

# Impact of Transformational Leadership on R&D Leader Performance



Pradeep Kumar Rout, Jyoti Ranjan Das, Monoranjan Puthal

**Abstract:** *In this study we provide a new conceptualization of R&D leadership with a multilevel and integrative approach. Integrated leadership is being conceptualized based on extant literature. This study develops an inventory to access integrated leadership. It examines the impact of integrated leadership on R&D performance and leader performance. It also examines the moderating effects of leaders' motivation, knowledge sharing, R&D climate and HRM practices between integrated leadership and R&D performance and leader performance. Data were collected from selected 139 R&D laboratories in India; from each laboratory one leader and three of his or her subordinate scientists working in coordination with the leader, were surveyed administering the questionnaire. The subordinate assessed the leadership and knowledge sharing, and the leader assessed all other variables. An instrument to access integrated leadership includes, cognitive, personal, and interpersonal factors. ]*

**Keywords:** *integrated leadership, R&D performance, leader performance, R&D climate, HRM practices, motivation, knowledge sharing.*

## I. INTRODUCTION

Leadership is the ability of a person to influence a group of people to achieve organizational objectives or goals. It has witnessed complex and phenomenal research in the last several decades. Academicians as well as practitioners are still focusing on finding out the attributes, behaviors, abilities, personalities, cognitive abilities, and emotions of successful and effective leaders for organizations. The organizational goal can be achieved through an effective leader, who shows the vision and path to achieve the goal. Leaders have various roles in the organization. Organizations need leaders who understand organizational needs in terms of goals, vision, mission, as well as personal and professional needs of employees or subordinates' abilities, aspirations, feelings, emotions, core values, responsibilities, and workload.

A country's success and survival depends on Research and Development (R&D) in science and technology.

Therefore, any R&D organization requires an effective leader, who can lead and influence scientists and engineers, so that they can produce more R&D outcomes in the form of patents, research publications, new knowledge, new technologies and processes. Yukl (1998) points out that the R&D leader plays a significant role in influencing subordinates which further leads to R&D performance.

R&D leaders are the Head of the research department, unit, team or group, Chief Scientists, Principal Scientists and Professors at different levels. The subordinates include Junior Scientists, Scientists, Senior Scientists, Principal Scientists, and academicians at different levels. Leaders, being motivated, can promote a supportive climate, improve HR policies and practices, and create avenues for knowledge sharing so that subordinates take the challenges for any novel idea and engage in their jobs and enjoy their work for the high performance of the R&D organizations. The leader of a R&D unit directly influences and leads their subordinate scientists in the context of research projects. The leader makes a supportive R&D climate, for the subordinates so that, they perform well, produce more, and became effective.

In R&D organizations, the leader leads and influence the highly educated, specialized, competent and domain expert scientists and engineers who deliver high levels of R&D outputs. The leader's competencies and abilities in planning, decision making, abstracting and critical thinking make their research project successful, and produce high level of R&D outcomes. Few studies have focused on how leadership influences R&D outcomes and performance. The conventional leadership theories may not explain the leadership required in R&D units. It calls for a new conceptualization of leadership for R&D organizations. R&D leadership can be multi-dimensional and integrative borrowing the ideas and themes from extant theories. Accordingly, a new conceptualization of the R&D leader can be made that can influence R&D performance and his or her performance.

## 1.1 Literature Review

In the 20th century creativity and innovation in science and technology has become the key for success for the survival of a nation. Any county is not unaware of the fact that a country's success and survival depends on R&D. In a globalized and knowledge-based economy, an essential determinant for economic prosperity is R &D productivity (Noor and Dzulkifli, 2013). R&D productivity is essential for boosting economic growth and sustainability. The R&D organizations should be careful while dealing with their innovative employees who produce quality R&D outcomes.

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Creativity and innovation is the prime driver for economic prosperity (Zheng et al., 2010); for instance, the USA's technological and business process innovations have added 45% of productivity gain from 1987 to 2007. Thus countries have focused on their R&D units which are essential for economic development. Any country needs leaders who can lead R&D teams. The subordinates who are involved in doing R&D depend on the nature of the work environment, infrastructure, facilities and leadership for R&D.

Many research literature debates on leader's traits and behavior. Leader's behavior and supervision influence subordinate's creativity (Gupta and Singh, 2011). R&D professionals are more educated than manufacturing and service employees (Gupta and Singh, 2014). The R&D leaders are selected for their organization on the basis of their higher education, technical and domain expertise, and for their leadership skills and abilities. Few studies have focused to examine the impact of leadership and leadership competencies (Gupta and Singh, 2014) on R&D outcomes and leader performance. For that, there is a need of research that examines the influence of leadership on R&D performance and leader performance and also the necessity of motivation and contextual factors needed for R&D organizations.

Whether a leader is made by will power or position offered to him or her, he or she can be effective through self-development, education, training, and experience (Jago, 1982). Leaders have different styles for leading subordinates. Some are authoritarian, some are democratic and still some others are achievement-oriented, transformational, charismatic, transactional, instructional, spiritual, and authentic. Most of the studies talk about some common characteristics or traits and behaviors of leaders. For example, dimensions of transformational leadership overlap with charismatic leadership. (a) Idealized behavior and attitudes, (b) inspirational motivation, (c) intellectual stimulation, and (d) individualized consideration of transformational leadership overlap with (a) charisma, (b) strong articulation, (c) anti-status quo, and (d) sensitivity to the member needs of charismatic leadership respectively.

Evidence suggests that creativity, innovation, problem-solving, R&D performance and R&D leader performance are influenced by leader's domain expertise (Ericsson and Charness, 1994, Mumford et al., 2002), technical skill (Farris, 1988), motivation (De Dreu et al., 2012), personality (Hoff et al., 2012) and supportive climate and culture for creativity and innovation (Amabile et al. 1996). Transformational R&D project leaders who convey an inspirational vision, give intellectual stimulation, develop a high level of leader-member exchange relationship with their subordinates or team members associate with greater R&D project success and outcomes (Elkins and Keller 2003; Keller 1992; Waldman and Atwater, 1992, Waldman and Bass, 1991). The R&D leader's behaviors encourage innovation, goal attainment and also affect the R&D subordinates expectancies, performance, and satisfaction (House, 1971, 1996; House and Dessler, 1974). Effective and successful leadership of an R&D organization focuses on creative and innovative efforts, R&D performance and outcomes (Barnowe, 1975). Also, the leadership style is effective with collaborative effort of subordinates towards achieving the goal of R&D organizations (Van Wart, 2006).

Though leadership is an influential factor for R&D subordinates creativity, few studies have been conducted on the relationship existing between leadership and R&D performance (Amabile et al., 1996, Amabile et al., 2004, Montag et al. 2012).

The R&D group or team members have the mission for carrying out R&D projects for organizational competitiveness. The R&D group or team consists of professionals of distinct characteristics, behaviors and attitudes. They have goal orientation, mission for achievement, and separate behavioral patterns for R&D project success (Engwall et al. 2005). Gupta and Singh (2012) have identified a set of leader's behavior that influences R&D subordinate scientists. There are no clear cut guidelines that have been derived as to how to lead scientists and engineers in R&D organization (Buijss, 2007). Research is required to provide a deeper understanding of leadership attributes and behavior needed for R&D group or team which influence the team members for R&D outcomes.

The R&D employees ability to be creative and innovative not only depends on their characteristics and behavior but also on their work environment. It seems R&D leader characteristics, motivation, R&D climate and HRM practices can have an influential role to lead the subordinates. Such study has the potential for giving empirical support to the leadership theory in R&D organizations. For a R&D work, to achieve higher performance there is a need to develop and improve the standard of effective and responsible leadership for encouraging and influencing high quality research vis-a-vis organizational performance. In this study, the focus is on the integrated leadership (IL) and its impact on R&D performance and leader performance.

R&D professionals acquire high level of intelligence, education, expertise, self-motivation, and generally they crave for more autonomy and greater responsibility to work on their own. However, it is sometimes argued that the vision established by transformational leaders may obstruct the autonomy of scientists and engineers in the R&D organization (Mumford et al., 2002). The study is to assess the leadership of creative people and the antecedents and moderators responsible for R&D performance and leader performance.

In order to promote effective and successful R&D leaders in the organizations, they must have high level of leadership quality, skill, domain expertise, strong research knowledge, cognitive abilities, special leadership attributes and behavior, to lead scientists and engineers for quality R&D outcomes. Apart from R&D, the leaders are a part of different administrative activities like recruitment, training, setting up laboratories, forming procedures, policies and rules, providing right responsibilities and workload, coordinating with organizational procedures and monitoring the subordinates with abilities. Researchers of organizational behavior have given little emphasis on cognitive, motivational and attitude of R&D leaders. By observing the leaders in R&D organizations, it can be realized that, R&D leadership can be multidimensional and integrative to ensure successful and effective leadership.

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## 1.1 R&D Outcomes or Performance

R&D organizations are different from service and manufacturing organizations. R & D organizations do not deliver products and services for marketing. Therefore, different yardstick can be used to measure R&D performance. R&D works are turbulent, uncertain, and ambiguous. R&D performance can be assessed on the basis of nature of the work, technological complexities, uncertainties, radical innovation, and incremental innovations (Banwet and Desmukh, 2005). However, the final deliverables of R&D unit can include: (a) disclosed patents, (b) research publications, (c) citations of publications, (d) technology developed, (e) product developed, and (f) process developed. It is a performance assessment system which provides the information to the organization and the funding agencies about the effectiveness of a R&D unit in the organization and its team members. R&D performance of an organization can be gauged over a timeframe. In some year, there may be many running projects and in other year, there may be few R& D projects. In R&D organizations, projects are generally of high value and those take years to complete. The engineering and biomedical projects of high value of can take three to five years for completion compared to agricultural engineering projects of low value which can take one to three years for completion. Because the R&D projects remain unfinished in a short-time, a duration of five years can be considered to assess the number of disclosed patents,

**Objective 1.** To develop a scale to assess IL.

**Objective 2** To examine the influence of IL on R&D performance and leader performance.

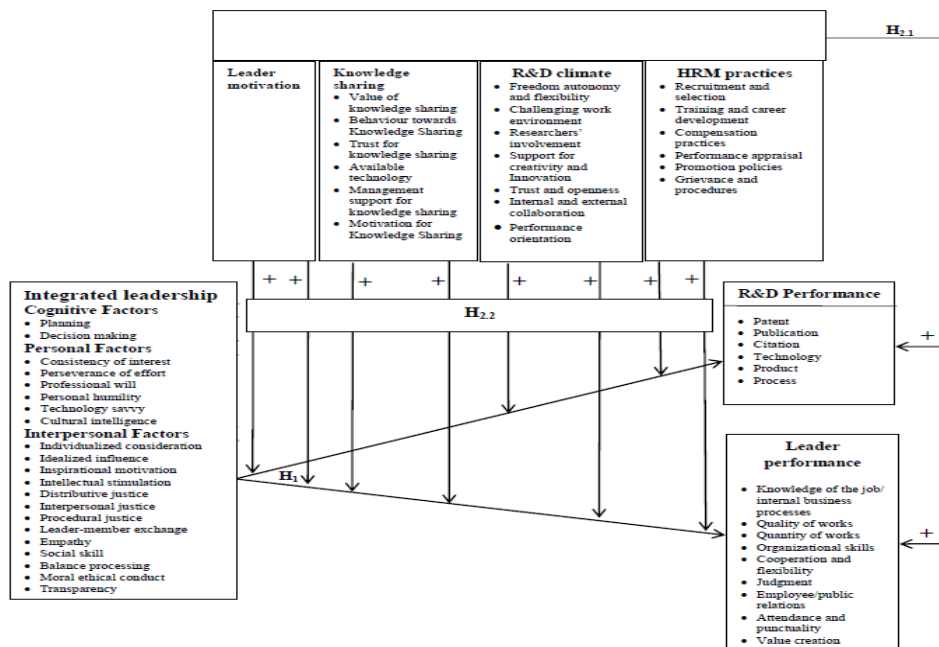
H<sub>1</sub>, IL will positively affect (a) R&D performance (b) leader performance.

## 1.6 Moderators

journal publications, citations of publications, and development of new technologies and processes.

## 1.2 Leader Performance

The leader leads a team of R&D scientists and engineers. What the leader does in daily activities and in research projects can indicate his or her performance. Also, the leader performance relates to the performance of team members to whom he or she leads. It can be evaluated on varied dimensions (Henderson, 2011). *Knowledge of the job* is the overall knowledge of the leader in understanding of assigned duties, responsibilities, relevant policies, and procedures. It also includes the planning, organizing, staffing, delegation, directing, controlling, decision-making, and problem-solving abilities to manage the R&D project and the team. *Quality of work* includes the accuracy, thoroughness, and neatness of work in R&D project teams on the basis quality, cost and time. *Quantity of works* is the amount of work successfully completed on timely basis. *Attendance and punctuality* include leader's attendance record and daily timeliness in entry and exit to the organization. *Value creation* includes expanding the R&D team and fund raising for new R&D activities. The next section deals with the IL that influences R&D outcomes and leader performance. The dimensions of the leader include traits, attributes, and behaviors.



Note. “+” indicates positive relations.

**Figure 1.1 Conceptual model for testing hypotheses and moderators**

## II. METHOD

### 2.1. Participants

Each R&D laboratory was an unit for the study. Data were collected from scientists, from 139 R&D laboratories, 24

geographically separated large R&D organizations in India. The survey was conducted by administering the questionnaire on the Head of Department/Team/Group Directors, Chief Scientists, Principal Scientists and Professors.

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Head of each laboratory was the leader and three of each leader's subordinates were those who were working in R&D projects. The subordinates were scientists, senior scientists, assistant professors and associate professors. In total, 139 leaders and 417 (139x3) of their subordinates participated in the study. The R&D organizations were Council of Scientific and Industrial Research (CSIR), Indian Council for Agricultural Research (ICAR), Indian Council for Medical Research (ICMR), Indian Space Research Organization (ISRO), Department of Biotechnology (DBT) and Department of Atomic Energy (DAE). The leaders and the subordinates were administered two separate questionnaires (Appendix B and Appendix C). As R&D organizations are restricted for entry by authorized persons only, the researcher approached the Heads of the R&D organizations (Directors) to conduct the study in their respective organizations. After getting the permission, the concerned scientists were selected randomly using lottery method from the list of scientists contacted. The age of the leaders ranged from 38 to 60 years ( $M_{age} = 53.41$  years,  $SD = 4.20$ ) and the subordinate's age ranged between 31 to 55 years ( $M_{age} = 41.99$  years,  $SD = 4.36$ ). The leaders' professional experience in R&D ranged from 11 to 39 years ( $M_{experience} = 26.19$  years,  $SD = 5.52$ ) and the subordinates in R&D ranged between 4 to 34 years ( $M_{experience} = 14.77$  years,  $SD = 5.54$ ). From 139 leaders, 24 (33.36%) were females and from 417 subordinates, 90 (37.53%) were females. The highest professional qualification of the leaders was Ph.D. and the highest professional qualification of the subordinates was Ph.D. and masters' degree in science and engineering.

## 2.3. Procedure

After receiving the permission from the head of organization (Directors), the concerned scientists (Head of Department or group or team and their subordinates) who were selected randomly were contacted and given the questionnaire. Each scientist was briefly described about the purpose of the study and requested to fill the questionnaire in their leisure time and return the filled-in questionnaire within a week. They were assured about the confidentiality of their responses and to use the response in an aggregate manner without disclosing their identity. Participation was voluntarily with their consent.

## III. RESULTS AND DISCUSSION

The descriptive statistics, Pearson's correlation, and Partial least-square structural equation modeling (PLS-SEM) were used to examine the reliability and validity of the data and test the hypothesized relations (Hair *et al.*, 2013). The PLS-SEM is a non-parametric, statistical test which incorporates regression-based factor analysis and path relations like the covariance-based SEM. It works on small sample, makes no prior assumptions about data distribution, examines both formative and reflective indicators and estimates complex models with many observed variables and their relations. Even it considers one indicator for a variable or a construct. Smart PLS 3.2.7 software was used to analyze the data. The data was analyzed in two stages (Ringle *et al.*, 2012). In the first stage, the reliability and validity of the first-order reflective indicators were established and in the second stage, the latent score of first-order variables were used as reflective

indicators for second-order constructs and the hypothesized relations among constructs were tested.

## 3.1. Measurement model: First-order variables

In the measurement model, outer model assessment was carried out. The outer model assessment provides the evidence of reliability and validity. This examined the reliability and validity of each construct. The convergent validity and the composite reliability were estimated-- indicators measuring a construct suggested convergent validity and the indicators' internal consistency indicated composite reliability (Hair *et al.*, 2012).

All the first order variables were measured reflectively. For measurement scale, confirmatory factor analysis (CFA) was conducted to assess convergent validity (average variance extracted (AVE) $\geq .50$ ). The composite reliability ( $\geq .70$ ) of items of each variable indicated internal consistency. For the second order construct like four dimensional transformational leadership, the validity and the reliability of second-order factors were estimated.

From the 79 items of the IL, all items were retained (Table 3.1). No item was dropped or deleted because the *outer loadings* of the items were  $\geq .70$ . Only one item of personal humility and one item from cultural sensitivity had outer loading  $< .70$ . Without removing the items, the convergent validity of the constructs was  $\geq .50$  and the composite reliability was  $\geq .70$ . All the variables of IL had the *composite reliability*  $\geq .70$  which confirmed internal consistency of items (Table 3.1). Therefore, the items measuring each variable of IL had accepted validity and reliability. Thus, cognitive abilities, grit, personal humility, professional will technology savvy, cultural sensitivity, transformational behavior, emotional intelligence, LMX, authentic behavior and justice orientation, were the valid and reliable dimensions of IL (Table 3.1).

Table 3.1 Outer loadings of IL items, validity and reliability of the dimensions

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Dimension/ factor	Items	OL	Retained/ Dropped	CV/ AVE	CR
Planning	...first moment latency	.94	Retained	.89	.96
	...total time taken	.96	Retained		
	...correct solutions	.92	Retained		
Decision Making	...fluency	.98	Retained	.86	.98
	...decision making	.96	Retained		
Technology savvy	...inspires colleagues and team members to adopt latest technology in R&D works.	.77	Retained	.71	.88
	...prefers technologically oriented people while recruiting in R&D projects.	.86	Retained		
	...is a role model in our organization for adoption and use of new technology.	.86	Retained		
Individualized consideration	... spends time teaching and coaching.	.79	Retained	.52	.81
	... treats others as individuals rather than just as a member of a group.	.71	Retained		
	...considers an individual as having different needs, abilities, and aspirations from others.	.69	Retained		
	... helps others to develop their strengths.	.68	Retained		
Inspirational motivation	...talks optimistically about the future.	.86	Retained	.66	.94
	...talks enthusiastically about what needs to be accomplished.	.75	Retained		
	...expresses confidence that goals will be achieved.	.71	Retained		
	... articulates a compelling vision of the future.	.79	Retained		
Distributive justice	...always ensures right responsibilities and workload to the subordinates.	.87	Retained	.72	.84
	...always ensures that rewards and benefits are rationalized based on R&D outcomes.	.82	Retained		
Interpersonal justice	...is always truthful to subordinates.	.92	Retained	.83	.91
	...is always sensitive to the personal needs of team members.	.89	Retained		

Note. AVE=Average variance extracted, CV= Convergent validity, OL= Outer loading, CR= Composite reliability.

### 3.2. Measurement model: Second-order construct

The latent scores of first-order variables were used for second-order constructs (Henseler and Chin, 2010). First, the convergent validity was checked for assessing the redundancy of all constructs. Second, the constructs of IL were tested for collinearity statistics. The variance inflation factors (VIF) was below 5 for each variable. It rejected the collinearity among variables and accepted the singularity of each construct. There were two dimensions of cognitive abilities, two dimensions of grit, one dimension each of personal humility, professional will, technology savvy, cultural sensitivity, and LMX, four dimensions of transformational leadership, two dimensions of emotional intelligence, three dimensions of authentic behavior, and three dimension of justice orientation. As a whole there were 21 variables and 11 constructs of IL

(Table 3.2). All variables reflected their respective constructs. The cognitive, personal and interpersonal dimensions reflected IL. All the path coefficients from IL to 11 constructs were significant (Table 3.2). Thus, IL was a multidimensional, multilevel and hierarchical construct.

### 3.3. Hypothesis testing

The hypothesized relations were tested in inner model path coefficients, t-values, R-square and their corresponding p-values (Heir *et al.* 2012). The R&D outcomes and R&D performance are used interchangeably. Three hundred bootstrap samples were used. In accordance with the first two hypothesis, IL positively predicted the R&D performance and the leader performance .

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IL explained 62% ( $R^2=.62$ ) of R&D performance and 80% ( $R^2=.80$ ) of leader performance (Table 3.4). These observations provided evidence that high (low) IL of scientists and engineers was associated with high (low) R&D performance and leader performance (Figure 3.1) and supported the two parts of the first hypothesis.

Table 3.4: IL indicates R&D performance and leader performance

Path	Coefficients	R <sup>2</sup>	t	p	Inference
IL --> R&D performance	0.79	0.63	33.076***	0.001	H <sub>1a</sub> Supported
IL --> Leader performance	0.89	0.8	43.239***	0.001	H <sub>1b</sub> Supported

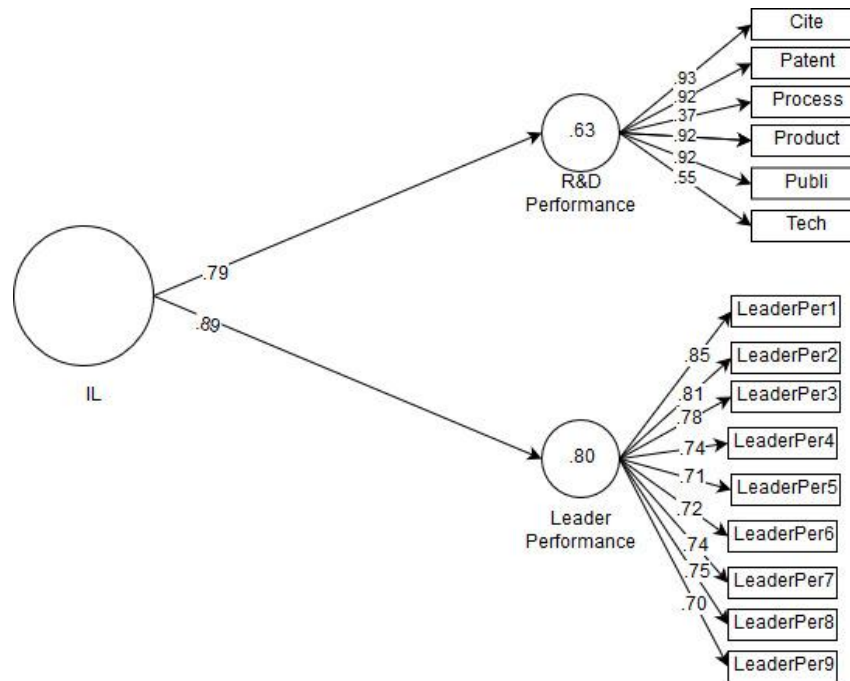
\*p<.05. \*\*p<.01. \*\*\*p<.001.

**Table 3.3: Descriptive statistics and Pearson correlation among studied variables**

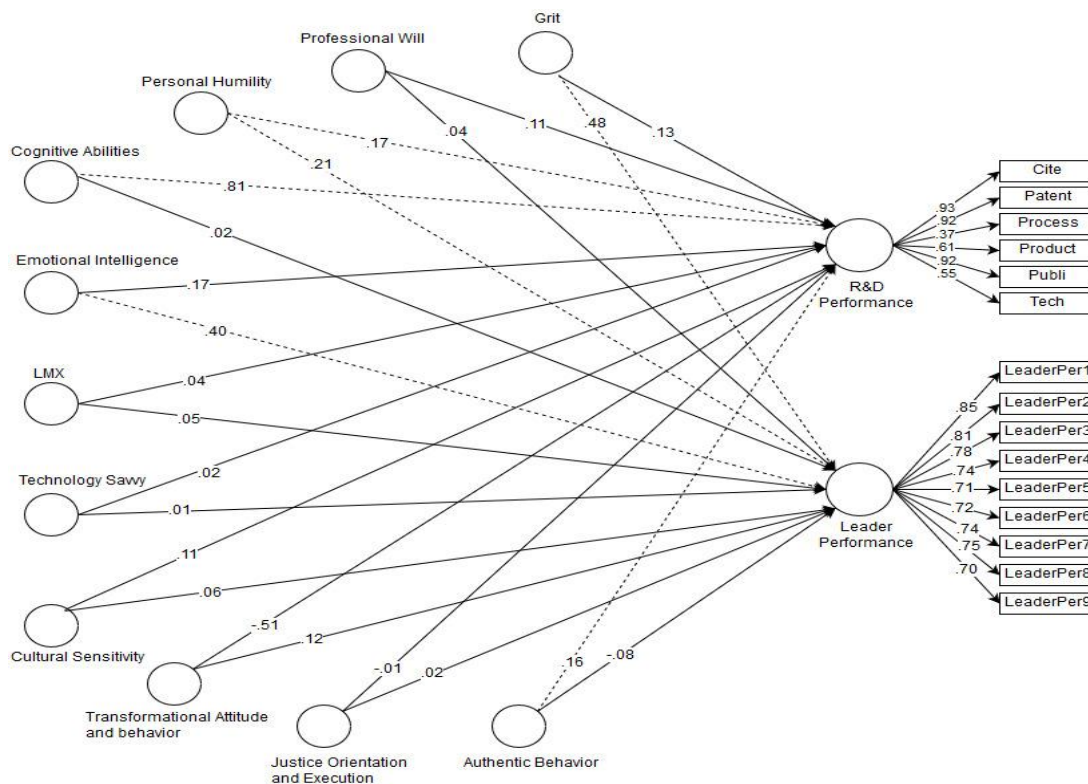
Dimensions of IL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	R&DP	LP
1 Idealized influence	1																					.78***	.88***
2 Individualized consideration	.93***	1																				.71***	.84***
3 Inspirational motivation	.95***	.93***	1																			.75***	.85***
4 Intellectual stimulation	.96***	.91***	.94***	1																		.74***	.89***
5 Empathy	.94***	.92***	.97***	.95***	1																	.70***	.87***
6 Social skill	.96***	.90***	.94***	.93***	.94***	1																.77***	.81***
7 LMX	.89***	.95***	.93***	.92***	.94***	.90***	1															.74***	.85***
8 Balance processing	.72***	.70***	.71***	.68***	.72***	.71***	.74***	1														.57***	.67
9 Moral ethical conduct	.69***	.71***	.73***	.67**	.71***	.68***	.70***	.58**	1													.62***	.62
10 Transparency	.69***	.67***	.71***	.67***	.69***	.68***	.70***	.51**	.58**	1												.54***	.57
11 Planning	.81***	.81***	.82***	.80***	.81***	.80***	.81***	.62***	.60***	.61***	1											.85***	.72***
12 Decision making	.84***	.85***	.85***	.83***	.80***	.84***	.84***	.65***	.64***	.63***	.94***	1										.88***	.76***
13 Personal humility	.70***	.72***	.68***	.70***	.70***	.71***	.71***	.52***	.58***	.46***	.61***	.65***	1									.62***	.77***
14 Professional will	.78***	.73***	.75***	.76***	.75***	.76***	.72***	.59***	.55***	.57***	.64***	.68***	.76***	1								.65***	.74***
15 Distributive justice	.24*	.21*	.26*	.22*	.28*	.23*	.25*	.23	.29*	.26*	.21*	.26*	.30**	.34**	1							.21*	.29*
16 Interpersonal justice	.25*	.26*	.28	.24	.31**	.25**	.33**	.35**	.31**	.33**	.17	.22*	.33**	.36**	.55***	1						.24*	.34**
17 Procedural justice	.26*	.22*	.24*	.20*	.27*	.21*	.31**	.34**	.30**	.37**	.31**	.33**	.30**	.34**	.54***	.66***	1					.16	.28*
18 Consistency of interest	.94***	.96***	.91***	.93***	.94***	.90***	.93***	.71***	.67***	.71***	.81***	.84***	.71***	.77***	.24*	.24*	.24	1				.74***	.84***
19 Perseverance of effort	.95***	.94***	.92***	.91***	.89***	.94***	.91***	.71***	.68***	.67***	.80***	.84***	.71***	.73***	.27***	.26	.22	.94***	1			.78***	.88***
20 Technology savvy	.15	.14	.11	.12	.19	.15	.18	.27*	.22*	.25*	.07	.11	.27*	.37**	.42**	.62***	.25***	.15	.11	1		.09	.21*
21 Cultural sensitivity	.08	.011	.012	.009	.14	.07	.13	.23*	.21*	.17	.11	.13	.37**	.19	.53***	.42**	.45**	.08	.12	.42**	1	.07	.24*
M	3.19	3.13	3.26	3.17	3.24	3.28	.27	3.18	3.26	3.35	3.58	7.86	3.28	3.45	3.56	3.78	3.56	3.17	3.21	3.48	3.40		
SD	.94	.79	.92	.95	.87	.91	.78	.83	.78	.80	.58	2.08	.81	.88	.63	.77	.68	.86	.81	.71	.62		

Note. R&DP= R&D performance, LP= Leader performance. \*p<.05. \*\*p<.01. \*\*\*p<.001.

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**Figure. 3.1** IL relations with R&D performance and leader performance



**Figure. 3.2** All the dimensions of IL predicting R&D performance and leader performance

It was further analyzed to examine which were most important attributes and behaviors that predicted R&D outcomes and leader performance. Cognitive abilities, authentic behavior, and personal humility positively predicted R&D outcomes. Of these, cognitive ability was the most important positive predictor of R&D outcomes (Beta = .81). Grit, emotional

intelligence and personal humility positively predicted the leader performance. Of the two traits, grit was the most important positive predictor (Beta=.48) of leader performance (Figure 3.2)

### 3.4. Moderating effect of motivation, knowledge sharing, R&D climates and HRM practices

To test the moderating effects of motivation, knowledge sharing, R&D climates, and HRM practices on IL→R&D performance and IL→Leader performance, the three-step model of Baron and Kenny (1986) was followed. For testing the moderators, first the IL will predict R&D performance and leader performance. This is already reported in testing the first two hypotheses. Second, the moderators of motivation, knowledge sharing, R&D climate and HRM practices will predict R&D performance and leader performance. Third, IL interacting with the moderators will positively predict R&D performance and leader performance.

Before examining the moderator effects, the outer loadings of moderator constructs, their validity and reliability are shown (Table 3.5). Motivation had one dimension, knowledge sharing had five dimensions, R&D climate had nine dimensions, and HRM practices had six dimensions.

Studying 139 R&D leaders and 417 subordinates of 24 R&D organizations in India, this study develops and validates a scale for accessing IL. Based on attributes and behaviors of relevant leadership theories, IL encapsulates the cognitive abilities, personal attributes, and interpersonal behaviors of R&D leaders. IL promotes R&D performance and leader performance. Cognitive ability of the leader was the most important positive predictor of R&D outcomes and grit was the most important positive predictor of leader performance. Though the motivation of leaders, knowledge sharing, R&D climate and HRM practices of R&D organizations do not relate to R&D outcomes and leader performance, interaction of the former constructs with IL positively predicts R&D outcomes and leader performance. Accordingly, the high(low) levels of motivation, knowledge sharing, R&D climate, and HRM practices raise (diminish) the positive impact of IL on R&D outcomes and leader performance. However, all these moderators had weaker effects.

### 4.6. Implications

Promoting the IL through coaching, counseling and training can improve the R&D performance and the subordinates evaluation of the leader. Because subordinates are self motivated knowledgeable employees, facilitates factors like improving HRM practices can improve the R&D performance and leader performance.

### 4.7. Limitation and scope for future research

This study is not free from limitations. First, the self-reported responses to the questionnaire may not be free from social desirable responding. Moreover, the leaders were the heads of research department, team, group and the subordinates were those who worked directly under the leader. In many research organizations, the Heads of Department, team, group are rotated in a fixed time interval. This short duration in leadership position might have affected the replies to the statements and questions. However, the leader responded to certain statements and questions, and subordinates responded to other statements or questions about the leader, that procedurally arrested the common method bias. Second, the IL questionnaire containing 79 items may not be easy for

administration to assess leadership in R&D organizations. Keeping the importance of the contributing factors to R&D performance, a shorter version can be developed, validated and used to assess IL in R&D organizations. This may include cognitive abilities of planning and decision-making, personality traits of grit and humility, interpersonal attributes of empathy, social skills and authentic behavior. Further, IL which is found to be in R&D units with knowledge employees may not be so important in the manufacturing and service sector. This calls for replication of finding beyond R&D organizations. Third, while four moderators have been studied, psychological capital, encompassing optimism, hope, self-efficacy, and resilience can be a possible moderator in the relationship of IL with R&D performance and leader performance.

## IV. CONCLUSION

This study identifies the cognitive abilities, personality traits, and interpersonal behavior of R&D leaders. The study has developed a scale that can be used to access R&D leadership. The study suggests the IL predicts R&D performance and leader performance. Additionally, HRM practices are found to be a potential moderator to promote the relations IL with R&D performance and leader performance. If the leader, model his or her behavior in accordance with IL, he or she can improve R&D performance and facilitative HRM practices can further such performance.

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