MANUAL FOR "INNOVATION" SCALE

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Published and Distributed Exclusively by:

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Printed in INDIA.

Introduction

This inventory is designed to help researchers and practitioners to assess the current state of ***Innovation*** on account of and with the presence of various Strategic Human Resources Management (SHRM) systems, policies and practices.

Innovation is regarded as a change in the thought process for doing something, or developing something new that can prove useful (McKeown and Max, 2008). It can be defined in various ways. Gallouj & Weinstein (1997) defined innovations as being at the heart of the entrepreneurial role: the creation of a linkage between new ideas and markets. Hislop (2005) defined innovation as "a deliberate and radical change in existing products, processes or the organization in order to achieve a competitive advantage over competitors". From this definition we can figure out that there are several aspects of innovation: (1) the introduction of something new, including new products or services, new technology or new forms of organization; (2) a process aspect, this means that there are activities/stages such as goal formulation, design and organization, implementation and monitoring; (3) development with radical leaps or incremental innovation; and (4) the goal of innovation activities is to gain advantages for the organization (Leede, J. Looise, & J., 2005).

The literature surrounding innovation focuses on identifying the main domains of innovation and how to measure it. Because of its wide usage and a wide variety of definitions, there are several classifications of innovation domains. For example, Damanpour & Evan (1984) state that innovation includes technological innovation and administrative innovations. Technological innovations contain both product or process innovation. Tidd, Bessant, & Pavitt (1997) proposed three domains in innovation: product, service and process innovations. Boer & During (2001) identified three types of innovation. Product innovation includes

development of new products and/or services, while process innovations means the introduction of new production or service technologies, the third innovation is concerned with organizational innovations, meaning the creation of new organizational forms and/or management practice; Avermaete, Viaene, Morgan, & Crawford (2003) distinguishes four main domains of innovation, namely product, process, organizational and market innovation.

Product innovation includes any product, service or idea that is generally perceived as new. Product innovation may also emerge as a result of changes in the organizational structure or strategy. Process innovation includes adaptation of the existing production systems and may include introducing new infrastructure and the implementation of new technologies. Damanpour F. (1992) categorizes product and process innovation as technical innovation, since they concern basic work activities. Organizational innovation, also referred to as administrative innovation, includes changes to a wide range of activities in an organization such as marketing, purchases, sales, administration, management and staff policy (Damanpour 1992). Lastly, the market innovation domain includes exploitation of new territorial markets and the acquisition and addition of new markets (Avermeate et al. 2003).

Rogers (2003) found five kinds of firms according to the extent of innovation adopted: ***innovator, early adopters, early majority, late adopters and laggards***. Firms profiting from innovation activities will be different according to the timing and extent of firm adoption of innovation. Generally, early adopters have more significant benefits from innovation than laggards (Rogers, 1995; Subramanian and Nilakanta, 1996, Dobni, 2006).

Innovative organizations support creative activities through offering employees the freedom to work independently in pursuit of new ideas (Dobni, Bruce, & Scott, 2006). Employee's skills and knowledge are important factors to firm's successful innovation, since the human element is involved in the whole innovation process (Jiménez-Jiménez, Sanz-Valle, & R, 2005).

Innovation inventory provides measures of ***five*** empirically derived dimensions of ***Innovation.*** Reliability, validity and stability data, based on responses from 725 employees, has shown that the ***Innovation*** inventory has quite satisfactory characteristics. Measures of ***Innovation*** are common in group-level, organization-level and multi-level studies and gaining the momentum for design and implementation of SHRM systems, policies and practices.

Development of the Inventory

In the initial stage experts in the field of Management, Human Resources Management, Psychology, Education and Sociology were contacted and the objective of developing the Innovation inventory was explained to them. Incorporating their input, five dimensions of ***Innovation*** were finalized, and are: Thinking Space, Innovation Entrepreneurship, Idea Management, Innovation Culture, and Innovation Technology.

Operational Definition

Thinking Space

Thinking Space is a platform for spatial experimentation and conceptual exchange of ideas.

Innovation Entrepreneurship

Innovation entrepreneurship is the effective combination of labor, capital and property utilized to create innovative products in keeping with the changing demands of the market.

Idea Management

Idea management is a structured process of generating, capturing, discussing and improving, organizing, evaluating and prioritizing valuable insight or alternative thinking that would otherwise not have emerged through normal processes.

Innovation Culture

Innovation cultures have the determinants of organizational culture which influence creativity and innovation. The determinants are strategy, structure, and support mechanisms, behavior that encourages innovation, and open communication.

Innovation Technology

Innovation Technology can be explained by technology acceptance model (TAM), which attempts to extend TAM to business-level innovation technology adoption. Empirical results indicate that perceived usefulness, subject norm, perceived easy-of-use, and characteristics of the firm itself are very important factors influencing attitudes of businesses at the pre-decision stage, while only perceived usefulness and subject norm significantly affect attitudes of businesses at the in-decision stage.

First Draft of the Inventory & Item Analysis

In the first phase, a pool of 35 items keeping in consideration the operational definition of possible dimensions with Likert type, 5-point responses, viz., **Strongly Disagree, Disagree, Neutral, Agree and Strongly Agree** were prepared. This inventory was administered on a representative sample of 250 male employees working in manufacturing sector in India and who were above 25 years of age.

After scoring the inventory, the sheets were arranged in the order of highest scoring to lowest scoring. From this order, two groups, one of 27% from highest scoring and other of 27% from the lowest scoring were selected. In these two groups inter-correlation matrix was examined in order to overcome existence of multicollinearity and singularity in the inventory. On this basis items having multicollinearity and singularity were rejected and the final draft of the inventory had 28 items distributed across five dimensions. The description of dimensions and items in representative dimensions are given in Table 1.

Table 1.

Dimensions and No. of items

Dimensions	No. of Items	No. of items
1. Thinking Space (X1)	S24, S28, S23, S26, S22, S27, S25, S21, S20	9
2. Innovation Entrepreneurship (X2)	S16, S15, S18, S13, S17, S19, S12, S14	8
3. Idea Management (X3)	S5, S6, S7, S4, S11	5
4. Innovation Culture (X4)	S1, S2, S3	3
5. Innovation Technology (X5)	S8, S9, S10	3
Innovation Items		28

It is a paper pencil type inventory which can also be converted in to computerized format to enable online testing.

Scoring System

Table 2.

Scoring System

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

The test sheets were scored as per scoring system criteria in table 2. The responses of the corresponding items were added to generate ***Innovation*** dimension score and summing-up all 28 items to generate overall ***Innovation*** score. Thus, the minimum possible score will be 28 and the maximum 140. Higher the score indicates high level of agreement and lower the score indicates low degree of agreement on Innovation facet.

Instructions for Administration

Instructions for administration have been printed on the cover of manuscript of this inventory. The inventory can be administered on an individual or on a group (preferably not more than 30 at a time) on adult male population.

Standardization of the Inventory

The ***Innovation inventory*** has been standardized on 725 participants selected from fourteen engineering companies situated in Gujarat and Madhya Pradesh states of India. Their age varied from 25 to 62 with mean age 35.40 years. Working experience varied from 1 to 31 years with mean 9.60 years. In qualification they were ITI, Diploma in Engineering, Graduate and Postgraduates in Engineering. They were working in manufacturing organizations. The demographic characteristic of the employees participated in the standardization are shown in Table 3.

Table 3.
Demographic Characteristics of Participants

Demographic Characteristics	Sub-Characteristics	No. of Subjects	Percent
Age (Years)	Below 35 yrs	502	69.2
	35 yrs & above	223	30.8
Working Experience (Years)	Below 10 yrs	454	62.6
	10 yrs & above	271	37.4
Qualification	Technical	564	77.8
	Non Technical	161	22.0

Reliability

The considerations of validity and reliability typically are viewed as essential elements for determining the quality of any standardized test. For establishing the internal consistency: Cronbach's alpha along with other descriptive statistics is shown in Table 4a & 4b.

Table 4a.

Descriptive Statistics of items, Inventory and reliability coefficients.

Item Nos.	Descriptive Statistics for Items				Descriptive Statistics forInventory		
	Range	Mean	Variance	SD	Mean if item deleted	*Item total correlation	*Alpha if item deleted
Inv1	4	3.43	0.781	.884	91.36	.448	.902
Inv2	4	3.25	0.659	.812	91.54	.380	.903
Inv3	4	3.58	0.785	.886	91.21	.414	.903
Inv4	4	3.42	0.753	.868	91.38	.517	.901
Inv5	4	3.24	0.691	.831	91.55	.415	.903
Inv6	4	3.21	0.645	.803	91.59	.361	.904
Inv7	4	3.57	0.671	.819	91.22	.433	.902
Inv8	4	3.18	0.762	.873	91.61	.214	.907
Inv9	4	3.37	0.587	.766	91.42	.487	.902
Inv10	4	3.27	0.549	.741	91.53	.373	.903
Inv11	4	3.28	0.579	.761	91.51	.468	.902
Inv12	4	3.35	1.080	1.039	91.45	.422	.903
Inv13	4	3.47	0.764	.874	91.32	.547	.900
Inv14	4	3.23	0.723	.850	91.56	.478	.902
Inv15	4	3.29	0.859	.927	91.51	.514	.901
Inv16	4	3.39	0.794	.891	91.40	.575	.900
Inv17	4	3.53	0.821	.906	91.26	.573	.900
Inv18	4	3.26	0.799	.894	91.53	.553	.900
Inv19	4	3.27	0.920	.959	91.52	.538	.900
Inv20	4	3.22	0.951	.975	91.57	.438	.903
Inv21	4	3.62	0.748	.865	91.18	.536	.901
Inv22	4	3.41	0.845	.919	91.38	.571	.900
Inv23	4	3.37	0.823	.907	91.42	.509	.901
Inv24	4	3.47	0.711	.843	91.33	.550	.900
Inv25	4	3.62	0.701	.837	91.17	.533	.901
Inv26	4	3.46	0.654	.809	91.34	.588	.900
Inv27	4	3.46	0.613	.783	91.34	.504	.901
Inv28	4	3.59	0.598	.773	91.20	.477	.902

** $p < 0.001$(one tailed)*

Table 4b.

Descriptive statistics of Inventory and Reliability (Cronbach's A l p h a)

Statistics for Inventory	Mean	Variance	Std. Deviation	Alpha Coefficient	No. of Items
	94.79	163.68	12.79	0.91	28

One of the most commonly used reliability coefficient i.e. Cronbach's Alpha was calculated and was 0.91, significant at 0.001 level of significance. The internal consistency of the inventory is quite high and this gives a support that the inventory is highly reliable. Descriptive statistics and Inter-correlations among dimensions of the inventory are given in Table 5.

Table 5.

Descriptive statistics and inter-correlation among *Innovation* dimensions

Dimensions	Descriptive Stats				Correlations*					
	Min	Max	Mean	SD	X1	X2	X3	X4	X5	X6
1. Thinking Space (X1)	12	46	31.22	5.31	1	.59	.42	.31	.30	.83
2. Innovation Entrepreneurship (X2)	9	40	26.78	4.86		1	.52	.41	.37	.86
3. Idea Management (X3)	5	25	16.71	2.79			1	.34	.43	.71
4. Innovation Culture (X4)	3	15	9.93	2.20				1	.19	.56
5. Innovation Technology (X5)	3	15	9.82	1.80					1	.53
Innovation (X6)	43	128	94.45	12.77						1

** r=.06 (p<.05); .10 (p<.01)*

Validity

Content (Face and logical) validity of the inventory was verified by number of experts, academicians and professionals. Good correspondence was found to exist between the inventory results and the considered judgments of experienced observers.

There are various methods to establish construct validity of the tool. Hence, quite a few of them are having limitations as role of time and existence of subjectivity in experts' ratings. To overcome these limitations, Exploratory Factor analysis (EFA) with Varimax rotation was used to establish the construct validity of the tool. Data screening was carried out in order to overcome existence of multicollinearity (i.e. items that are highly correlated) and singularity (i.e. items that are perfectly correlated) in the scale. For testing multicollinearity and singularity 'Determinant' of the R-matrix was estimated and it was greater than 0.00001. Sampling adequacy was also carried out and found to be greater than 0.50 as required in both cases. The results of EFA with varimax extracted and composite reliability for innovation inventory is given in table 6.

Table 6.

Factor loadings, percent of variance composite reliability dimension wise

Items	Factor & Loadings				
	I	II	III	IV	V
Inv16	.724				
Inv28	.689				
Inv23	.688				
Inv26	.686				
Inv22	.679	Thinking Space			
Inv27	.631				
Inv25	.590				
Inv21	.590				
Inv20	.540				
Inv16		.678			
Inv15		.662			
Inv18		.570			
Inv13		.555	Innovation Entrepreneurs hip		
Inv17		.549			
Inv19		.520			
Inv12		.497			
Inv14		.476			
Inv5			.738		
Inv6			.673		
Inv7			.598	Idea Management	
Inv4			.568		
Inv11			.422		
Inv2				.795	
Inv1			Innovation Culture	.730	
Inv3				.568	
Inv10					.720
Inv8				Innovation Technology	.695
Inv9					.644
Pct of Var.	16.75	11.41	9.67	6.99	6.75
Cum Pct of Var.	16.75	28.15	37.82	44.81	51.56
Average Var Extraction	0.39	0.32	0.37	0.50	0.47
Composite Reliability	0.88	0.79	0.74	0.74	0.73

Using a more structured method, confirmatory factor analyses presents evidence of the measures' convergent and discriminant validity. Five factors emerged and confirmed in the factor analysis. The percent of variance accounted by factors varies from 6.75to 16.75%. In summing up all the five factors explained 51.56% of the total variance. The factorial validity of the inventory is highly satisfactory.

Norms

While norms are usually thought of as being age-related, norms can also be tied to other developmental variables such as qualification and working experience. Overall norms using standard (Z-score) developed.

Standard (z) Score:

The standard score (more commonly referred to as z-score) is a very useful statistics, as it enables us to compare two scores that are from normal distribution. Standard (z-scores) scores can be calculated using the descriptive statistics (Mean=94.79, SD=12.79 with N=725) as given in Table 5 and using formula:

$$Z = \frac{(X - \mu)}{\sigma}$$

Where; X is the raw score of ***Innovation***, μ is the mean and σ is the standard deviation.

On the basis of descriptive statistics z-score norms have been prepared which are valid for adult male population only. The same have been given in Table 7.

Table 7.

Z - Score Norms for Innovation inventory

Mean = 94.79 SD = 12.79 N=725

RAW Score	z-Score	RAW Score	z-Score	RAW Score	z-Score	RAW Score	z-Score
58	-2.876	77	-1.391	96	0.095	115	1.580
59	-2.798	78	-1.313	97	0.173	116	1.658
60	-2.720	79	-1.235	98	0.251	117	1.737
61	-2.642	80	-1.156	99	0.329	118	1.815
62	-2.564	81	-1.078	100	0.407	119	1.893
63	-2.486	82	-1.000	101	0.486	120	1.971
64	-2.407	83	-0.922	102	0.564	121	2.049
65	-2.329	84	-0.844	103	0.642	122	2.127
66	-2.251	85	-0.765	104	0.720	123	2.206
67	-2.173	86	-0.687	105	0.798	124	2.284
68	-2.095	87	-0.609	106	0.876	125	2.362
69	-2.016	88	-0.531	107	0.955	126	2.440
70	-1.938	89	-0.453	108	1.033	127	2.518
71	-1.860	90	-0.375	109	1.111	128	2.597
72	-1.782	91	-0.296	110	1.189	129	2.675
73	-1.704	92	-0.218	111	1.267	130	2.753
74	-1.625	93	-0.140	112	1.346	131	2.831
75	-1.547	94	-0.062	113	1.424	132	2.909
76	-1.469	95	0.016	114	1.502		

Interpretation of scores for ***Innovation*** may be seen in Table 8.

Table 8.

Interpretation of the *Innovation* scores

Rank	Range of Z Scores	Grade	Level of *Innovation*
1	+1.50 and above	A	Extremely High (Positive)
2	+1.00 to +1.49	B	High (Positive)
3	+0.51 to +0.99	C	Above Average (Positive)
4	-0.50 to +0.50	D	Average/ Moderate (Neutral)
5	-0.99 to -0.51	E	Below Average (Negative)
6	-1.49 to -1.00	F	Low (Negative)
7	-1.50 and below	G	Extremely Low (Negative)

Summary

The innovation inventory has excellent internal consistency, composite reliability and intra-factorial reliability. The face, content and factorial (construct) validities are also high. It can be concluded that the inventory is highly reliable and valid for measurement of innovation in industry/organization.

Uses

This inventory can be used to help self-analysis, researchers and practitioners to measure the level of overall innovation and on its sub-domains viz. thinking space, innovation entrepreneurship, idea management, innovation culture and innovation technology.

The inventory can also be used for training of Managers, Supervisors, and other employees as a part of human resource development (HRD) for appraising and modifying SHRM systems, policies and practices.

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Consumable Booklet
of
Innovation (English)

Please fill in these entries: Date: ☐☐☐☐☐☐☐☐

Name:_____ Date of Birth: ☐☐☐☐☐☐☐☐

Experience in Years:_____

Marital Status:_____

Higher Qualification:_____ Profession_____

Designation:_____

Post: Technical ☐ Managerial ☐ Clerical ☐ Any other ☐

Name of Organization/Industry:_____

Instructions:

On the next page 28 items concerning your level of ***Innovation*** in the organization/industry have been given. Read each statement carefully and decide your response on a five-point alternative, viz., ***Strongly Disagree***, ***Disagree***, ***Neutral***, ***Agree and Strongly Agree*** and put a (√) mark in the box of respective alternative which is close to your response. Please answer to all the 28 statements in order to prepare your profile for level of *Innovation*.

Be assured your responses will be kept confidential.

Raw Score Total	Z-score	Grade	Level of Innovation

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Inventory

Sr. No.	Statements	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	Our company has adopted *evolutionary innovation* in Technology (continuous or dynamic evolutionary innovation) that are brought about by many incremental advances in Technology.					
2	Our company has adopted *revolutionary innovation* in Technology (also called as discontinuous innovation) which often brings disruptive and new Technology.					
3	Our company has great risk bearing capacity to create revolutionary new products that adds value to customers and contributes to the knowledge store of the organization.					
4	In our company, people who are engaged in innovation activities have a broad knowledge beyond their own domain which is developed through training and development.					
5	In our company, innovation related activities are triggered bottom-up.					
6	In our company, innovation related information is rapidly diffused through formal channels.					
7	People in our company, those who are engaged in innovation activities are well respected inside the organization.					
8	In our company, innovation related information is communicated through informal networks.					
9	In our company, people who are engaged in innovation activities have a strong internal network.					
10	In our company, people who are engaged in innovation activities have a strong external (outside organization) network.					
11	In our company, people of diverse backgrounds are involved in innovation activities.					
12	Our company is faster than our competitors in generating promising innovative ideas that bring to us sustainable competitive advantage.					
13	In our company majority of innovations lead to development of new technologies.					
14	In our company most of the innovations are differentiated and patented.					
15	My work place is designed in such a way that I am inspired to carryout innovation for products, processes and services.					
16	My Job/work (task and activities) are designed in such a way that I am inspired to innovate products and processes.					
17	I am encouraged to use my creativity and I have freedom to innovate product and processes.					
18	I am provided adequate tools and other resources to innovate products and processes.					
19	I am provided enough opportunity for training & learning to develop required knowledge and skills to innovate products and processes.					
20	I am empowered to take decisions related to change in products and processes.					
21	My seniors develop positive perspective in me about creativity and innovation.					
22	I am allowed to do experimentation and take risk to innovate products and processes.					
23	I am involved in decision making process for developing new products and improve processes.					
24	I am allowed to acquire and share required knowledge to innovate products and processes.					
25	My ambition for innovation is supported by my seniors.					
26	I am encouraged to take initiatives to do innovation in products and processes.					
27	I am treated an equal and respected irrespective of hierarchy when it comes to innovation activities carried out by me.					
28	I am trusted and allowed to collaborate with others for innovation activities for products and processes.					
	Total Score					