excellence in a fast and frugal way.
REFERENCES


