Tool/ Questionnaire for Studying Organizational Climate for Innovation in Public Funded R&D Lab.

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ABSTRACT

Innovation can be defined as putting creativity to use. It is being used to establish or improve technology, product, process, services or market in many organizations. Now a day's innovation is considered a must for improving efficiency and sustainability. As there was hardly any literature available in Indian context for public R&D sector, the present work was taken up in a government funded laboratory in India with an aim to study organization climate in the laboratory for innovation. A specific organizational climate is essential for R&D Institution to foster innovation. Further, to carry out this study no validated tool was available which is being addressed through this paper. Study of organizational climate for innovation using this tool is expected to identify the gaps and may help organization in improving the level of innovation. Fostering innovation is expected to further benefit the organization in many ways including improvement in project management efficiency, combat internal competition, technology readiness for future, retention of talent etc. The present research paper describes the conceptualization of a customized management tool to study organizational climate defined by unique combination of determinants required for technological innovation in a government run R&D laboratory and also to assess/measure the prevailing level of innovation in the organization. This includes identification of climate determinants from literature, case studies and experience of project teams followed by short listing using survey amongst the actual respondents. For measuring innovation as per literature, secondary data based indicators were preferred but due to non accessibility of many parameters, perception of respondents collected through a survey tool was selected. The tool has undergone various tests & reviews before its deployment. The tool has been utilized successfully in collection and analysis of data in one of the public funded laboratories.

Keywords:

Case Study, Determinants, Government, Innovation, Innovation Markers, Organizational Climate, Reliability, R&D, Tool, Questionnaire.

Introduction

Most of the organizations today combat a dynamic environment, accordingly organization needs to be more innovative than before to compete, to survive, to grow, to lead and to succeed (Gunusluoglu & Ilsev, 2009). To be successful, change is must (Vazifeh, 2011) and government R&D laboratories are no exception to it. R&D employees are considered to be more innovative than others. Innovation has always been essential for the organizations' long-term survival & growth. Currently it plays even more crucial role to follow the rapid pace of evolution (Vijande *et al*, 2007). Innovation (Jon Ander Lone *et al*, 2011) is considered essential for efficiency and survival (Jansen, 2004). Companies consider innovation as the key to improve profit and market. Governments emphasize innovation in their attempts to create a competitive economy (Baer & Frese, 2003) and the European Union places innovation at the heart of its ten year strategy known as Europe 2020 (European Commission, 2011). Business and technological changes also are threatening sustainability and modern management faces many challenges (Koc, 2007). One of the most serious challenges which, a high-technology organization are facing is how to manage innovation as the organization evolves (Koberg *et al*, 1999). It is apparent that in order to satisfy the customer's unlimited expectations, companies need to orient themselves to their customer's wants, as well as latent needs (Soltani iraj *et al*, 2011) and as a result provide valuable products and services.

A combination of innovative ideas and good organizational innovation management (OIM) is the key to sustaining competitive organizational innovation in the long term (Ahmed, 1998). In the present study in a public funded R&D laboratory in the country the organizational climate parameters were selected from literature and customized for the laboratory based on survey.

The present work deals with finalizing the management survey tool to study organizational climate defined by unique combination of sixteen determinants required for technological innovation in a government run R&D laboratory and also to assess/measure the level of innovation in the organization. This includes preparation of list of climate determinants derived from literature, case studies and experience of project teams followed by short listing using survey. For measuring innovation as per literature secondary data based indicators were also given thought but due to non availability/accessibility of many parameters this method could not be finalized. However, perception of respondents (Jon Ander Lone *et al*, 2011) collected through a survey tool was selected. The tool has under gone pilot test, experts review and reliability test before its deployment as discussed ahead.

REVIEW OF LITERATURE

Organizational Climate

The term "organizational climate" can be understood as "a set of measurable properties of the work environment, based on the collective perception of the people who live and work in the environment and demonstrate to influence their motivation and behavior." It describes the way it feels to work in an organization. People use "climate" as a phrase to describe the overall "work atmosphere" of an organization. Simply stated, climate is people's perception of the environment in which they work. Organizational climate has been researched and studied extensively since 1967. (Litwin and Stringer, 1968, as cited in Al-Shammari, 1992), defined organizational climate as "a set of measurable properties of the work environment and assumed to influence their motivation and behavior". As per (Ekvall, 1991), climate

acts as an intervening variable in an organization. Climate influences and is subsequently influenced by the outcome of organizational operations. Climate affects outcomes by influencing organizational processes such as problem solving, decision making, communicating and coordinating, the individual processes of learning & creating, and levels of motivation & commitment. These, in turn, influence the ways in which the organization uses its resources viz. men, infrastructure, intellectual property and finance.

METHODOLOGY ADOPTED

Identification of Climatic Parameters

The climatic parameters were identified initially through the two case studies done in the laboratory followed by literature survey towards defining organizational climate and its determinants, these are detailed below:

From Case Studies

Two case studies were done initially on successful development projects completed in recent past to identify key success factors of innovative projects in the laboratory. One was on development of heat stabilized narrow fabrics and the second one was on development of flexible envelope material with specific life for Aerostat. The two case studies (Thakare & Gyan Prakash, 2014) revealed that the shortlisted key success factors/climate determinants are able to foster environment in the laboratory for innovation as also suggested by the literature. The findings of these case studies are also backed by the limited secondary data from laboratory where in it was shown that the laboratory is improving fast in recent years with respect to climate for innovation. This is indicated through improvement in a few available innovation markers. The 14 key success factors (KSF) for the two cases are furnished in Table 1 and are considered as an input for identifying the climate factors.

S.No	Case- I	Case- II
1.	Autonomy	Autonomy
2.	Integration	Integration
3.	Supervisory Support	Involvement
4.	Training	Supervisory Support
5.	Outward Focus	Efficiency
6.	Clarity of Organization Goal	Flexibility
7.	Efficiency	Outward Focus
8.	Efforts	Reflexivity
9.	Performance Feedback	Clarity of Organization Goal
10.	Quality	Training
11.		Performance Feedback
12.		Pressure to produce
13.		Quality

 Table – 1: Key Success Factor (KSF) – Organization Climate determinants found affecting the cases

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From the Literature

Further, determinants of organizational climate were also compiled from the literature, based on their frequent utilization in various studies and necessity for R&D environment under study. As a summary, a few of the organizational climate frame works from literature are furnished in Table 2. The literature in support of various determinants for the organizational climate is summarized in Table 3.

Table -2: Existing Tools for Organizational Climate Study	

Tools	Author (Years)	Parameters/Determinants	Total
			Numbers
OED	Cannon (2004)	Commitment, Support, Clarity ,Recognition, Standard,	
		Responsibility	06
LSOCQ	Litwin & Stringer (1968)	Responsibility, Support, Warmth, Risk, Reward, Structure,	08
		Conflict and Identity	
	Cambell Dunnelt Lawler &	Autonomy, Degree of structure imposed on situation,	04
	Weike (1970)	Reward, Orientation, Consideration, warmth and support	
	Jones & James (1979)	Leadership Facilitation & support, Work group	08
		cooperation, friendliness & warmth, Importance of	
		variety, Professional & Organizational support, Job	
		challenge, Conflict & ambiguity and Mutual trust	
	James& James (1989),	Role stress & lack of harmony, Job challenge &	04
	James & Mcintyre (1996),	autonomy, Leadership facilitation & support, Work group	
	James & Sells, (1981)	cooperation, friendliness and warmth	
CCQ	Ekvall, (1996)	Freedom, Trust/Openness, Idea, Idea time, Idea support,	
		Challenge, Dynamic/Liveliness, Playfulness/Humor, Risk	
		taking and Debate/ Conflict	
	Moos (1994)	Autonomy, Involvement, Cohesion, Supervisor support,	
		Managerial control, Clarity, Task orientation, Co-worker,	
		Physical comfort and Work Pressure	
OCM	M. Patterson (2005)	Autonomy, Integration, Involvement, Supervisory	17
		support, Flexibility, Clarity of organizational goals,	
		Quality, Formalization, Tradition, Outward focus,	
		Reflexivity, Training, Welfare, Efficiency, Effort,	
		Performance feedback and Pressure to produce	
	Hunter (2007)	Autonomy, Positive Interpersonal exchange,	
		Participation, Positive Supervisory relation, Intellectual	
		simulation, Mission clarity and Product Emphasis	
NOCM	Lone Jon Anders et al (2011)	Autonomy, Positive interpersonal exchange,	11
		Participation, Positive supervisory relation, Intellectual	
		simulation, Mission clarity, Product emphasis,	
		Formalization, Conservatism, Outward focus and	
		Reflexivity	

Domain	Determinants/	Literature cited	
	Parameter		
Human	Autonomy (AN)	Hunter et al, 2007; Campbell et al, 1970; Patterson et al, 2005; James	
Relation & James, 1989; James & McIntyre		& James, 1989; James & McIntyre 1996; James & Sells, 1981; Lone	
		Jon Anders et al, 2011; Amabile et al, 1996; Mishra & Shrinivasan,	
		2008.	
	Integration (INT)	Amabile, 1988; Scott William, 2001; Martins & Terblanche, 2003;	
		Morris, 2005; Hassan <i>et al</i> , 2006; Dixit Gopal Krishna, 2011;	
		Patterson <i>et al</i> ,2005; Lone Jon Anders <i>et al</i> , 2011.	
	Involvement (INV)	Hunter et al, 2007; Jon Anders Lone et al,, 2011; Patterson et al,	
		2005	
	Supervisory Support (SS)	Kimberley and Evanisko, 1981; Hunter <i>et al</i> , 2007; Teresa, 1973;	
		Patterson <i>et al,</i> 2005; Lone Jon Ander <i>et al,</i> 2011.	
	Training (TRG)	Gattiker, 1995; Morrow et al, 2000; Patterson et al, 2005, Lange et	
		al 2000, Oyelaran 2010, Dixit Gopal Krishna et al, 2011	
Internal Formalization(FMZ) Pugh <i>et al.</i>		Pugh <i>et al,</i> 1968; Patterson <i>et al,</i> 2005, Lone Jon Ander <i>et al,</i> 2011.	
Process	Tradition (TRD)	Coch and French, 1948; Patterson et al, 2005; Lone Jon Ander et al,	
		2011.	
Open	Flexibility (F)	Garrahan & Stewart, 1992; King & Anderson, 1995; Hunter et al	
Systems		2007; Patterson <i>et al,</i> 2005; Lone Jon Ander <i>et al</i> , 2011.	
	Outward Focus (OF)	West and Farr, 1990; Nijssen et al, 2006; Patterson et al, 2005, Lone	
		Jon Ander <i>et al</i> 2011	
	Reflexivity (RFY)	West, 1996 & 2000; Patterson <i>et al,</i> 2005, Lone Jon Ander <i>et al</i> 2011	
Rational Goal	Clarity of Organizational	Hunter et al, 2007; Chang, 2008; Cott,1995; Patterson et al, 2005,	
	Goals (OG)	Lone Jon Ander <i>et al</i> 2011, Van Gundy, 1988; Martin <i>et al</i> 2003;	
		Dixit Gopal Krishna, <i>et al</i> 2011	
	Efficiency (EFY)	Ostroff and Schmitt, 1993; Patterson <i>et al</i> , 2005	
	Efforts (EFT)	McCaol et al, 1987; Patterson et al, 2005	
	Performance feedback (PFB)	Annett,1969 and Kopelmann 1986; Patterson <i>et al,</i> 2005	
	Pressure to produce(PP)	Teresa, 1998; Taira, 1996; Patterson et al, 2005	
	Quality (QT)	Deming, 1986; Hackman and Wageman, 1995; Patterson et al, 2005,	
		Lone Jon Ander <i>et al</i> , 2011	

Finalizing the Determinants/Factor of Organization Climate

From the literature and the two case studies total 23 factors were compiled as shown in Table 4. Out of these 23 factors the final 16 determinants were decided based on discussions amongst the scientists, project leaders & experts and also agreement by most of the respondents (more than 80%) through a survey as shown in Table 4. For final survey, accordingly 7 parameters were dropped and were not considered for the questionnaire/tool. This may be due to the fact that they are otherwise overlapping with other parameter viz. Managerial trust, Trust/Openness, recognition & reward are covered under performance feedback, goal and mission clarity are covered under clarity of organization goal intellectual simulation and idea support is covered under flexibility commitment & participation are covered under involvement, freedom is covered under autonomy, positive interpersonal exchange is covered under integration, positive supervisory relation and support are covered under supervisory support, product emphasis is covered under quality; Harmony, Communication & Open mindlessness are covered under tradition and work group cooperation with existing factors viz. Tradition & Integration. The remaining set of 16 parameters which are to some extent similar to the parameters given in OCM (17 items) for manufacturing organizations (Patterson *et al*, 2005). The finalized sixteen parameters under study are divided in four domains as mentioned above in Table 3.

S. No	Determinants / Scale	% Agreement for the scale for
		considering in the study
1.	Autonomy (AN)	82
2.	Integration (INT)	87
3.	Involvement (INV)	90
4.	Supervisory Support (SS)	91
5.	Training (TRG)	85
6.	Welfare (WEF)	68
7.	Formalization (FMZ)	85
8.	Tradition (TRD)	82
9.	Flexibility (F)	89
10.	Outward Focus (OF)	86
11.	Reflexivity (RFY)	85
12.	Clarity of Organizational Goals (OG)	90
13.	Efficiency (EFY)	88
14.	Efforts (EFT)	88
15.	Performance feedback (PFB)	87
16.	Pressure to produce(PP)	87
17.	Quality (QT)	88

 Table - 4: Determinant /Scales for organization climate identified from literature and percentage agreement to consider this for present study

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18.	Reward	72
19.	Risk Taking	75
20.	Trust/Openlessness	75
21.	Challenge	68
22.	Play fullness/humor	71
23.	Standard	76

Scope of Finalized determinants of climate

The scope of 16 finalized determinants as per literature is furnished below:

S.No	Determinant	Detailed Scope	Authors
1.	Autonomy	Designing jobs in ways which give employees wide scope to enact work	Cherns, 1976; Klein, 1991
2.	Integration	The extent of interdepartmental trust and cooperation	Lawrence & Lorsch,1967; Nauta & Sanders, 2000
3.	Involvement	Employees have considerable influence over decision making	Miller & Monge, 1986; Hollander & Offerman,1990; Heller, Pusi, Strauss & Wilpert 1998
4.	Supervisory Support	The extent to which employees experience support and understanding from their immediate supervisor	Cummins 1990; Eisenberger et al 2002
5.	Training	A concern with developing employee skills	Gattiker 1995; Morrow, Jarrett & Rupinski 1997
6.	Flexibility	An orientation toward change	Garrahan & Stewart 1992; King & Anderson, 1995
7.	Formalization	A concern with formal rules and procedures	Pugh, Hickson, Hinings & Turner 1968; Hall 1991
8.	Tradition	The extent to which established ways of doing things are valued	Coch & French, 1948
9.	Outward Focus	The extent to which the organization is responsive to the needs of the customer and the market place in general	Kiesler & Sproull,1982: West & Farr 1990
10.	Reflexivity	A concern with reviewing and reflection upon objectives , strategies and work processes in order to adapt to the wider environment	West 1996,2000
11.	Clarity of	A concern with clearly defining the goals of the	Locke 1991

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	Organizational Goals	organization	
12.	Efficiency	The degree of importance placed on employee efficiency and productivity at work	Ostroff & Schmitt1991
13.	Efforts	How hard people in organization work towards achieving goals	McCaol, Hinsz & McCaol, 1987
14.	Performance Feedback	The measurement and feedback of job performance	Annett, 1969; Kopelmann 1986
15.	Pressure to Produce	The extent of pressure for employees to meet targets	Taira, 1996
16.	Quality	The emphasis given to quality procedures	Deming, 1986 ; Hackman & Wageman 1995

Measure of Innovation

Many literature suggested measurement of innovation through secondary data viz. number of patents, number of research papers, number of successful products, technology etc. In our case being government defence organization accessibility was not available for many parameters to be used for public domain. Hence as suggested in many literature (Bunce & West, 1995; West & Anderson, 1996; Jon Ander Lone *et al*, 2011) innovation was decided to be measured as self reports of innovativeness by managers/scientists in various departments of the laboratory for a given time period. In our case the time period taken is 2011 to 2013. However, limited secondary data was used for validation. The scale has got 7 items which is based on already validated [cronbach's alpha $\alpha = 0.92$ & Inter rater agreement = 0.71] similar tool used for studies in service sector in past (Jon Ander Lone *et al*, 2011). The seven items addresses seven issues pertaining to innovation in any organization at a specific time frame are furnished below:

S.No	Question/ Item	Target	
1.	To what extent has the laboratory introduced and utilized innovation in	General perception	
	last five years		
2.	To what extent did the laboratory at the end of 2013 have an ongoing	Ongoing innovation	
	activity for the development or the introduction of innovations that were		
	not yet finished?		
3.	What has been the extent of the consequences of the innovation (s) for	Magnitude	
	the laboratory?		
4.	To what extent has (have) the innovation (s) changed how things used to	Radicalness	
	be at the laboratory?		
5.	How different has (have) the innovation	Novelty	
	(s) been?		
6.	To what degree has (have) the innovation(s) contributed to improving the	Effectiveness	
	laboratories ability to attain goals?		
7.	In general, how important is innovation in order for the laboratory to	Significance of	
	attain its goal?	innovation for	
		attaining goals	

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Design of Questionnaire/Tool

The finalized tool has got 16 scales to study the organizational climate similar to 17 scale OCM (Patterson *et al*, 2005) for manufacturing organization and one scale for innovation similar to one used earlier for service sector (Bunce & West, 1995; West & Anderson, 1996; Jon Ander Lone *et al*, 2011). The complete tool customized for study of organizational climate for innovation is in the form of a questionnaire. This questionnaire has 3 sections A, B & C. Section 'A' is for general information about the respondent and can be utilized for demographic analysis. Section 'B' has got 16 scales for organization climate having 76 items initially, refined to 74 items finally after reliability analysis & section 'C' is for innovation scale having 7 items. In section B for data collection each item has got a four point likert scale defined as - 1. Definitely false 2. Mostly false 3.Mostly true 4. Definitely true. Similarly for section 'C' the data is collected through 7 item through a 5 point likert scale. Before finalization, all the scales of section B & C have been tested for reliability through cronbach's alpha values.

Reliability of Scale

The reliability of these scales were established for public funded R&D climate before its actual use for survey, cronbach's alpha (α) values were calculated and are placed in Table 5. All the values corresponding to 16 scales were above 0.7 except Autonomy & Reflexivity. These two were also 0.67 i.e. nearing 0.7 hence considered reliable. For the scales on efficiency the cronbach's alpha was improved from 0.53 to 0.749 and similarly for the scales on quality the cronbach's alpha was improved from 0.162 to 0.678 by dropping one item in each scale. Thus scale refinement was established. The items dropped may not be fitting in the specific organization climate of the laboratory. Innovation scale was also tested for its reliability as mentioned in Table 5 and Cronbach's alpha value was found to be 0.843 which is considered highly reliable. It is worth mentioning that as per literature similar organization climate scales (Patterson *et al*, 2005) were validated in detail for manufacturing organization.

S.No	Scales	Cronbach's Alpha (α) (n=71)
1	Innovation	0.843
2	Autonomy	0.67
3	Integration	0.83
4	Involvement	0.819
5	Supervisory Support	0.854
6	Training	0.823
7	Flexibility	0.872
8	Formalization	0.743

 Table -5: Reliability of Scales for organization climate and innovation

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9	Tradition	0.781
10	Outward Focus	0.758
11	Reflexivity	0.676
12	Clarity of Organizational Goals	0.91
13	Efficiency	0.749
14	Efforts	0.853
15	Performance Feedback	0.86
16	Pressure to Produce	0.767
17	Quality	0.678

Factors Structure

No further change in factor structure of this tool was done as correlation between none of the combinations of 16 climate factors or innovation was found to be extraordinarily very high (above 0.8) to be considered for merger as shown in Table 6 below.

Table- 6: Descri	ptive statistics and	correlation between	various scales a	and innovation
	prive statistics and	conclution between	various scales a	

	Mea	Std.	Correlation																
	n	Devi																	
		atio	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1
		n																	7
INNOVATION	3.33	.685																	
	60	16																	
	2.55	.520	.193																
AUTONOMI	49	66																	
INTRGRATION	2.78	.566	.399	.271															
	31	44																	
	2.83	.518	.543	.360	.564														
	33	70																	
SUPERVISORY	3.06	.483	.425	.273	.482	.533													
SUPPORT	76	96																	
TRAINING	3.06	.552	.165	.309	.300	.507	.648												
TRAINING	69	52																	
FLEXIBILITY	2.75	.516	.550	.273	.396	.723	.573	.532											
	35	29																	
FORMALIZATIO	2.98	.444	.026	-	.042	.101	.096	.173	.177										
Ν	31	32		.174															

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	2.60	.564	-	-	-	-	-	-	-	-									
TRADITION	21	70	.620	.239	.441	.473	.423	.354	.478	0.78									
OUTWARDFOC	2.91	.497	.521	.040	.447	.565	.385	.223	.509	.324	-								
US	55	61									.444								
	2.82	.478	.544	.232	.287	.592	.499	.356	.670	.255	-	.66							
	54	01									.441	3							
CLARITY OF	3.03	.674	.547	.262	.480	.596	.476	.450	.590	.221	-	.64	.63						
ORGANIZATION	38	42									.591	5	2						
AL GOALS																			
EFFECIENCY	2.76	.586	.446	.258	.426	.566	.382	.295	.532	.186	-	.45	.55	.41					
	53	61									.336	3	5	8					
EEEOPTS	2.86	.593	.521	.168	.480	.524	.377	.309	.586	.329	-	.45	.60	.44	.67				
EFFORTS	20	87									.452	9	0	4	1				
PERFORMANCE	2.97	.616	.657	.239	.585	.704	.509	.504	.696	.199	-	.51	.65	.67	.54	.71			
FEEDBK	75	49									.580	9	7	8	6	6			
PRESSORETO	2.66	.530	.603	.353	.439	.649	.444	.341	.527	.017	-	.49	.54	.52	.33	.51	.64		
PRODUCE	20	87									.417	4	8	7	5	0	3		
	2.95	.617	.602	.231	.616	.647	.673	.518	.562	.178	-	.60	.55	.66	.26	.40	.66	.67	
QUALITY	77	03									.483	9	9	3	2	8	3	7	

Successful Use of Tool for Data Collection & Analysis

This questionnaire tool has been successfully used for data collection (n = 71) in the laboratory. The collected data has under gone limited analysis including descriptive statistics i.e. mean & standard deviation for each scale and correlation amongst each scale/ determinant which has establish strong relation between the 16 climate scales and innovation in addition to inter scale relationship for organization climatic parameters as shown in Table 6. Further regression analysis was also done to generate the regression model. The β (Beta) value were also calculated for each variable/ scale to generate a regression equitation with 16 climate variable/scale and 01 dependent variable i.e. innovation. The strength of the tool can be assured by very high value of R² (R² > 0.715) which means that the 16 variables / scales are able to explain climate for innovation more than 70% (Thakare Vikas & Gyan Prakash, 2014).

CONCLUSION

- 1. Extensive literature survey and two case studies generated 23 parameters for climate to initiate towards formation of climatic scales.
- 2. After refinement through pilot survey 16 scales for organization climate were finalized as no further merger of determinants were feasible as in no case correlation between various scales were very high i.e. above 0.8 & 01. Similarly 1 scale having 7 items was finalized for innovation.
- 3. The complete tool for study of organizational climate for innovation is in the form of customized questionnaire with likert scales. This questionnaire has 3 sections A, B & C for general information, organizational climate scales and innovation respectively.
- 4. All the scales were found reliable on trial run ($\alpha > 0.7$).
- 5. The tool was successfully used for data collection and analysis in the laboratory and this customized tool having 16 scales/determinants for organizational climate seems to be reasonable ($R^2 > 0.7$) for studying innovation in public funded laboratory.

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