





R&D Leadership Styles and Behaviors: A Review and Research Agenda

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(Review Paper)

Abstract—R&D leaders are critical actors in creating and executing organizational R&D strategies and leading R&D departments. R&D leaders spearhead and manage innovation activities and efforts that are essential for organizational survival and growth. Despite the importance of the R&D leader role, there is a scant focus on R&D leadership styles and behaviors within the existing fragmented literature. Accordingly, in this article, the purpose is to address this deficit by examining R&D leadership styles and behaviors through a systematic literature review. Based on 60 articles, we identified three main themes: the influence of leadership style; R&D leader behaviors; and R&D leader human capital. We analyze and discuss these themes along with positing future research avenues for further understanding of R&D leaders and leadership.

Index Terms—Creativity, innovation, leadership styles, R&D, R&D leader behaviors, R&D leadership, systematic literature review (SLR).

I. INTRODUCTION

THE R&D environment is a complex function to organize and lead. It has a unique type of environmental atmosphere, far more distinct than other functions in organizations, as Gupta and Singh [1, p. 23] note: “tasks are unstructured and instead of timely and market-sensitive measures of performance, R&D has a time-lagged, sporadic, and nonmarket nature to its outputs.” Increasingly, R&D research is becoming a multidisciplinary team task and, accordingly, the workforce is becoming more composed of multidiverse knowledge workers [2]; a factor that adds further complexity to an already complex environment [3]. The R&D environment is a knowledge-intensive context, which is based on intellectual knowledge, skills and abilities, and the fundamental competencies to enhance innovativeness [138].

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This renders it a very particular environment and, consequently, it requires leadership styles and behaviors to lead and manage these complexities in order to realize envisaged outcomes [4], [5]. It is striking that, even though leadership is a research theme that has been heavily studied, there has been a scant focus on leaders and leadership in R&D environments [6], [7]. Moreover, R&D contexts call for an effective leader [8], whose role has been proven crucial not only in small work teams but also in the context of large organizations [9].

While there has been an abundance of literature that has attempted to explore how R&D improves the performance, productivity, and competitiveness of organizations, there has been limited theoretical and empirical focus on the leaders and leadership styles in R&D contexts [6], [10]. This deficit has been highlighted by several scholars. For example, Zheng et al. [11] argue that there is a need for research into leadership implications in R&D environments due to their complexity and differences with other areas. Similarly, based on their study findings, Keller [12] calls for a deeper investigation looking for a clearer definition of R&D leaders and leadership.

Against this background, the purpose of this article is to examine R&D leadership styles and behaviors used in the R&D context in order to enable a clearer understanding of how this leadership role is defined and conceptualized by scholars given its importance and relevance to firm performance [13]. Given the fragmented nature of the literature and limited empirical focus on leadership styles and behaviors, we conducted a systematic literature review (SLR). This methodology is especially pertinent when the aim is to synthesize a considerable amount of information in a replicable and seamless manner while also highlighting new future research interests [14], [15], [16]. Therefore, our study contributes not only to outline this literature but also to pinpoint new themes and expand and deepen the knowledge that exists on this topic by stressing the existing gaps in the current literature. Based on the above, the following research questions are pursued in this study: What are the leadership styles adopted by R&D leaders? What are the leadership behaviors adopted by R&D leaders?

Our contributions lie in addressing our study questions focused on R&D leadership styles and behaviors. One of our contributions stems from our SLR, where we identified three main themes, namely the influence of the leadership style, R&D leader behaviors, and R&D human capital. Our analysis also unearthed two-level clusters of papers’ scales for measuring R&D leadership styles, R&D leader behaviors, and R&D leader

human capital in the SLR sample and outcome variables for the level of performance, the level of innovation, and the level of creativity. We also find that there are several terms used in studies to describe and define the R&D leader. Another contribution is that we reflect actions and strategies that could be carried out by R&D leader in knowledge-intensive contexts. We also posit some future avenues of research given for each of the themes we identified. Furthermore, we have compiled a list of scales and criteria for measuring the different leadership styles used by the different authors of the SLR sample. Moreover, we have contributed to expand the theoretical background of R&D leadership in knowledge-intensive environments by identifying the different types of leadership styles and behaviors that enhance innovativeness, creativity, and knowledge sharing in these particular contexts.

II. BACKGROUND AND METHODOLOGY: AN SLR

A leadership style is defined as the attempt to influence the members of a team, project, department, or organization, to do something in a particular way, which they would have done differently otherwise [9]. Across different disciplinary fields, studies have addressed various aspects of leadership styles, such as gender [17], [18], age [19], job satisfaction [20], and in different country and sectoral contexts [21], [22], [23]. Studies have focused on what leadership styles leaders adopt, such as engaging, involving and goal oriented [24], and transformational and transaction [25], [26], [27]. For leaders leading in a new context and being a new leader, they have to consider carefully their leadership styles, particularly how they are perceived by colleagues and their impact on organizational culture [28], [29], [30].

Leadership behavior focuses on what leaders do that contributes to the success of an organization that embraces people and activities [31], [32]. Among leadership scholars, there is no universal agreement as to what behaviors contribute to being an effective leader [33] and there have been numerous studies testing different combinations of variables [34]. For example, Yukl et al. [35] identified three metacategories of leader behaviors—task, relations, and change—and measured 12 specific behaviors including clarifying roles, monitoring operations, short-term planning, consulting, developing, etc. However, there is an ongoing debate among scholars as to what behaviors contribute to leadership effectiveness [36], [37] and the differences in leadership behaviors due to cultural dissimilarities [38].

Against this background in an R&D environment, leadership is significantly different from that found in other organizational functions [12], [39]. However, in the latter cases, the leader is empowered, and in R&D contexts, the leader is also seen as “a communicator and a coordinator in a horizontal community group, rather than the leader in a hierarchical group” [40, p. 11]. This is indicative of how particular the R&D environment is, and therefore requires a distinctive R&D leadership that adapts to its inherent characteristics. Some authors advocate for leadership styles that provide more flexibility and freedom to researchers due to their highly specialized profiles, and the fact that their knowledge and skills are often very difficult to find and retain [101], [138].

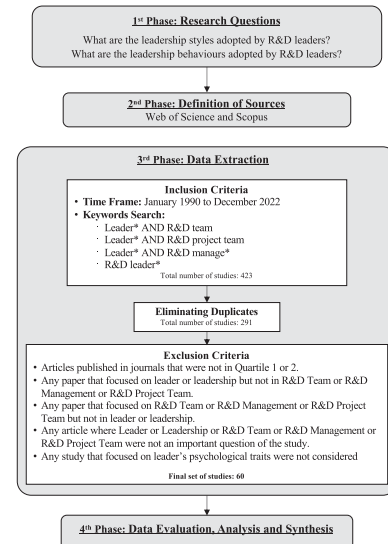


Fig. 1. Systematic review protocol.

In the development of organizations and in the process of reaching their objectives, innovation and creativity are essential [79], [82]. Creativity is the generation of original and qualified solutions to the problems that either exist or arise in organizations [137]. Innovation is the process through which this original and qualified solution becomes viable and is materialized in a product, service, or even a process [134]. Very often, when decisions are taken in order to influence innovation and creativity at one level of the organization (individual, grouped, and organizational), these do not always have the same impact on the remaining levels. This is due to the complexity of both concepts and their multilevel nature [82]. Some existing studies have highlighted how leadership in R&D contexts can make organizations more competitive by enhancing their level of innovation. For instance, enhancing employees’ creativity in R&D teams or considering the impact of leaders in the R&D context can translate into a competitive advantage [5], [41], [42]. Despite such studies affirming the importance of the R&D leader role, there is a need to better understand what are the leadership styles and behaviors that they adopt.

We carried out a systematic review of the literature, which provides a “replicable, scientific, and transparent process” [43, p. 209] in order to achieve a frame of reference that identifies fields and subfields from collective perspectives, avoiding any traces of bias and error [44]. The SLR design comprises different phases [16], [43], [45] (see Fig. 1).

For the first phase, we defined the central topic of the study and the research objective so that the research questions that prompted this study, as outlined in Section I, were set [14], [43]. In the second phase, the sources and type of data for review were defined [43]. In order to ensure the relevance of the publications, the search was conducted in Scopus and Web of Science, two major databases and highly recommended in prior studies [16], [46], [47]. For the third phase, we extracted the data, and we created the inclusion criteria in order to screen out those articles that would not contribute to address the research questions. The time frame was limited from January 1990 to December 2022

(both inclusive) and a set of keywords reflective of our objectives was defined (see Fig. 1). Those search parameters were used in queries to the databases, including titles, keywords, and abstracts. This searching process yielded a total of 423 articles (180 from Web of Science and 243 from Scopus), although, after eliminating duplicates, the total was 291 articles. Our exclusion criteria for this phase [16], [43] included those articles published in journals that were not Quartile 1 or Quartile 2 on Web of Science and/or on Scopus were excluded. Subsequently, the remaining articles were carefully analyzed in full in order to determine their main focus of study, excluding those that do the following:

- 1) studied leaders or leadership but not in R&D teams, R&D management, or R&D project teams;
- 2) studied R&D teams, R&D management, or R&D project teams but did not focus on leaders or leadership;
- 3) made references to leaders, leadership, R&D teams, R&D management, or R&D project teams but these were not an important question of the study;
- 4) studied leaders in R&D contexts but focused only on their psychological traits.

For this purpose, the title, abstract, keywords, and, if necessary, the full article were reviewed [43]. Consequently, the articles composing the corpus of the study were the most relevant ones in order to address the research questions.

For our final phase, we evaluated, analyzed, and synthesized the data from the 60 selected articles [43], [45], which, having completed the SLR process, constituted the final sample (see Appendix A). An in-depth analysis was conducted by the authors on each of them in order to gather all the relevant content and key findings useful for the resolution of the research questions [43], [45]. In doing so, several different issues emerged, and this resulted in a debate about their appropriateness. Those issues on which consensus was reached are addressed in the following sections of this article.

Metadata that have been extracted from the 60 articles that comprised the final sample have provided us with a comprehensive overview of their information content. Appendix B presents the journals compilation, which are all high-quality peer-reviewed journals. Total 40% of the articles from the final sample are published in only seven journals (*R&D Management*, *Research-Technology Management*, and *International Journal of Innovation Management* are examples of them). A common feature that stands out in their titles is the management. This reinforces and provides robustness to the study since the articles that have emerged from the SLR come from journals whose scope is focused on how to improve the management of R&D people. The distribution of studies classified by years of publication (see Fig. 2) suggests that the research issue started to acquire momentum from 2013 onward, as almost 70% (41 out of 60) of the publications in the sample are concentrated in the last ten years. Quantitative is the most utilized research methodology. It represents 78% of the sample (47 out of 60). It highlights a demand for more qualitative methodologies in order to contrast and combine results (see Fig. 3). The context in which the studies are undertaken also provides interesting information and corroborates that organizations that operate in ever-changing markets are the most frequently used to carry out this type of study. In this sense, 75% of the studies are conducted

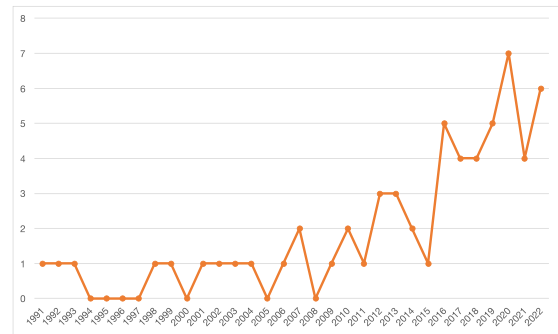


Fig. 2. Number of selected articles in the period from January 1st, 1990 to December 31st, 2022.

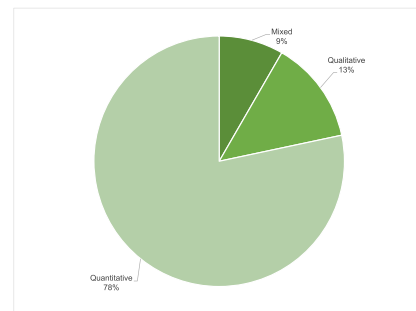


Fig. 3. Research design of the studies reviewed.

in ever-changing markets, and most of the organizations are involved in high-tech or pharmaceuticals. This is because, in this type of context, organizations are constantly challenged to maintain a high level of creativity and innovation in order to remain competitive. Based on global citations, the top ten articles of our sample are listed in Table I. Global citation is comprised of the citations that a Scopus indexed study has received from other studies indexed in Scopus [48].

III. R&D LEADERS AND LEADERSHIP: THEMES FOUND IN THE SLR

Based on our analysis, interestingly, we found interchangeable terms and the lack of consensus regarding the terms used to identify the person who is in charge of leading in R&D contexts. Terms, such as “R&D leader,” “R&D team leader,” “R&D project (team) leader,” and “R&D manager,” are commonly used, in some cases even interchangeably [6], [49]. Whether these differences in terminology imply differences in roles or responsibilities is hard to ascertain since only a few articles (“R&D Leader” = 2; “R&D Team Leader” = 4; “R&D Project Team Leader” = 2; and “R&D Manager” = 3) among the 60 articles in our study have explicitly defined or described one of those terms, albeit with significant differences [6], [12], [40], [41], [50], [51], [52], [53], [54], [55]. There are, however, some studies where a distinction between some of these terms has been emphasized. For example, Gumusluoglu et al. [41] argue that, whereas an “R&D manager” is seen as the person who represents the authority, the “R&D team leader” is perceived as a colleague. This delineation is in keeping with other studies

TABLE I
TOP TEN ARTICLES OF THE SLR

Rank	Article title	Author(s)	Year	Citations
1	How leaders influence the impact of affective events on team climate and performance in R&D teams	Pirola-Merlo, Härtel, Mann, and Hirst	2002	284
2	Can Knowledge-Intensive Teamwork Be Managed? Examining the Roles of HRM Systems, Leadership, and Tacit Knowledge	Chuang, Jackson, and Jiang	2016	224
3	Managing innovative R&D teams	Thamhain	2003	194
4	Examining the antecedents of knowledge sharing in facilitating team innovativeness from a multilevel perspective	Liu and Phillips	2011	127
5	Learning to lead: The development and testing of a model of leadership learning	Hirst, Mann, Bain, Pirola-Merlo, and Richver	2004	101
6	Does SSL Hinder Team Creativity? A Moderated Dual-Path Model	Peng, Wang, and Chen	2019	87
7	CL, change, and innovation in an R&D organization	Paulsen, Maldonado, Callan, and Ayoko	2009	74
8	Psychological capital as a mediator of the relationship between leadership and creative performance behaviors: empirical evidence from the Indian R&D sector	Gupta and Singh	2014	70
9	Leadership and innovation: relations between leadership, individual characteristics, and the functioning of R&D teams	Stoker, Looise, Fisscher, and de Jong	2001	70
10	The roles of R&D team leaders in Korea: A contingent approach	Kim, Min, and Cha	1999	70

Note: Global citations according to Scopus as of the end of 2022.

suggesting that the formal authority is not represented by the “R&D team leader.” Instead, they are seen as a coordinator, being the hierarchical authority represented by the “R&D project team leader” [40] or by the “R&D manager” [41], [56].

Our analysis also revealed some differences regarding the extent of the influence of certain roles. Some studies defined the roles of “R&D manager” and “R&D project (team) leader,” referring to them as a person who perceives and evaluates the connections of the factors inside and outside the R&D team or the R&D project (team) [12], [51], [52]. In contrast, the studies that focused on the “R&D leader” and the “R&D team leader” define these roles pointing out that they only focus on the internal factors of the team or project (team) [6], [40], [50], [53]. Nevertheless, in some studies, these terms are used interchangeably to refer to the unit of analysis. For instance, Kim et al. [49] used “R&D team leader” and “R&D project (team) leader” without distinction. The same applies to “R&D leader” and “R&D manager,” which are both used to describe the person who is in charge of the team or the project in several studies [6], [52], [53], [57], [58]. However, from our analysis, we found four studies where “R&D manager,” “R&D project (team) leader,” and “R&D team leader” are distinguished [40], [41], [56], [59].

Despite these different interpretations and terminology, from our analysis, three main themes emerged concerning R&D leadership styles and behaviors that address our research question namely, the influence of leadership style, R&D leader behaviors, and R&D leader human capital.

A. Influence of Leadership Style

Even though there is an acknowledgment that leadership styles play an influential role in the achievement of objectives in the R&D environment, the literature analyzed in this study notes and highlights that there is a lack of consensus on this theme. The effects that certain leadership styles can have in a number of areas, such as innovation, creativity, or knowledge sharing, are still unclear. Furthermore, there is a lack of consensus concerning the variables that could mediate these relationships. All these aspects will be analyzed in detail in the rest of this section.

1) *Leadership Styles and Innovation:* While there seems to be a clear consensus on the fact that the role played by the leadership style is crucial in innovation processes [60], [61],

[62], the effects of a particular leadership style are not yet empirically clear. Even though some studies suggest beneficial effects when team members are encouraged and guided in order to achieve their objectives rather than subjected to a more autocratic leadership, there are no definitive empirical studies about which leadership styles are most effective in R&D environments [63].

The extent to which the conclusions about the effects of certain leadership styles can be contradictory is best exemplified when comparing the studies by the authors in [64] and [65]. Both studies share the same objective, which is to achieve a positive impact on new product development processes by applying different leadership styles. Transformational leadership (TFL) style is the leadership style applied to both studies. With this leadership style, the leader is able to associate the necessities and desires of the team members with their own. This is done by encouraging team members to share their opinions, motivating them as well as inspiring them to be critical and to focus on their personal improvement [66]. R&D leaders implementing TFL foster their team members to improve their innovative behavior [67]. In the case of the study of Darawong [64], TFL was used as a way to influence team members through enhancing individual consideration, intellectual stimulation, and charisma, which led to an improvement in the speed and the level of success of the new product development process. In contrast, the study of Schroeder and Baldegger [65] found that applying TFL did not improve new product development and that, in fact, the effect was negative. Contrastingly, this study found a positive impact on new product development performance by implementing empowering leadership (EL) [65]. This leadership style provides more independence to team members when they are performing their responsibilities than TFL. Actually, in knowledge-intensive environments, a distinctive feature of EL is that, by fostering teamwork, enhancing self-development and establishing collaborative aims, the leader encourages team members to lead themselves [68], [69]. Therefore, EL goes a step further in delegating autonomy and responsibility to its team members compared with TFL [70].

Furthermore, there is empirical evidence showing that similar results can be achieved by applying different leadership styles. For instance, Zhu and Chen [58] stated that team innovation can be achieved by applying group-focused EL, while Paulsen et al. [63] stated that the same objective can be achieved by applying the charismatic leadership (CL) style. CL is much more focused on inspiring team members to go beyond the

established boundaries, and to do so, the charismatic leader relies on their charisma [71]. Conversely, the authors in [40] and [57] applying the same leadership style (TFL) obtained different results. The former demonstrated a direct relationship, while the latter showed an inverted U-shaped relationship with team innovation.

Moreover, adding to this confusion, TFL is not the only leadership style that has been linked to negative outcomes in new product development. Zhou et al. [72] found that differential leadership was detrimental not only to new product development but also to the relationships and conflicts within the team. Differential leadership describes a leadership style where the leader distinguishes team members as insiders or outsiders, giving preferential treatment to the former over the latter, resulting in competitive situations within the team [73].

TFL has also been studied somewhat extensively concerning team innovation, although some studies ended up with slightly different findings [57], [74], while others reached totally opposite findings [40], [75]. In the former case, the authors in [57] and [74] asserted a positive direct relationship between TFL and R&D team innovation. In the case of [57], Paulsen et al. demonstrated this positive relationship with different mediator variables, namely, team identification and team member's perception of support for creativity, while in the case of Liu and Phillips [74], R&D team knowledge sharing was the variable that mediated this relationship.

In contrast, the authors in [40] and [75] proposed a nonlinear relationship instead of a direct relationship, although with opposite conclusions. On the one hand, Eisenbeiß and Boerner [75] suggested a U-shaped relationship, asserting that not just any level of TFL will result in high team innovation. Thus, in their model, team innovation is greater in those R&D teams with high or low levels of TFL, compared with those R&D teams with moderate levels of TFL. Even though these results may seem confusing—since team innovation is improved both under low and high TFL levels—the poor results achieved with moderate levels of TFL are explained by the strong need that R&D members have for intellectual freedom and autonomy to act, which can cause TFL to be perceived as a threat. On the other hand, Chung and Li [40] proposed an inverted U-shaped relationship based on the theory of positive emotions and the self-efficacy of R&D team members. Their findings suggest that both under high and low levels of TFL, team members' innovation behavior is negatively impacted, whereas a moderate level of TFL is optimal to improve innovative behavior in the R&D team. This may be explained by cultural differences or the unit of analysis, as the former study is conducted in an individualistic culture and the unit of analysis is the R&D team [75], while the latter is conducted in a collectivist culture and its unit of analysis is the R&D project team [40]. Furthermore, Chung and Li [40, p. 11] labeled this effect as “the dark side of the TFL,” referring to a relationship between TFL and R&D team innovation, which is in complete contradiction to that of Eisenbeiß and Boerner's article [75].

Some studies that analyzed the effect of leadership styles on team innovation have proposed several different mediating variables, such as team identification, intrateam cooperation, personal initiative, individual intrinsic motivation, or team knowledge-sharing intention [41], [54], [63], [74]. Based on

our analysis, we found several differences, as well as certain similarities. For example, in the case of team identification, Gumusluoglu et al. [41] demonstrated a positive mediating effect on individual innovative behavior with a benevolent leadership style (BL), while Paulsen et al. [63] came to similar conclusions by using a CL style. BL promotes a working environment where followers feel appreciated, their confidence is strengthened, and they are even made to feel as if they are a part of a family, creating a sort of a parent–child relationship [41], [76]. CL is believed to be similar to TFL and, in fact, Eisenbeiß and Boerner [77] consider them synonymous. However, the difference is that the transformational leader does not necessarily have to be charismatic [40]. Therefore, this illustrates that different leadership styles can achieve the same objective through the same mediating variable, which is due to the cultural context [41], [63]. Additionally, Denti and Hemlin [54] applied leader–member exchange (LMX) leadership style in their study. LMX is a leadership style where the team member operates according to what they are expecting to receive from the leader [78]. Denti and Hemlin [54] stated that individual innovation is achieved indirectly by applying LMX. This was possible mediating this relationship by fostering team member's personal initiative—recognizing their contributions, encouraging knowledge exchange, and developing trust within the team—instead of mediating it by intrinsic motivation.

2) *Leadership Style and Creativity*: Another area where the influence of leadership style has been widely studied is concerning creativity, which is the cornerstone for accomplishing innovation [79]. Prior studies assert that creativity is the seed from where innovation blossoms [79], [80], [81]. Even though they are interconnected, they are different concepts [82], [83]. In order to achieve creativity, the role of the leadership style is crucial [84], [85]. However, in this case, based on the need for autonomy that researchers in knowledge-intensive teams have, several studies have proposed other types of leadership styles instead of TFL [7], [65], [84], [85], [86], [87]. One such style is shared leadership (SL), which is applied by leaders who decide to share the responsibility of leading the team with the rest of the members to accomplish their objective [88]. Song and Gu [85] strongly encourage leaders in the R&D context to promote SL to increase the level of creativity within their teams. In a somewhat similar way, Cavazotte and Paula [86] asserted that applying SL enhances creativity in project teams, although there is a threshold after which this positive effect may be diminished. This slight difference may be explained partly because Song and Gu [85] conducted their study in a collectivist culture and Cavazotte and Paula [86] did not.

Furthermore, another leadership style, namely the self-sacrificial leadership style (SSAL), is used by Xu et al. [87]. This is similar to TFL, although SSAL prioritizes the followers' interests over those of the leader, even accepting individual costs to the leader. When the leader applies this leadership style, they make the followers feel well treated, so this engages them in the creative productive process that improves their creativity [87]. Additionally, Schroeder and Baldegger [65] were able to demonstrate a positive impact on R&D team members' creativity and innovation level, although in their case, through the use of EL, which is arguably one of the most suitable leadership styles for the R&D context [65]. In line with these studies,

Chen et al. [84] found that those R&D leaders who involved team members in decision-making and problem-solving processes through a participative leadership style can foster R&D team creativity. Finally, Schneider et al. [7], given the complexity of drug-discovery projects in pharmaceutical R&D, recommended a distributed leadership (DL), where the responsibilities embedded in the role of the R&D project team leader become distributed among team members.

Therefore, the traditional conception of leadership, in which a group of people report to an individual, is not the most suitable for fostering creativity [88]. On the other hand, those leadership styles where the responsibility of leading is shared or team members are involved in the decision-making process are more suitable to exploit all the available creative potential [7], [84], [85], [86], [88]. On the contrary, if the exchange between the leader and their followers is different depending on the team member, its impact on team creativity is negative. This leadership style is a variant of LMX and is called LMX differentiation [10].

Unlike the vast majority of studies mentioned so far, which were focused on trying to find the leadership style best suited for a particular goal, Peng et al. [89] centered their research on the study of a leadership style that is detrimental to team creativity, as a warning to the R&D team or research organization. They studied the self-serving leadership style (SSL), which represents a selfish leadership style, where the leader only operates for their own benefit against even the general or the team members' interest [90]. Their findings of the negative effect of the SSL on team creativity led them to identify what leaders should avoid and what could help to lessen the impact. Accordingly, they proposed that psychological safety should be fostered in the R&D team, and, more importantly, that leaders should promote sharing knowledge and information in order to decrease knowledge concealment among the R&D team members [89].

3) *Leadership Styles and Knowledge Sharing*: Knowledge sharing is defined as that knowledge transferred from one person to another within a team or outside the team [91]. Not only how much knowledge is shared but also how is it communicated is crucial to increase the team innovation level [92]. In order to foster team innovation, R&D leaders can stimulate knowledge sharing by applying a particular leadership style [5]. From our analysis, some studies found that TFL [74], [93] and visionary leadership (VL) [5] can promote an employee's intention to share knowledge. The positive influence of TFL on knowledge sharing has been demonstrated not only directly [74] but also in terms of the climate that this particular leadership style develops in the R&D team, encouraging employees to share knowledge [93]. Team climate can be defined as "the set of norms, attitudes, and expectations that individuals perceive to operate in a specific social context" [94, p. 384], and these can be positively impacted by TFL [95], [96]. Similarly, Zhou et al. [5] study found positive direct results on knowledge sharing by applying VL, which is quite similar to TFL and CL, although its main concern is to convey the vision (i.e., the goal to be achieved in the future), convincing followers to participate in its accomplishment [97]. VL combines some features of TFL with other characteristics, such as helping team members to perform organizational objectives. Finally, Engelsberger et al. [98] found that relational leadership also enhances the openness of team members to

learn and to share ideas, experiences, or expertise, which are all crucial factors to enable knowledge sharing and even to support open innovation among team members. This leadership style is especially recommended in situations where there is significant cultural diversity and complex business problems, enhancing the sharing and understanding of different values or opinions [98].

Apart from certain leadership styles, some human resources management systems (HRMS) or practices (HRMP) can also be put in place to accomplish the same objective: knowledge sharing among team members [99], [93]. In particular, Chuang et al. [99] asserted that an HRMS for knowledge-intensive teamwork and the EL may replace one another to increase team knowledge sharing since both of them can ensure knowledge sharing within the team and knowledge acquisition from outside of the team. Additionally, a trusting climate, as Jones and George [100] defined it, can be induced by TFL to foster employee knowledge-exchange behaviors, although this can also be nurtured by HRMS [96]. Furthermore, Liu and DeFrank [93] demonstrated that both HRMP—namely, team-based job design and knowledge-sharing incentives—as well as TFL climate can diminish and mitigate the negative effect that an employee's self-interest can have on knowledge sharing. Therefore, in order to achieve the same goals, developing certain leadership styles might be an opportunity to reduce costs rather than implementing HRMP [99]. In this line, Stock et al. [101] asserted that innovation-oriented leadership and innovation-oriented rewards, as well as training and development human resources practices, enhance cross-functional R&D cooperation, which fosters product program innovativeness.

4) *Leadership Styles and Cultural Context*: Over the past five years, most of the studies covered in this review have been conducted in countries outside the Western culture, such as Taiwan, India, China, or Japan, to control for one of the most obvious variables that can have an influence on leadership in R&D contexts, which is the different cultural environments [41]. The reason behind this is that using the traditional leadership styles differentiation does not provide a conclusive answer on its own. Even though a few existing studies proposed that leadership theories are culture free [56], [59], several authors have provided a reality check [5], [41].

In countries, where a collectivistic culture is rewarded and developed, leaders can set autocratic leadership styles more successfully than in countries where an individualistic culture is prevalent [5], [41], [102]. In this sense, Gumusluoglu et al. [41] asserted that BL has a positive effect on team innovation, enhancing team identification. Similarly, the conclusions of the studies by Zhou et al. [5] regarding VL and Zhu and Chen [58] regarding group-focused EL are restricted to the particular cultural context of their countries—China and Taiwan, respectively—where people are accustomed to obeying direct orders from their superiors due to the fact that there is a wide distance between leaders and followers [102]. Moreover, in the Japanese culture, gatekeeping leadership, instead of TFL, has a positive direct impact on team performance [59]. In contrast, an SL style can fit into R&D contexts regardless of whether the culture is collectivist or individualistic [56].

Despite this, some studies, such as [40] and [74], still recommend applying TFL in order to enhance team innovation

even in collectivist cultures, although the latter points out that a moderate level of TFL should be applied in order to obtain the optimal level of team innovation.

B. R&D Leader Behaviors

Leadership behaviors may act as a contextual factor influencing team performance and team innovation by modifying team processes [58], [64]. Considering the particularities of the R&D context, appropriate leadership behaviors are key to the achievement of objectives [61], so they should be coherent with the context [57], [77]. Based on the social learning theory, the leader's behaviors can act as a behavioral model for the rest of the team members and, thus, the daily interactions of leaders with their subordinates in the R&D context can influence the overall performance [50], [60], [61], [84]. Despite this, there is limited and scant literature focused on such relationship [42], [103]. Moreover, the lack of agreement about what behaviors should be studied makes the research even more difficult. Following the stream of research focused on enhancing leadership effectiveness, we are considering behaviors as what leaders in the R&D context do, which have the potential to positively impact the achievement of objectives [103].

The R&D team leader should not only provide the necessary resources according to the planned program but also encourage team members to collaborate as a community. In order to do so, avoiding favoritism toward someone, in particular, is paramount since it has been demonstrated contrary to intrateam collaboration [58]. Instead of that, Zheng et al. [11] suggested encouraging individual noncompetitive success as a possible alternative in order to improve whole-team innovation. Continuous feedback by the R&D leader is also essential to maintain increasing levels of innovation within the team not only in order to control any deviation but also in order to give visibility to the contributions made to the client or the rest of the organization and to offer recognition to team members, which is another important leader behavior [11], [52].

In the literature, it is assumed that fostering more cooperation within the team or making efforts to enable collective resolutions among team members will improve team innovation [42], [58] or will enhance creative process engagement [1], [84], [103], [104]. In addition, encouraging and enabling team members to be proactive to undertake some activities and even to make some individual decisions also has a direct effect on creativity behaviors [1], [42], [103], [104] and an indirect effect on team innovativeness [54]. In this sense, getting team members involved in decision-making processes—identifying problems and proposing possible solutions—and enhancing discussions about control or supervision mechanisms indirectly impact team members' creativity [84].

In contrast to the social identity theory, Grosse [51] suggested that there is no correlation between team identification and the efficiency of the R&D project team leader. In fact, advocating a too-close relationship with the R&D project team members might lead to group thinking, and leaders should try to balance the interests of the organization and the R&D project team. In line with this study, Lin and Li [105] asserted that R&D leaders with high social skills may induce and shape deliberation processes, influencing the achievement of the objectives by

displaying certain social behaviors. Conversely, several studies advocated that R&D team leaders who developed a sense of belonging to the team [1], [103], [104] and who developed caring behaviors to team members have eventually encouraged innovation in the team [41]. Hence, by promoting team members' identification with behaviors, such as enhancing shared efforts or fostering participation in cooperative decisions and collective goals, leaders in the R&D environment can positively impact team performance, innovative behaviors, or knowledge sharing [1], [41], [57], [63], [103], [104]. In addition, clarifying objectives and aligning personal goals with the collective ones is crucial to reach team innovativeness [11], [52], to develop employee creativity [5], to enhance team performance [49], [106], and to become effective [52].

Among the articles in our study, only two studies have explicitly listed a set of particular R&D leaders' behaviors [49], [103]. Both of them were carried out in India and Korea, respectively, presenting both similarities and differences between them. Gupta and Singh [103] identified 13 R&D leaders' behaviors, which led to an increase in creativity within (project) team members, and, therefore, in innovation. For their part, Kim et al. [49] proposed five different R&D leader roles, which are linked to a set of different behaviors. All of these roles (strategic planner, technical expert, gatekeeper, and team builder) coincide with one or two of the behaviors identified and described in the study of Gupta and Singh [103], with the only exception of the role of champion (also known as entrepreneur). It is striking, that there are a few behaviors identified by Gupta and Singh [103] that do not correlate with any role described by Kim et al. [49]. These are leading by example, empowering the team members and consulting with them before making changes, as well as supporting, developing, and informing behaviors, which seek to strengthen relationships among team members.

Moreover, Ishikawa [59] asserted that R&D leaders' behaviors that positively impact team performance are influenced by the cultural context. In fact, their study found that, in Japan—which is a collectivistic culture—R&D leaders' behaviors, such as facilitating their internal communication among the R&D team members and their external communication with other R&D teams, are much more important in order to accomplish team performance than those that rely on inspiring, stimulating, or encouraging R&D team members.

C. R&D Leader Human Capital

The uniqueness of the R&D environment requires that leaders have certain idiosyncratic human capital (HC), different from those needed in other leadership positions [12]. HC is composed of all the individual's knowledge, skills, and abilities [107]. R&D teams are quite distinct since their members are highly skilled technically speaking, are more creative, and they are used to being autonomous, together with the fact that, in this function, there is usually a lack of stability [8], [11], [103]. R&D leaders require a certain HC to successfully lead their research projects, and even to guarantee a sustained improvement in their research results [108]. Studying and defining such characteristics is of practical importance since, as McDonough III and Barczak [109, p. 51] suggested, the selection of an R&D project leader should

not be based on what they called a “gut feel” of the person who is hiring. Rather, it should be informed by scientifically contrasted findings to narrow down any risk of not selecting the right person for the job.

Some HCs of the R&D leader (of a team or a project team) were common across these studies, namely, that leaders should have a cognitive problem-solving orientation, they should lead rather than do, and they should be able to encourage other people. The first one, a cognitive problem-solving orientation, is required in order to enhance and speed up the innovation process [109] to positively influence the innovative R&D project team performance [52], to improve the R&D team creativity [110], and to become a successful R&D leader [6], [51]. The second one is that R&D leaders should lead rather than do [11], [51], [111]. R&D leaders need to lead the team to unify the vision and direction in order to achieve the established goals. Therefore, even though technical skills had traditionally been used as a criterion to select the leader of the R&D team [55], some scholars argue that nowadays, that does not seem to be enough [112], [113]. Several articles on our study came to a similar conclusion. For example, Kim et al. [49] asserted that the technical expert role is not enough to achieve the R&D project’s performance and, thus, other roles must be employed. The same applies equally to both R&D teams and R&D project teams. In this sense, McDonough III and Pearson [111] found that, whereas the R&D project leader’s administrative skills had no impact on performance, their technical skills had a negative impact and their human relation skills had a positive one. Similarly, Elkins and Keller [8] asserted that, even though technical expertise and leadership skills are reasons to select R&D leaders, they must also be able to resolve any interrelation conflict among team members or project members. That is why human relation skills, such as giving constructive feedback and appreciation, and providing recognition, need to be considered in the selection process [6], [52], [111], [112]. So much so that those R&D leaders who displayed a higher level of interpersonal skills were able to make a difference, becoming highly effective [112].

On a similar note, R&D leaders should be able to encourage and stimulate their team members to be more effective [52], [55]. They need more consolidated soft skills: coaching and inspiring, fostering interfunctions communication, and collaboration in a highly fluid environment [113]. However, it was highlighted that, when leaders in R&D contexts display high social skills, this can lessen the advantages of human capital heterogeneity since they tend to dominate potential discussions, with the undesired effect of constraining team members in their willingness to explore different alternatives to those presented by the leader [105].

Moreover, Grosse [51] conducted a study where, based on 50 semistructured interviews with the supervisors of the R&D project leaders, leadership knowledge, skills, and abilities were ordered according to their importance for fulfilling project success. To have the knowledge, to be creative, to be committed, to be tolerant of risk, to be able to manage conflicts, and to be accountable were ranked at the top. Among them, risk tolerance, i.e., having a certain level of risk and being able to manage it, is crucial if the established objectives are to be achieved in such an uncertain environment as R&D is [51], [64].

IV. DISCUSSION AND FUTURE RESEARCH AGENDA

What is evident from this SLR is that our understanding of the R&D leadership role warrants significant and sustained empirical attention from scholars. R&D is a complex organizational activity to organize because it requires higher degrees of autonomy as well as typically a different working and cultural environment. From our analysis, we identified three main themes, namely, the influence of leadership style, R&D leader behaviors, and R&D leader human capital, and for each one of these themes, significant avenues for future research have emerged, which are presented in Table II and discussed as follows.

A. Influence of Leadership Style

Since leadership is an important part of the innovation process in organizations [4], [5], it is striking that the literature is quite fragmented about this issue, including confronting ideas and questions that have not been clearly answered yet. In this regard, it is important to underline the opposing results of the studies undertaken by Chung and Li [40] and Eisenbeiß and Boerner [75]. Both argued that there is a nonlinear relationship between TFL and innovation, but the former stated that it is a U-shaped relationship and the latter stated that it is an inverted U-shaped relationship. Further understanding of this nonlinear relationship is needed. Moreover, there are unclear conclusions about which leadership style is most effective in R&D environments [63]. We found studies that achieved similar results by applying different leadership styles [58], [63] as well as studies that, by applying the same leadership style, obtained different results [40], [57]. There are even studies where both contradictions can be found at the same time [64], [65]. The challenge is that based on the nuances and fragmented data that we have in this SLR, it is still very fuzzy. This is because there is still not enough empirical evidence to clearly articulate which particular leadership style for a specific construct yields a certain outcome. Therefore, this is an important future research avenue. Moreover, there is a need for further large-scale, multi-country, industrial, and organizational research to shed a more definitive light on the influence of leadership style in the R&D environment.

1) *Leadership Styles and Innovation and Creativity*: Regarding innovation and creativity achievement, several authors have expressed their reservations concerning leadership styles that may compromise the level of autonomy of researchers and team members and their potential negative effects [2], [65], [75], [77]. However, more research is still needed where the leadership style used is more flexible and permissive, granting more autonomy to the team or the project team members. This would include leadership styles, such as EL [65], [68], SL [85], [86], [88], participative leadership style [84], DL [7], and self-managed leadership style [50]. Since the R&D environment is so complex, the workforce is usually highly qualified, so they tend to demand a little more autonomy and trust in their competencies to perform their roles and may, therefore, welcome a more flexible leadership style from their R&D leaders [88].

Although there are several scholars [57], [63], [114] who have already shown that team identification exerts a positive mediating effect between certain leadership styles—inclusive CL and TFL—and team innovation, there are several studies

TABLE II
FUTURE RESEARCH AGENDA

Main themes	Sub themes	Research questions
1. Influence of the leadership styles	1.1. Leadership style and innovation and creativity	What leadership style is more appropriate in a complex and uncertain context, such as an R&D environment? Might some team characteristics, such as team processes and team identification, influence the relationship between leadership style and creativity or/and innovation? Might they enhance this relationship? Or might they diminish this relationship? How can extrinsic motivators—external regulation, introjection, identification, and integration—influence the relationship between leadership style and creativity or/and innovation?
	1.2. Leadership styles and knowledge sharing	Might an ambidextrous orientation be a variable that further clarifies the influence of leadership styles on creativity or innovation? What kind of knowledge does an R&D leader impart to their team or project team? Is it technical knowledge? Is it knowledge of the process? Is it strategic knowledge?
	1.3. Leadership styles and cultural context	In an increasingly globalized world, can we still admit that cultural context can be a factor in the impact of leadership style on innovation? Which are the factors that can inoculate or amplify the cultural effect, regarding the goal?
2. R&D leader behaviors	-	What empirical lines of enquiry can be undertaken in order to deepen the understanding of leaders' behaviors in the R&D context? Building on the social identity theory, what are the leaders' behaviors that facilitate the inclusion process of the R&D team members in order to enhance innovation?
3. R&D leader human capital	-	What are the knowledge, skills, and/or abilities that researchers require in order to become a leader in the R&D context? Is there any special knowledge, skills, and/or abilities required for playing the R&D leader role depending on the moment of their career?

that question this positive effect based on the results of their studies [41], [115], [116]. Given such mixed empirical findings regarding the effects of team identification on team innovation, this might be a worthwhile mediating variable to apply with other types of leadership styles that grant more freedom of action and autonomy to the team or project team members. Extrinsic motivators might be another variable to be considered and included to reach a more definitive empirical conclusion [117], [118]. Although there is much literature that has studied motivation and its effects, as Fischer et al. [117] point out, the effect of extrinsic motivators on innovation and creativity is still barely investigated. A more in-depth study of this variable could be made by taking the four types of extrinsic motivators defined in the work of Ryan and Deci [118]—external regulation, introjection, identification, and integration—as a reference. Disaggregating the extrinsic motivators can provide a more detailed understanding of their effect on team and project team innovation and creativity [117]. The ambidextrous orientation of the leader while they are applying the leadership style might be another interesting future research avenue [114].

2) *Leadership Styles and Knowledge Sharing*: Although team members can decide with whom they want to share their knowledge, as well as to decide whether or not to do so [119], R&D (Project) team leader's behaviors might prove crucial for this exchange of knowledge [120]. Therefore, some further studies are required to address such issues as what kind of knowledge does an R&D leader impart to their team or project team? Is it technical knowledge? Is it knowledge around the process? Is it strategic knowledge? What knowledge hiding practices do R&D leaders engage in when managing R&D departments?

3) *Leadership Styles and Culture Context*: Based on our analysis, there is a need to bring focus to advancing our understanding of culture and R&D leaders. Our review highlighted some studies where applying the same leadership style in different geographical areas obtained different results [5], [41]. Further research should be focused on identifying factors that can inoculate or amplify the cultural effect on leadership styles. In Appendix C, we have graphically illustrated what we have gathered from the articles that comprise our study. Based on

our analysis, we can observe that the largest number of studies in our study that investigate the impact of leadership style on creativity are conducted in China. Leadership styles that succeed in improving creativity have in common the absence of selfishness and differentiation among subordinates, while sacrifice, sharing leadership, and sharing a vision toward the achievement of the objective prevail. In contrast, Xu et al. [87] in China and Cavazotte and Paula [86] in Brazil conclude that, applying team authoritarian leadership to the former and SL to the latter, there is a nonlinear relationship with creativity.

In the case of innovation, studies are conducted in a wider variety of countries, but fewer leadership styles are applied. Here again, it can be seen that a leadership style, such as differential leadership, is not the most suitable one for driving innovation [72]. In contrast, applying TFL styles in Asian countries or CL in Australia will obtain a positive result [40], [63], [64], [74]. This is striking in the case of Asian countries, where more autocratic leadership styles are expected, as they are collectivist societies.

B. R&D Leader Behaviors

We found that the R&D leader behaviors received relatively surprisingly little empirical attention. Only two studies out of the 60 that emerged from the SLR proposed a list of behaviors and these were carried out in South Korea and India [49], [103]. There is a need to extend this empirical line of enquiry to other country contexts in order to deepen the understanding of leader behaviors in R&D in contrast to the cultural effects. Moreover, based on the social identity theory, an interesting future research avenue opens up, calling to further explore those R&D leader behaviors that may facilitate the inclusion process of R&D team members so that they would prioritize the collective interest [114].

C. R&D Leader Human Capital

This literature review has highlighted that even though it has been traditionally assumed that the leaders of the R&D context should have higher technical skills to obtain recognition within the team [55], they should also have some other knowledge,

skills, and abilities [6]. The relationship between administrative skills and team performance was found not to be significant [111], but the literature demonstrated that a certain amount of the time available for leaders in the R&D context is taken up with management and administrative tasks [121]. Therefore, there is a need to expand our current understanding of the HC required of individuals who are the leaders in the R&D context. There is also a need to further test this HC in a variety of organizational (public, nongovernmental, and private) and industry settings. To further bolster this research avenue, there is a need to have a better understanding of how R&D leaders acquire this specific HC before they take up an R&D leadership role as well as during their R&D leadership tenure.

There is an increasing scope to expand our limited understanding by addressing the future research lines through a new theoretical lens, for example, the theory of purposeful work behavior [122]. Based on this theory and related to task and social job characteristics performed in the team or project, an interesting future research line can be used to identify the R&D leader's HC that better fits to achieve the team or project's goals. The social influence theory might be another interesting theory to support future studies with the purpose of widening awareness of the leaders' HC in the R&D context [105]. This theory may be used for determining what HC the R&D leader of a team requires in order to overcome challenges, such as knowledge sharing, discussing topics or objectives within the team, team diversity, and dealing with conflict.

D. Two-Level Cluster of the Corpus of Emerged Themes

Most of the articles analyzed have as dependent or outcome variables the level of performance or the level of innovation of the R&D team. These variables have based the establishing of two clusters (see Appendix D). These clusters reflect leadership styles that have been treated, either as direct independent variables, as moderating variables, or as mediating ones in the works indicated in each of them. They also show whether these outcome variables have been associated, by any of these mechanisms, with the behaviors and human capital of the R&D leaders, or with R&D management practices. The coincidence of these factors in both clusters also provides useful knowledge for researchers analyzing ambidexterity in R&D teams, i.e., both exploitation or performance, and innovativeness. As an antecedent or driver of the latter, the creativity of R&D teams is the basis of the third cluster created. SL and TFL styles, R&D leader behaviors, and R&D leader human capital have been studied as variables in all three clusters, while LMX style has been studied in the creativity and innovation clusters. Among the studies contained in the creativity cluster, several have been found that, dealing with psychosocial issues, such as employee or team member satisfaction, team well-being, task ambiguity, task autonomy, work climate, team psychological safety, or team psychological capital have been reflected in all three clusters. In this way, our work also reflects studies that, in addition to outcome variables, address leadership factors that influence aspects necessary for decent and healthy work from a psychosocial point of view, which would contribute to compliance with UN Sustainable Development Goal-3 (Health and Well-Being) and

Sustainable Development Goal-8 (Decent Work and Economic Growth).

Creativity, innovation, and team performance are different terms [79], [82], [83], although they can sometimes be interconnected. There are cases in which the ideas generated by the team through their creativity end up becoming innovations. Prior studies assert that creativity is the seed from where innovation blossoms [79], [80], [81]. In turn, innovation in the team often leads to increased performance [133]. However, this relationship does not always hold true. Sometimes, an idea, as a product of creativity, ends up not generating an innovation. Some studies confirm that creativity can improve business performance through innovation indirectly [133], [134]. However, team creativity might be a necessary but insufficient factor to explain innovation [135], [136]. Creativity is the generation of original and qualified solutions to the problems that either exist or arise in organizations [137]. Creativity is an individual cognitive process. Nevertheless, it can be converted into a group process through the knowledge shared among the members of the team [136]. It is usually an ad hoc process. Innovation is the process through which this original and qualified solution becomes viable and is materialized in a product, service, or even a process [134], [135]. Innovation depends on organizational structures, organizational systems, organizational planning, and control. When these requirements are not adequate, a potentially brilliant creative idea may not become an innovation. On the other hand, there are innovations that do not originate from creativity. Very often, when decisions are taken in order to influence innovation and creativity at one level of the organization (individual, grouped, and organizational), these do not always have the same impact on the remaining levels. This is due to the complexity of both concepts and their multilevel nature [82].

E. Other Potential Research Avenues

Our study has also identified some other fruitful research avenues that can contribute to the current empirical and practice deficits. As such, we suggest some other potential research lines for scholars to address. For instance, different aspects of gender should be considered in future research avenues. Among the studies reviewed, the lowest percentage of men interviewed is 61% [57], [63], [85], [123], while most of the studies are over 80% [12], [54], [56], [59], [65]. This would suggest that there is an under-representation of women in leadership positions, in terms of parity. We, therefore, call for further research into the barriers that hinder women from attaining R&D leadership positions [124], [125]. Additionally, future research studies in leadership styles and R&D leaders could also consider a meta-analysis approach, requiring further efforts to obtain enough and adequate statistical data to implement it.

It is also striking that only a handful of studies included in this review have made the R&D leader their unit of analysis. Of them, two studies—[11] and [12]—used data only from R&D leaders. The former asked about the characteristics of an effective leader in R&D contexts, and the latter interviewed four different R&D team leaders. Yin et al. [102] based their conclusions about R&D leader's conflict management style exclusively on leaders'

responses, although team members were questioned on the other variables of the model proposed in the study (team innovation performance, team trust, and team psychological safety). Another two studies have inquired about both leaders and members of R&D teams in order to evaluate team leader's behavior [103] and leader's facilitative leadership [53]. In contrast, the rest of the studies only relied on one of the parties involved in the leadership relation in order to measure it; namely, the members of R&D teams. Therefore, in order to further our understanding of R&D leaders, additional future studies should be focused on them and examine such issues as their entrepreneurial behaviors, agency, boundary spanning activities, or entrepreneurial orientation. For this purpose, it would be interesting to undertake 360° studies of the R&D team.

There is also a need to examine the dark side of R&D leaders and leadership that draws on the growing body of literature [5], [126]. Destructive leadership is a theme of growing interest among leadership researchers [127]. Drawing on this growing literature can further develop our understanding of R&D leadership failures, behaviors, and actions in such circumstances. Moreover, we have a better understanding of the consequences and the different destructive leadership styles among R&D leaders as well as behaviors. Further research efforts on destructive leadership are warranted to understand the impact on followers and the organizational environmental conditions that would be conducive to behaviors. In this sense, potential lines of research could be oriented toward the dark side of entrepreneurial leaders, or focused on how to reconduct those leaders who are on the dark side and attract them to the bright side of the force. Moreover, further exploration of R&D autonomy and destructive leadership is necessary.

As highlighted in our review, there is a variety of terms used to describe the R&D leader. To address this, a relevant future research avenue is to undertake comparative studies to better understand the different configurations of R&D teams and leaders tasked with a variety of R&D task and activities, for example, R&D leadership of a team that is formed for a once off project or R&D leadership of various R&D teams in a large department that combine several research objectives at the same time and have the resources and people available on demand of each objective. More research is needed to clarify the leadership styles and behaviors that are needed, whether R&D project oriented or, if not, in what other formats is R&D performed?

As our study highlighted, there is limited research on the HC that R&D leaders require to be an effective leader. In this sense, future research needs to address what kind of knowledge, skills, or abilities they need? And what impact on their outcomes could acquiring such HC bring about? Similarly, it would be interesting to deepen the understanding of what skills or abilities are beneficial for achieving certain results versus which ones would be sufficient. Moreover and related to the existing debate in the literature [8], [49], [55], [111], [112], [113], several questions arise: is it preferable to select candidates for leadership positions in R&D contexts on the basis of their technical knowledge of the field and then provide them with adequate training in leadership skills? Or would it be more advisable to prioritize leading highly qualified people and base recruitment on these skills and abilities even at the expense of technical knowledge?

V. THEORETICAL AND MANAGERIAL IMPLICATIONS, AND CONCLUSION

With respect to the theoretical contribution to leadership literature, our study confirms and further extends the argument noted by Thamhain [52] that there is a lack of a clear conceptual approach of leadership theories in relation to R&D environment due to its complexity. Surprisingly, most of the articles comprising the corpus of the study did not apply any leadership theory on which to base their hypotheses on. Only one-third of the research clearly stated the theory of leadership style on which their study was based. Such a deficit constraints the potential contribution that their results could make to making theoretical advances to leadership theories. In extending Thamhain's [52] study, we have identified the leadership theories, their bibliographical references, and the studies in which they appear (see Appendix E), therefore providing future research with some basis to make future contributions to leadership theories. Specifically, our SLR demonstrates for R&D leadership in a knowledge-intensive environment addressing the challenges of leadership is critical. Actually, leadership in this type of environment heavily affects creativity among employees and innovation [87]. Therefore, it is strongly recommended to focus and concentrate more attention on establishing a better theoretical basis for the phenomena under study.

Our study has a number of managerial contributions. First, R&D managers need to be self-aware of the appropriateness of their leadership style for the R&D department or team that they lead. R&D leaders need to consider their own abilities in order to adapt their leadership style so that it supports different aspects of the R&D process, such as creativity, ideation, and knowledge sharing. R&D leaders also need to be mindful of the organizational culture as well as the wider cultural environment and adjust their leadership styles accordingly. Our review highlights the importance of essential knowledge, skills, and abilities of R&D leaders, such as problem solving, the ability to lead and to motivate teams, as well as some others to avoid, such as arrogance. To this end firms, managers recruiting R&D leaders need to put in place a robust and thorough recruitment process that engages and involves the R&D department and a variety of internal stakeholders so as to ensure that they have the essential characteristics for the role. For R&D professionals seeking to take up an R&D leadership role, our study highlights that they need to develop certain essential human capital, such as an ability to manage risk, to be proactive, and motivated. In this sense, they should create policies and practices that stimulate and complement the personal initiative of team members, providing them with greater autonomy through the allocation of the necessary resources [54]. Managers also need to be mindful of what professional development supports and opportunities they provide to the existing employees to prepare them for R&D leadership roles as a part of their talent management and succession planning strategies and processes. They should establish policies and training programs for R&D leaders, both in leadership skills and in the necessary specialized knowledge. In this way, they would be better accepted by the team members. It would also be appropriate for company managers to give these leaders the freedom to determine the structure of the work [51].

More importantly, our study reveals that certain strategies are more suitable than others depending on the objective. In this

sense, if the aim is to increase the performance of the R&D team, leadership styles that improve knowledge sharing, such as transformational and gate leadership styles, are usually appropriate [92], although these are not recommended in collectivist culture contexts. In such cases, SL is recommended instead [56], [59], [74], even for R&D virtual teams, although the leader must have previously created a climate of trust among its members that facilitates the sharing of knowledge [123]. Moreover, the development of an unofficial communication climate facilitates increased team performance, and this applies to a variety of leadership styles [39]. Additionally, if the aim is to increase the innovative capacity of the R&D team, then adopting a TFL is advisable when the team has a high innovative capacity [64]. However, the degree to which the TFL is applied has an influence because, if the leader trusts in the intellectual autonomy of the team members and in their specialized knowledge, at a higher level, it can demotivate the team [75]. In this context, when the team's experience is high, a large dose of social behavior on the part of the leader does not seem to be required in order to ensure the diversity within the team contributes to increased results [105]. Steering rather than managing would be recommendable or applying leadership styles, such as benevolent style [11], [41], [62]. They should give team members the opportunity to use their individual initiative [54]. It is recommended that they should lead the team through management by objectives, and delegate tasks and decisions to the most knowledgeable members of the team, although the leader should control the performance of these tasks [51]. It is even recommended that DL be followed [7]. On the other hand, it does not seem appropriate for the leader to use a leadership style that encourages differentiation among team members, as it would increase conflict in the team, which would affect their innovative capacity [5]. When the leader is under time pressure for the achievement of an innovative result in the team, it is recommended that he/she use team temporal leadership, as it achieves that effect by generating learning behavior in the team [128].

Finally, if the objective is to increase the creative capacity of the R&D team, then it is worth noting that the "Too-Much-of-a-Good-Thing" (TMGT) effect has been observed in the analyzed studies in relation to the parameters associated with the R&D team creativity. TMGT is the effect of certain antecedents of positive organizational psychology that occurs when an antecedent traditionally considered beneficial turns its effects into detrimental if it reaches an excessive level [129]. The team leader must keep this in mind. Thus, for example, in order to increase team creativity, the SL style would work, but only up to a certain point. If it reaches an excessive level, the effect would be the opposite, so the leader must analyze what the appropriate dose should be [86]. The same occurs if authoritarian leadership is applied: the lower the level of mindfulness of the team members, the less innovation will be obtained; and the same will occur when this exceeds a certain level [130]. Styles, such as LMX differentiation [10] or self-service style, do not seem advisable, as this would reduce the psychological security of the team and would induce the concealment of knowledge among its members, harming the team's creativity [89]. On a different note, our work also has practical implications for managers of companies where R&D is conducted. They could develop certain management practices in order to increase the positive or decrease the negative effects detected in the studies analyzed in this review. When there is

no participative, visionary, transformational, or EL style, it is recommended to design human resources management models that support knowledge-intensive teamwork in order to generate higher levels of knowledge acquisition and sharing among R&D team members [99]. Finally, psychosocial aspects can also be taken into account. Thus, when faced with self-service leaders, the company can implement practices to promote and stimulate the psychological capital of the R&D team members since this capital would reduce the negative effects of such leadership on the team's creativity [41]. If the detriment affects the leader, for example, due to family-work conflict, the company should implement clear organizational support to reduce this effect [61].

While appreciating our study found that there is limited research on R&D leader behaviors, our study does highlight the need for R&D leaders to carefully consider their behaviors and how this is perceived by the people they lead through fostering effective team collaboration, providing continuous feedback and developing a strong sense of team. Moreover, R&D leaders in adopting their behaviors need to be aware of the cultural context(s) and, more generally, how they engage with their team. Our study also unearths some wider implications for the R&D professional community. What are the optimal educational, mentorship, and professional experiences needed so that there is the breadth and depth of capable R&D professionals that have the requisite role characteristics and preparation in order to take on a variety of R&D leadership roles in any organizational setting? Given the demands of R&D leadership within existing R&D professional bodies and at organizational levels, there is a need to provide continual professional development opportunities for R&D leaders to reflect and learn with respect to their leadership styles and behaviors, so they are effective in their role. The ongoing challenge for profession bodies and organizations is to ensure that they are providing such professional opportunities that reflect the leadership challenges faced by R&D leader and are designed to offer practical approaches designed to enhance their effectiveness.

Our SLR is not without limitations. Our literature review was purposeful in terms of journal selection for inclusion in our study and this may have resulted in missing out on further articles if we had taken a different approach to selecting journals and or using other databases, such as EBSCO or ABI Inform. Although our search terms were broad, we do acknowledge that we have inadvertently not captured specific terms that may be further reflective of R&D environments. The fragmented nature of the information provided in the articles in our study means that we could not do an in-depth analysis by differentiating the studies by cultural backgrounds, hence a limitation to our study. Being able to do this, sufficient information and data would further enhance our analysis we respect to the divergent findings of the individual studies. Also, this constrained our ability to carry out more in-depth analysis regarding the relations among specific leadership styles, core constructs, and outcomes.

Finally, we hope that our SLR and posited research agenda inspires further scholars and studies. In this sense, for the purpose of future research that researchers may undertake following these proposed lines, we complement our study findings by indicating the different scales and criteria applied by the authors of the analyzed works for measuring the leadership styles that they used in their studies (see Appendix F).

APPENDIX A
SYSTEMATIC LITERATURE REVIEW PAPERS

Year	Author(s)	Research Question(s) or Research Objective(s)	Main results	Unit of analysis	Journal	Country	Research Design	Context
2019	Berger, Czakert, Leuteritz, and Leiva	How and when two contrasting leadership styles, TFL and passive-avoidant leadership, are related to employees' anxiety and thereby either promote or inhibit employees' well-being	Relationships between TFL as well as PAL on the one hand and anxiety on the other hand were fully mediated by role ambiguity and team climate for learning. Job autonomy moderated the quality of the leadership-job demand relationship for TFL and PAL.	All participants were a part of teams, mainly R&D teams (85.8%)	Frontiers in Psychology	Germany	Quantitative	High-tech or Chemical
2021	Castellano, Chandavimol, Khelladi, and Orhan	The research objective of this study is to analyze the effects of self and SL on the performance of virtual R&D teams	The results show that self-oriented leaders need potency and commitment to extract higher performance levels from virtual R&D teams. In addition, trust is a necessary construct to achieve shared leadership through self-leadership.	Virtual R&D Teams	Journal of Business Research	Cross countries	Quantitative	Mix
2020	Cavazotte and Paula	What is the influence of SL leadership on creativity and absorptive capacity in R&D teams? This study proposes that SL positively affects such team outcomes up to a certain point, but at very high levels could cause a loss of synergy and effectiveness, and therefore, the relationship will follow an inverted U-shaped curve	Results indicate that there is a curvilinear relationship between SL and external assessments of creativity, creativity and absorptive capacity in R&D teams. Although leadership shared among team members tends to favor creativity and realized absorptive capacity, at very high levels, it yielded less than optimal outcomes. Team creativity had a direct positive effect on the teams' ability to explore and transform knowledge.	R&D Teams	European Journal of Innovation Management	Brazil	Quantitative	High-tech or Chemical
2020	Chen, Wadei, Bai, and Liu	The research objective of this study is to examine the sequential mediating roles of psychological safety and creative process engagement between participative leadership on creativity	Results indicated that participative leadership is positively related to creative process engagement; psychological safety significantly mediates the relationship between participative leadership and creative process engagement; creative process engagement significantly mediates the relationship between psychological safety and employee creativity; psychological safety and creative process engagement sequentially mediates the relationship between participative leadership and creativity.	R&D Teams	Leadership and Organization Development Journal	China	Quantitative	Nonspecified
2016	Chuang, Jackson, and Jiang	What is the influence of HRMSs for knowledge-intensive teamwork on external team knowledge acquisition and internal team knowledge sharing? How does influence EL in the relationship between HRMS for knowledge-intensive teamwork and team knowledge acquisition and team knowledge sharing?	They found higher levels of team knowledge acquisition and team knowledge sharing for R&D teams working in firms with HRM systems designed to support knowledge-intensive teamwork. Their results also showed that strategically aligned HRM systems were most strongly associated with knowledge activities in the absence of an empowering team leader and for teams engaged in work that involved relatively less tacit knowledge.	R&D Teams	Journal of Management	Taiwan	Quantitative	High-tech or Chemical
2018	Chung and Li	What are the potential consequences of TFL on follower innovative behavior? What is the moderating effect of team learning on the relationship?	Multilevel analysis confirmed a nonlinear relationship (an inverted U shape) between the TFL of team leaders and innovative behavior of team members. It means innovative behavior was negatively related to excessive TFL and positively related to a modest level of the leadership. Statistical analysis confirmed the positive multilevel moderating effect of team learning	R&D Teams	Journal of Organizational Change Management	South Korea	Quantitative	Nonspecified
2020	Darawong	The research objective of this study is to investigate the impact of leadership styles on new product development and how product innovativeness of new product development projects moderates this impact	Results show that TFL has a significantly positive effect on new product success and NPD speed, whereas transactional leadership has a significantly negative effect on both outcomes. Furthermore, the positive impact of TFL on new product success for high innovativeness is stronger than for low innovativeness. In addition, the negative impact of transactional leadership on both new product success and speed for high innovativeness is stronger than for low innovativeness.	New Product Development Team	Asia Pacific Journal of Marketing and Logistics	Thailand	Quantitative	Manufacturing
2016	Denti and Hemlin	What is the link between quality LMX and individual innovation in R&D teams?	LMX leadership was associated with individual innovation through the personal initiative of team members. Organizational support moderated the relationship between LMX leadership and individual initiative. High organizational support strengthened the relationship.	R&D Teams	International Journal of Innovation Management	Sweden	Quantitative	High-tech or Chemical
2007	Dreyfus	The research objective of this research is to determine the competencies that predict highly effective performance in R&D managers	Nine variables were found to differentiate the two groups of managers. These were similar enough to collapse into two competencies: managing groups and interpersonal sensitivity. For the highly effective managers who demonstrated these two competencies, development of their capability began at young ages and prior to work experience. Effective and regular use of the two competencies occurred later in life and typically as a result of taking on leadership roles outside the work setting.	Research Centre	Journal of Management Development	USA	Qualitative	Research Centres
2022	Du, Lin, Cai, Sun, and Amoah	Whether, how and when does LMX differentiation influence team creativity?	LMX differentiation negatively influences team creativity. They also found that team behavioural integration mediates this relationship, and team emotional intelligence moderates the relationship between LMX differentiation and team behavioral integration.	R&D Teams	Frontiers in Psychology	China	Quantitative	High-tech or Chemical
2010	Eisenbeiß and Boerner	Is there a U-shaped relationship between transformational leadership and innovation of R&D teams?	We confirm a U-shaped relationship between TFL and R&D team innovation. Hence, R&D team innovation was high both under high and low levels of transformational leadership. In contrast, R&D team innovation was low under moderate levels of transformational leadership.	R&D Teams	Creativity and Innovation Management	Not specified	Quantitative	High-tech or Chemical

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Year	Author(s)	Research Question(s) or Research Objective(s)	Main results	Unit of analysis	Journal	Country	Research Design	Context
2021	Engelsberger, Cavanagh, Bartram, and Halvorsen	How does relational leadership enable open innovation among employees with multicultural skills?	The decision for participants to collaborate and source and share knowledge is motivated by individual reward (such as establishing network or long-lasting contacts), skill acquisition (such as learning or personal growth in decision making), and a sense of reciprocity and drive for group gain. The authors encourage greater human resource manager support for relational leadership and the development and use of multicultural skills to promote Knowledge Sourcing and Sharing.	R&D Teams	Personnel Review	Cross countries	Qualitative	High-tech or Chemical
2017	Gritz, Fufeld, and Carpenter	What are the skills and attributes required to achieve success in R&D management, where the organizational environment that is so vital for innovation is created? What is the relative importance of particular leadership skills and styles in R&D compared with other business units?	R&D leaders tend to excel at those attributes unique to R&D (technical insight, global awareness, and the ability to foster an innovative environment and culture). At the same time, however, R&D managers are seen as falling short on some people management skills, such as managing conflict and addressing incompetence. Perhaps most critically, R&D managers could benefit by developing their ability to relate to and engage effectively with upper management.	R&D Department and non-R&D Department	Research-Technology Management	USA	Quantitative	Nonspecified
2007	Grosse	What tasks should project leaders perform by themselves and what tasks should they delegate? What personal characteristics should they be endowed with and what kind of relationships should they have with their team?	A successful R&D project leader has the following profile: she/he should possess leadership qualities; in addition to the leadership functions, she/he should contribute to the project; she/he should lead by means of "management by objectives"; leave the decisions of the projects in which the employees have more of an understanding to the employees; continuously control the completion of the tasks; provide incentives for the project; and she/he should obtain acceptance as the project leader from the employees through commitment and specialized knowledge.	R&D Project	Creativity and Innovation Management	Germany	Mixed	Nonspecified
2017	Gumusluoglu, Karakitapoglu-Aigün, and Scandura	What is the influence of BL as a precedent for innovative behavior within and across teams?	Benevolent leaders foster innovative behavior within teams and our team-level results suggest that these leaders play an important role in enhancing teams' innovative behaviors across the boundaries. Contrary to the expectations of the social identity theory, our individual-level results point to positive effects of identification in predicting innovative behavior across teams.	R&D Teams	Journal of Leadership and Organizational Studies	Turkey	Quantitative	High-tech or Chemical
2013	Gupta and Singh	What are the leader behaviors that can enhance creativity of Indian R&D professionals?	Our research has found relationships between leaders' behaviors and creativity. A final list of 52 behavior items representing five behavior metacategories was generated that has high potential of promoting employee creativity. A set of contextual variables was identified that can moderate the impact of leadership on employee creativity.	R&D Teams	Management Research Review	India	Qualitative	High-tech or Chemical
2014	Gupta and Singh	What is the relationship among leadership, psychological capital, and employee creative performance behaviors in the Indian R&D context?	R&D leaders who display positive behaviors are more likely to aid the development of their subordinates' positive psychological capacities. Psychological capital fully mediates the relationship between leadership behaviors and creative performance behaviors.	R&D Teams	International Journal of Human Resource Management	India	Mixed	High-tech or Chemical
2015	Gupta and Singh	What is the relationship between leadership and creative performance behaviors? Does justice perceptions play a mediating role in this relationship in an R&D context?	The study found evidence for both direct and indirect relationships between leadership and creative performance behaviors. Justice perceptions partially mediate the relationship between leadership and creative performance behaviors. The study presents a process model of creativity linking leadership to creative performance behaviors through employee justice perceptions.	R&D Teams	Journal of Leadership and Organizational Studies	India	Mixed	High-tech or Chemical
2017	Gupta, Singh, and Bhattacharya	What is the process through which leadership affects innovative performance of R&D professionals? What is the mediating role of work engagement for the positive relationship between leadership and individual-level innovative performance in the context of R&D work?	The study found that leadership plays a role in encouraging employee innovative performance. The study reported direct positive relationships between leader behaviors and work engagement. Work engagement was, in turn, positively related to innovative performance.	R&D Teams	International Journal of Innovation Management	India	Quantitative	High-tech or Chemical
1998	Harris and Lambert	How can managers best help teams to be more effective and produce results that make a difference?	Focusing on senior managers (defined as those managers with multiple teams reporting to them), it lays out a framework for a new role vital to their effective support of R&D teams, and identifies the key management practices that comprise that role.	R&D Teams	Research-Technology Management	USA	Quantitative	High-tech or Chemical
2004	Hirst, Mann, Bain, Pirolo-Merlo, and Richver	Would be leader's learning of project leadership skills related to facilitative leadership, team reflexivity, and team performance? Would new and experienced leaders differ in the amount they learn from their current and recent experience as project managers, and in the strength of the relationship among their self-reported learning, facilitative leadership, and team reflexivity?	We found evidence of a significant impact of the leader's learning on subsequent facilitative leadership and team performance 8, and 12 months later, suggesting a lag between learning leadership skills and translating these skills into leadership behavior. We found that new leaders reported they were learning more than experienced leaders, and importantly, their learning had a stronger relationship with facilitative leadership.	R&D Project Teams	Leadership Quarterly	Australia	Quantitative	Mix
2006	Huang and Lin	The research objective of this study is to identify the variables that affect the innovation performance of R&D teams and to investigate the interactions between these variables	It is concluded that the style of the upper management team and the leadership of the R&D manager are the main forces that determine R&D management practice, but that the educational background, work experience, and expertise of R&D managers do not distinguish the level of discipline or the sophistication of R&D management practice. Some aspects of R&D management practice, for example, the generation and utilization of technical reports and the cultivation of professional knowledge, can be reinforced by office support and alliance. With adequate resource support, more sophisticated R&D management practice leads to better innovation performance as measured by the number of new products, patents, and technical reports.	R&D Teams	Industrial Management and Data Systems	Taiwan	Mixed	High-tech or Chemical

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Year	Author(s)	Research Question(s) or Research Objective(s)	Main results	Unit of analysis	Journal	Country	Research Design	Context
2012	Ishikawa	What are the effects of both the TFL and gatekeeping leadership styles of formal leaders on SL? What is the effect of SL on R&D team performance?	TFL has a negative effect on SL through the norm for maintaining consensus such that it positively influences the norm, which, in turn, negatively influences SL. Gatekeeping leadership has a direct as well as an indirect positive impact on SL through the norm for maintaining consensus such that it negatively influences the norm, which, in turn, negatively influences SL. SL leadership positively influences R&D team performance	R&D Teams	Asia Pacific Journal of Management	Japan	Quantitative	Manufacturing
2012	Ishikawa	Has TFL a positive or negative impact on Japanese R&D team performance through norms for maintaining consensus? Which leadership style is more effective in Japanese context among gatekeeping leadership and TFL?	This finding suggests that TFL may have a negative impact on team performance in not only Japanese settings but also other collectivistic country settings. TFL has a positive impact on internal and external communication. Gatekeeping leadership influenced R&D team performance through a combination of a positive influence on group communication and a negative, or tempering, influence on rigid consensus norms	R&D Teams	Asia Pacific Business Review	Japan	Quantitative	Manufacturing
2020	Jiang, Zhang, and Wang	How and when does leader family-to-work conflict influence team innovation?	Leader family-to-work conflict negatively affects team innovation via leader creative process engagement. Leader family-to-work conflict alleviates the negative effect of leader family-to-work conflict on leader creative process engagement. Leader perceived organizational support also weakens the negative effect of leader family-to-work conflict on team innovation via leader creative process engagement.	R&D Teams	IEEE Transactions on Engineering Management	China	Quantitative	High-tech or Chemical
2017	Keller	What are the individual characteristics that hallmark effective R&D project team leaders?	The present study provides some important evidence that effective project team leaders in R&D tend to have high involvement in their jobs, an innovative orientation, a low need for clarity, and high self-esteem.	R&D Project Teams	R&D Management	Not specified	Quantitative	High-tech or Chemical
2021	Kim and Song	How and what type of team diversity is related to team creativity in R&D organizations, incorporating conflict as a mediator and TFL as a moderator	The data confirmed that team diversity, particularly informational diversity, was positively associated with team creativity. However, the conflict did not show a significant mediating effect between team diversity and creativity. TFL had a negative moderating effect between informational diversity and task conflict in such a way that when TFL was high, teams with higher informational diversity showed lower task conflict between team members.	R&D Teams	Management Decision	South Korea	Quantitative	Research Centres
1999	Kim, Min, and Cha	What is the relationship between the role of R&D project leaders and their team performance?	The results reveal that R&D project leaders played five different roles in performing their jobs (strategic planner, team builder, gatekeeper, technical expert, and champion). All but the champion role of a leader is positively related to project team performance and this relationship between the role of leader and project team performance varies according to the characteristics of R&D project teams and their tasks.	R&D Project Teams	R&D Management	South Korea	Quantitative	High-tech or Chemical
2019	Lenka and Gupta	The research objective of this study is to develop a conceptual framework exploring innovation process in research and development units of organizations	Findings of the study reveal that members' proactive personality, emotional intelligence and trust enhance members' learning ability called task reflexivity. This learning is further promulgated with the intervention of team information-sharing process and support for innovation. Team creativity enhances innovation implementation in organizations. However, resonant leadership style of team leaders does not support task reflexivity.	R&D Teams	European Journal of Innovation Management	India	Quantitative	High-tech or Chemical
2020	Lin and Li	The research objective of this study is to investigate a novel contrasting effect in which team-level expertise diversity is positively associated with individual creativity, but individual-level expertise dissimilarity negatively affects individual creativity. It further investigates whether this divergent effect is moderated by employee social skills, which mitigate the negative effects of individual expertise dissimilarity, and by leader social behavior, which can weaken the positive effect of team expertise diversity.	It was found that team-level expertise diversity is positively associated with individual creativity and team creativity. The individual-level expertise dissimilarity is negatively associated with individual creativity. Furthermore, employee social skills and leader social behavior play different moderating roles: when individual social skills are high, the negative effect of individual expertise dissimilarity on individual creativity is weaker.	R&D Teams	Current Psychology	Taiwan	Quantitative	High-tech or Chemical
2016	Lin, Tsai, and Liu	The research objective of this study is to develop a research model based on social identity theory and emotion regulation research to evaluate the performance development of work teams in technology industry	The test results find that team performance is influenced by team identification which is affected by inclusive leadership and effort-respect mismatch. Besides, dysfunctional behavior is also influenced by inclusive leadership and effort-respect mismatch. However, the relationships between effort-respect mismatch and dysfunctional behavior and between inclusive leadership and team identification are moderated by negative affective tone, the relationship between dysfunctional behavior and team performance is moderated by resource adequacy.	R&D Teams	Technological Forecasting and Social Change	Taiwan	Quantitative	High-tech or Chemical
2013	Liu and DeFrank	How do the roles of TFL climate and human resources practices influence the relationship between self-interest and employees' intention to share knowledge from a multilevel perspective?	TFL climate increases the intention to share knowledge partially by mitigating the negative impact of self-interest. Furthermore, the results indicate that team-based job design and knowledge-sharing incentives (HR practices) moderate the relationship between self-interest and the intention to share knowledge.	R&D Teams	International Journal of Human Resource Management	Taiwan	Quantitative	Manufacturing

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Year	Author(s)	Research Question(s) or Research Objective(s)	Main results	Unit of analysis	Journal	Country	Research Design	Context
2011	Liu and Phillips	How do TFL climate influences employees' team identity and their intentions to share knowledge and how team knowledge-sharing intention, subsequently, influences team innovativeness?	Results indicated that TFL climate was related to employees' intention to share knowledge through team identity. At the group level, results supported the relationships between team knowledge-sharing intention and team innovativeness. The results also indicated that team knowledge-sharing intention mediated the relationship between TFL climate and team innovativeness	R&D teams	International Journal of Information Management	Taiwan	Quantitative	High-tech or Chemical
2021	Liu, Liu, and Zhang	What is the relationship between team temporal leadership and team innovation performance based on the conservation of resource theory? What is the mediation effect of team learning behaviour and the moderation effect of time pressure on this relationship?	Team temporal leadership has a positive effect on team learning behavior and team innovation performance. Team learning behavior plays a mediating role in the relationship between team temporal leadership and team innovation performance. Time pressure can moderate positively the relationship between team temporal leadership and team learning behavior.	R&D Teams	Frontiers in Psychology	China	Quantitative	High-tech or Chemical
1992	McDonough III and Barczak	What is the impact of the cognitive problem-solving orientations of both members of the team and the project leader when they work with more familiar or less familiar technologies on the speed of new product development?	Their results suggest that familiarity with the technology is less important than cognitive orientation on speed of development. Perhaps of more importance is that technological familiarity plays an important role in moderating the relationship between speed and the cognitive problem-solving orientation of both the team and the leader. They found that different cognitive problem-solving orientations for leaders and members are needed in different situations.	R&D Project	Journal of Product Innovation Management	Great Britain	Quantitative	High-tech or Chemical
1993	McDonough III and Pearson	What are the moderating effects of urgency as perceived by the project team on the relationship between project performance and technological uncertainty? What are the moderating effects of urgency as perceived by the project team on the relationship between project performance and project leader skills?	It was found that, for less urgent projects, a significant negative relationship was found between the project leader's technical skill and performance, while a positive relationship that approached significance was found between the leader's human relations skill and performance. For more urgent projects, a negative relationship that approached significance was found between the leader's human relations skill and performance. The administrative skill of the project leader apparently does not have an impact on the performance of either more or less urgent projects. We also found that for projects perceived as being less urgent, more effective project their skilled, but more adept at stimulating leaders were seen as being less technically. This human relations orientation team, and providing encouragement and recognition, to take on new and apparently is key in fostering the team's creativity and willingness unfamiliar technologies successfully.	R&D Project	Journal of High Technology Management Research	Great Britain	Quantitative	High-tech or Chemical
1991	Oh, Kim, and Lee	What are the relationships among leadership, leader-subordinate interpersonal communication and subordinate satisfaction, and project success in project teams with special emphasis on official and nonofficial communication patterns?	The major findings are: Consideration of leader behavior is positively related to official communication and to nonofficial communication, while initiating structure is positively related only to official communication. Official communication is positively associated with nonofficial communication for all leadership types other than Leadership Type III (high C, low S). Official communication is positively related to both supervision and work satisfaction of subordinates. Nonofficial communication is positively related to supervision satisfaction of subordinates for all leadership types other than Leadership Type III (high C, low S) and positively related to work satisfaction for high initiating structure and low initiating structure of leader behavior (Leadership Type II).	R&D Project Teams	Journal of Engineering and Technology Management	South Korea	Quantitative	Research Centres
2019	Othman, Saad, and Robani	The research objective of this study is to examine the impact of leadership styles, specifically on TFL and transactional leadership in R&D team performance of researchers in UniversitiTeknikal Malaysia Melaka. Furthermore, this study was to examine the impact of knowledge sharing on R&D team performance as mediating variables.	It was revealed from the study that while TFL style had a positive impact on R&D team performance, transactional leadership style also had a positive impact on R&D team performance. It was also revealed from the study that knowledge sharing has a significant and positive relationship with mediating both TFL and transactional leadership on R&D team performance. It is recommended that leaders demonstrate both transformational and transactional leadership styles as both styles complement each other and enhance team performance.	R&D teams	Humanities & Social Sciences Review	Malaysia	Quantitative	Research Centres
2013	Paulsen, Callan, Ayoko, and Saunders	How do transformational leaders influence R&D team outcomes around being more innovative? In particular, the study aims to focus on the role of group identification in mediating innovative outcomes	Results revealed that group identification and perceived support for creativity exerted equal independent effects in fully mediating the relationship between TFL and team innovation.	R&D Teams	Journal of Organizational Change Management	Australia	Quantitative	Research Centres
2009	Paulsen, Maldonado, Callan, and Ayoko	What are the effects of the charismatic dimension of the TFL on team processes and innovative outcomes in R&D teams?	Results reveal the importance of managers assuming a charismatic style of leadership to encourage innovation. Charismatic leaders promote team innovation by supporting a sense of team identity and commitment, and encourage team members to cooperate through the expression of ideas and participation in decisions.	R&D Teams	Journal of Organizational Change Management	Australia	Quantitative	Research Centres
2019	Peng, Wang, and Chen	Does SSL hinder team creativity?	SSL not only reduced team psychological safety, but also induced team knowledge hiding, both of which ultimately affected team creativity. The presence of high task interdependence buffered the destructive effect of SSL on team creativity via team psychological safety as well as the indirect effect via knowledge hiding.	R&D teams	Journal of Business Ethics	China	Quantitative	Mix

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Year	Author(s)	Research Question(s) or Research Objective(s)	Main results	Unit of analysis	Journal	Country	Research Design	Context
2002	Pirola-Merlo, Härtel, Mann and Hirst	How do leaders influence the impact of affective events on team climate and performance in R&D teams?	The results provide evidence that obstacles have a negative impact on team climate. However, leaders may counterbalance this effect by adopting more facilitative and transformational styles, thereby reducing the negative effect of obstacles on climate. There was and evidence of strong relations between team climate and performance. Additionally, it was found that team climate mediated the relation between leadership and team performance.	R&D Teams	Leadership Quarterly	Australia	Mixed	Mix
2012	Schneider, Erden, Widmer, Koch, Billy, and Krogh	The research objective of this study is to explain the concept of DL for the pharmaceutical research departments to show how DL provides an opportunity to address challenges and to suggest possible ways to improve productivity through balancing centralized and DL	The study identifies three leadership challenges faced by R&D teams that could be addressed by implementing DL.	R&D Teams	Drug-Discovery Today	Not specified	Qualitative	Nonspecified
2020	Schroeder and Baldegger	The research objective of this study is to examine the influence of the contextual factors of strategic, structural, and cultural orientation on the relations between EL and new product development performance in R&D. Additionally, a wide range of leadership behaviours with transformational and transactional leadership is taken into account in this study	The results confirmed the main effect of EL on new product development performance. Additionally, moderation analyses showed moderating effects on strategic and cultural orientation, while structural orientation had no moderating effect.	R&D Department	International Journal of Innovation Management	Cross countries	Quantitative	Manufacturing
2018	Smith, Haslam, and Nielsen	How does leadership emerge and evolve in dynamic and flexible organizations?	Findings show that in the context of various events that impacted on the team, leadership emerged through interactions, processes, and practices that were perceived by team members to develop and advance shared goals and shared identity. Leadership responses to uncertainty surrounding the project were generally legitimated by team members' background and expertise in relation to this shared identity, while a lack of perceived legitimacy also compromised leadership. However, they also suggest that the form and nature of leadership is hard to predict because it is heavily structured by specific identity-relevant practices and perceptions that arise in the context of unforeseeable events. Leadership emergence is a process of group identity construction rather than of leadership identity construction, as implied by DeRue and Ashford (2010). Indeed, more generally our findings indicate that leadership is a relational phenomenon rather than leader centric. And in this, it centers not so much on dyadic relationships between a potential leader and individual followers (e.g., as suggested by LMX theory; Graen and Uhl-Bien, 1995), as on shared understandings of a person's capacity to help the group as a whole overcome challenges and seize opportunities.	R&D Teams	Organization Studies	Cross countries	Qualitative	High-tech or Chemical
2020	Song and Gu	The research objective of this study is to investigate the relationship between exchange ideology and employee creativity based on the social exchange perspective. It also attempts to examine the mediating role of perceived SL and the moderating role of vertical moral leadership	Exchange ideology was negatively related to both perceived SL and employee creativity, and perceived SL mediated the relationship between exchange ideology and employee creativity. Moreover, we revealed that vertical moral leadership buffered the negative relationship between employee exchange ideology and perceived SL and also the indirect effect of exchange ideology on employee creativity via perceived SL.	R&D Teams	Management Decision	China	Quantitative	High-tech or Chemical
2014	Stock, Totzauer, and Zacharias	How do innovation-oriented leadership and HR practices affect cross-functional R&D cooperation and thus product program innovativeness? How do market-related dynamism and customer integration affect the relationships of innovation-oriented leadership and HR practices with cross-functional R&D cooperation?	Both innovation-oriented leadership and training and development are particularly important for cross-functional R&D cooperation, as are innovation-oriented rewards. At high levels of customer integration, innovation-oriented leadership and training and development are important for fostering cross-functional R&D cooperation.	R&D Department	Journal of Product Innovation Management	Not specified	Qualitative	High-tech or Chemical
2001	Stoker, Looise, Fisscher, and de Jong	The main research objective of this study is the functioning of R&D teams, the role of the team leader, and the characteristics of individual team members	Leadership is important for the effectiveness of self-managing teams, especially charismatic and consultative leadership styles. Leaders can become more effective if they adapt their style to certain individual characteristics of team members. Charisma style might well be relevant for R&D teams, especially if we are concerned with the leadership task of getting the team to achieve results within time and budget constraints. It is possible that a combination of consultative leadership and charisma might be the key to effective functioning of R&D teams.	R&D Teams	International Journal of Human Resource Management	Netherlands	Quantitative	Manufacturing
2003	Thamhain	What are the principal factors that influence innovation-based performance of R&D teams?	The results identify specific barriers and drivers to innovative team performance and provide insight into the type of an organizational environment and managerial leadership that is conducive to innovative R&D team performance. The data further suggest that many of the performance variables have their locus outside the R&D organization. Yet, managerial leadership style, both at the R&D team level and at senior management, has a significant impact on creativity that ultimately affects R&D performance.	R&D Project	R&D Management	Cross countries	Quantitative	High-tech or Chemical
2022	Wei and Tang	What is the influence of SL on ambidextrous competence in R&D teams?	"SL of R&D team has a significantly positive impact on ambidexterity" (p.1). Moreover, strategic learning partially mediates the influence of SL and ambidexterity.	R&D Teams	Technology Analysis and Strategic Management	China	Quantitative	High-tech or Chemical

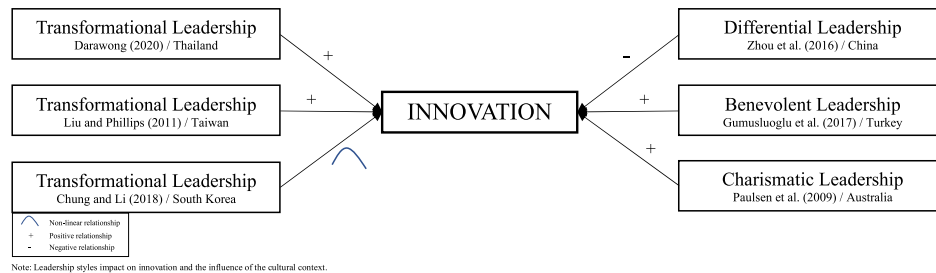
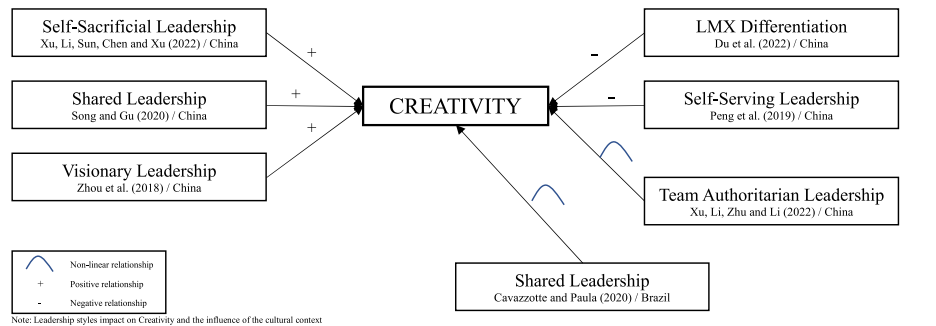
APPENDIX A
(CONTINUED)

Year	Author(s)	Research Question(s) or Research Objective(s)	Main results	Unit of analysis	Journal	Country	Research Design	Context
2018	Witzeman, Henderson, Welling, and Cosner	The environment in which industrial R&D operates is continually evolving. Within the enduring elements of R&D leadership—management of staff and content creation and dissemination, among others—significant changes in practice are emerging or can be expected to emerge over the next few years. These changes, their impact on R&D leadership, and a vision of what R&D leadership will need to be in the future are the focus of this article.	Implementing the Opportunity Thinking Vision Process with a large group of R&D leaders led to a vision of R&D leadership in the future.		Research-Technology Management	USA	Qualitative	High-tech or Chemical
2022	Xu, Li, Sun, Chen, and Xu	What is the influence of SSAL on employee creativity? What is the mediating role of employees' creative process engagement and shared vision in this relationship? How is the multilevel moderating role shared vision in this relationship?	"SSAL exerted a significantly positive impact on employee creativity, employees' creative process engagement, and shared vision, whereas employees' creative process engagement and shared vision mediated the relationship between SSAL and employee creativity, respectively. Moreover, shared vision significantly moderated the relationship between employees' creative process engagement and employee creativity such that the higher the shared vision, the stronger the relationship between employees' creative process engagement and employee creativity." (p. 2256)	R&D Teams	Management Decision	China	Quantitative	High-tech or Chemical
2022	Xu, Li, Zhu, and Li	Is team authoritarian leadership positively or negatively related to creative deviance?	They demonstrated that an inverted-U relationship between team authoritarian leadership and creative deviance holds up R&D teams.	R&D Teams	Frontiers in Psychology	China	Quantitative	High-tech or Chemical
2022	Yin, Qu, Li, and Liao	What is the impact of the team leader's conflict management style on team innovation performance in remote R&D teams?	"Team leader's cooperative conflict management style is conducive to enhancing team psychological safety and further effectively improves team innovation performance." (p. 1)	R&D Teams	Sustainability (Switzerland)	China	Quantitative	Nonspecified
2010	Zheng, Khoury, and Grobmeier	How do leadership and context matter in R&D team innovation?	The four teams demonstrated similar leadership characteristics as well as differences. The common theme of leadership is a dual focus on the internal and external domains of the team. The internal aspect involves steering rather than managing, a hands-off approach, and individual consideration; the external aspect involves buffering and rain making. At the same time, however, the intensity and demonstration of the SL characteristics were found to differ along three dimensions: funding model, nature of tasks, and team structure.	R&D Teams	Human Resource Development International	USA	Qualitative	High-tech or Chemical
2022	Zhou, He, and Jiang	What is the relationship between knowledge inertia and R&D team creativity? What is the mediating effect of cognitive conflict with direct and moderating effect of intentional unlearning capability to find out how to improve R&D team creativity for sustainable innovation from the perspective of coping with knowledge inertia?	"Knowledge inertia cannot only decrease R&D team creativity directly but also decrease it by reducing the level of cognitive conflicts among the R&D team members, causing serious damage to R&D team creativity." (p. 1) "Intentional unlearning capability can help the R&D team reduce knowledge inertia directly and moderated the negative relationship between knowledge inertia and R&D team creativity, which was when intentional unlearning capability was high, the negative relationship between knowledge inertia and R&D team creativity would be weakened, and when it was low, the relationship would be strengthened, thus further verifying the important role of intentional unlearning capability in reducing the negative impact of knowledge inertia on R&D team creativity for sustainable innovation." (p. 1)	R&D Teams	Mathematical Problems in Engineering	China	Quantitative	High-tech or Chemical
2019	Zhou, Li, Liu, Tian, Zhang, and Qin	The research objective of this study is to investigate the mediating effect of information search efforts on the relationship between leader narcissism and team creativity	This article found that leader narcissism had a positive impact on team information search effort, thereby promoting team creativity, and the effect of leader narcissism on team information search effort is more positive in the context of high participation in decision making.	R&D teams	Leadership and Organization Development Journal	China	Quantitative	High-tech or Chemical
2016	Zhou, Liu, Tian, Zhang, and Chen	What is the impact of native Chinese R&D team directors' differential leadership on team performance? So as to understand whether and how the directors' differential leadership impacts team conflict, whether and how team conflict impacts new product development performance of the R&D team, and whether team conflict plays full mediation on the relationship between directors' differential leadership and new product development performance	The team director's differential leadership would cause significant team relationship conflict and team task conflict in the R&D team. Team relationship conflict and team task conflict would produce significantly bad new product development performance in the R&D team. Team relationship conflict would significantly mediate the relationship between the team director's differential leadership and the team's new product development performance.	R&D Teams	Chinese Management Studies	China	Quantitative	High-tech or Chemical
2018	Zhou, Zhao, Tian, Zhang, and Che	The research objective of this study is to explore how VL influences employees' creativity in R&D teams in China, and the role of employee knowledge sharing and goal orientation	VL is positively associated with employee creativity in Chinese organizations and the relationship is positively mediated by employee knowledge sharing. Furthermore, employee "learning goal" orientation strengthens the relationship between VL and employee knowledge sharing, whereas employee "performance-avoid goal" orientation weakens the relationship between VL and employee knowledge sharing.	R&D Teams	International Journal of Manpower	China	Quantitative	High-tech or Chemical
2016	Zhu and Chen	What are the influences group-focused EL and differentiated individual-focused EL on the R&D team's processes and team effectiveness?	We found that group-focused EL is strongly related to intrateam collaboration, which in turn is positively related to both team innovativeness and performance. Differentiated individual-focused EL, however, is positively related to intrateam competition.	R&D Teams	R&D Management	Taiwan	Quantitative	High-tech or Chemical

APPENDIX B
JOURNALS COMPILATION

Journal Title	Papers Selected	Journal Title	Papers Selected
Asia Pacific Business Review	1	Journal of Engineering and Technology Management	1
Asia Pacific Journal of Management	1	Journal of Leadership and Organizational Studies	2
Asia Pacific Journal of Marketing and Logistics	1	Journal of Management	1
Chinese Management Studies	1	Journal of Management Development	1
Creativity and Innovation Management	2	Journal of Organizational Change Management	3
Current Psychology	1	Journal of Product Innovation Management	2
Drug Discovery Today	1	Leadership and Organization Development Journal	2
European Journal of Innovation Management	2	Leadership Quarterly	2
Frontiers in Psychology	4	Management Decision	3
Human Resource Development International	1	Management Research Review	1
Humanities and Social Sciences Reviews	1	Mathematical Problems in Engineering	1
IEEE Transactions on Engineering Management	1	Organization Studies	1
Industrial Management and Data Systems	1	Personnel Review	1
International Journal of Human Resource Management	3	R&D Management	4
International Journal of Information Management	1	Research-Technology Management	3
International Journal of Innovation Management	3	Sustainability (Switzerland)	1
International Journal of Manpower	1	Technology Analysis and Strategic Management	1
Journal of Business Ethics	1	Technological Forecasting and Social Change	1
Journal of Business Research	1	The Journal of High Technology Management Research	1

APPENDIX C
LEADERSHIP STYLE'S IMPACT ON CREATIVITY AND INNOVATION AND THE CULTURAL CONTEXT INFLUENCE



APPENDIX D
TWO-LEVEL CLUSTER OF THE CORPUS OF EMERGED THEMES

PERFORMANCE	Pirola-Merlo et al (2002) Hirst et al (2004)	FACILITATIVE LEADERSHIP	
	Schneider (2012) (and Balancing Centralized Leadership)	DISTRIBUTED LEADERSHIP	
	Ishikawa (2012a) Ishikawa (2012b)	GATEKEEPING LEADERSHIP	
	Lin, Tsai and Liu (2016)	INCLUSIVE LEADERSHIP	
	Stoker et al (2001) (and Consultative Leadership)	CHARISMATIC LEADERSHIP	Paulsen et al. (2009)
	Castellano et al. (2021) Wei and Tang (2022)	SHARED LEADERSHIP	Wei and Tang (2022)
	Harris and Lambert (1998) Kim, Min and Cha (1999)	LEADER'S ROLES	Witzeman et al (2018)
	Harris and Lambert (1998) Pirola-Merlo et al (2002) Ishikawa (2012a) Ishikawa (2012b) Othman, Saad and Robani (2019)	TRANSFORMATIONAL LEADERSHIP	Eisenbeiß and Boerner (2010) Liu and Phillips (2011) Paulsen et al (2013) Chung and Li (2018) Darawong (2020)
	Othman, Saad and Robani (2019)	TRANSACTIONAL LEADERSHIP	Darawong (2020)
	Oh, Kim and Lee (1991) Pirola-Merlo et al (2002)	R&D LEADER BEHAVIOURS	Gupta, Singh and Bhattacharya (2017) Zhou et al (2019) Jiang, Zhang and Wang (2020)
	McDonough III and Barczak (1992) Dreyfus (2007)	R&D LEADER HUMAN CAPITAL	Stoker et al (2001) Zheng, Khoury and Grobmeier (2010) Keller (2017) Gritzo, Fusfeld and Carpenter (2017) Witzeman et al (2018)
	Zhou et al (2016)	DIFFERENTIAL LEADERSHIP	Zhou et al (2016)
	Zhu and Chen (2016) (group-focused and differentiated individual-focused EL)	EMPOWERING LEADERSHIP	Chuang, Jackson and Jiang (2016) Zhu and Chen (2016) (group-focused and differentiated individual-focused EL) Schroeder and Baldegger (2020)
	Harris and Lambert (1998)	R&D MANAGEMENT PRACTICES	Huang and Lin (2006) Smith, Haslam and Nielsen (2018) Yin et al. (2022) Stock, Totzauer and Zacharias (2014)
		TEAM TEMPORAL LEADERSHIP	Liu et al. (2021)
		BENEVOLENT LEADERSHIP	Gumusluoglu, Karakitapoglu-Aigün and Scandura (2017)
	LEADER-MEMBER EXCHANGE LEADERSHIP	Denti and Hemlin (2016)	
	INNOVATION-ORIENTED LEADERSHIP (and innovation-oriented HR Practices)	Stock, Totzauer and Zacharias (2014)	
	RELATIONAL LEADERSHIP	Engelsberger et al. (2021)	
	MANAGERIAL LEADERSHIP	Thamhain (2003)	
		INNOVATION	

Note: Clusters of leadership styles, R&D leader behaviors, R&D leader human capital, and R&D management practices by the outcome variables performance and innovation.

APPENDIX D
(CONTINUED)

SHARED LEADERSHIP	Cavazotte and Paula (2020) Song and Gu (2020)	CREATIVITY
LEADER-MEMBER EXCHANGE LEADERSHIP	Du et al. (2022)	
SELF-SACRIFICIAL LEADERSHIP	Xu, Li, Sun, Chen and Xu (2022)	
VISIONARY LEADERSHIP	Zhou et al (2018)	
MORAL LEADERSHIP	Song and Gu (2020)	
R&D LEADER HUMAN CAPITAL	McDonough III and Pearson (1993) Zhou et al. (2022)	
MANAGERIAL LEADERSHIP	Thamhain (2003)	
R&D LEADER BEHAVIOURS	Gupta and Singh (2013) Gupta and Singh (2014) Gupta and Singh (2015)	
SELF-SERVING LEADERSHIP	Peng, Wang and Chen (2019)	
TRANSFORMATIONAL LEADERSHIP	Berger et al. (2019) (and Passive-Avoidant transformational leadership) Kim and Song (2020)	
PARTICIPATIVE LEADERSHIP	Stock, Totzauer and Zacharias (2014)	
TEAM AUTHORITARIAN LEADERSHIP	Xu, Li, Zhu and Li (2022)	

Note: Cluster of leadership styles, R&D leader behaviors, R&D leader human capital, and R&D management practices by the outcome variable creativity.

APPENDIX E
SYSTEMATIC LITERATURE REVIEW SAMPLE OF LEADERSHIP THEORIES UTILIZED IN THEIR STUDIES

Theories	References	Author(s) and year of the articles from the SLR
Behavioral theory of leadership	G. Yukl, A. Gordon, and T. Taber, "A hierarchical taxonomy of leadership behavior: Integrating a half century of behavior research," <i>J. Leadership Org. Stud.</i> , vol. 9, no. 1, pp.15–32, 2002. G. Yukl, <i>Leadership in Organizations</i> , 6th ed. New Delhi: Pearson Education, 2008.	V. Gupta, S. Singh, and A. Bhattacharya (2017)
Charismatic leadership theory	W. Gardner and B. Avolio, "The charismatic relationship: A dramaturgical perspective," <i>Acad. Manage. Rev.</i> , vol. 23, pp. 32–58, 1998. Y. Berson and J. Linton, "An examination of the relationship style, quality and employee satisfaction in R&D versus administrative environments," <i>R&D Manage.</i> , vol. 35, pp. 51–60, 2005. J. Conger and R. N. Kanungo, "Charismatic leadership in organizations: perceived behavioral attributes and their measurement," <i>J. Org. Behav.</i> , vol. 15, no. 5, pp. 439–452, 1994.	D. Grosse (2007) L. Zhou, S. Zhao, F. Tian, X. Zhang, and S. Chen (2018)
Contextual leadership theory	R. N. Osborn, J. G. Hunt, and L. R. Jauch, "Toward a contextual theory of leadership," <i>Leadership Quart.</i> , vol. 13, pp. 797–837, 2002.	W. Zheng, A. E. Khoury, and C. Grobmeier (2010)
Contingent leadership theory	F. E. Fiedler, "Validation and extension of the contingency model of leadership effectiveness: A review of empirical findings," <i>Psychol. Bull.</i> , vol. 76, pp. 128–48, 1971.	W. Zheng, A. E. Khoury, and C. Grobmeier (2010)
Differential leadership theory	X. Zheng, "Difference structure and Chinese organizational behavior", <i>Indigenous Psychol. Res. Chin. Soc.</i> , vol. 3, no. 1, pp. 142–219, 1995.	J. Zhou, S. Liu, X. Zhang, and M. Chen (2016)
Laissez-faire style under the label of passive-avoidant leadership	K. Heinitz, D. Liepmann, and J. Felfe, "Examining the factor structure of the MLQ: Recommendation for a reduced set of factors," <i>Eur. J. Psychol. Assess.</i> , vol. 21, pp. 182–190, 2005.	R. Berger, J. P. Czakert, J. P. Leuteritz, and D. Leiva (2019)
Leader-member exchange theory	G. B. Graen and M. Uhl-Bien, "Relationship-based approach to leadership: Development of leader-member exchange (LMX) theory of leadership over 25 years—Applying a multi-level multi-domain perspective," <i>Leadership Quart.</i> , vol. 6, no. 2, pp. 219–247. G. B. Gerstner and D. V. Day, "Meta-analytic review of leader-member exchange theory: Correlates and construct issues," <i>J. Appl. Psychol.</i> , vol. 82, pp. 827–844, 1997. G. B. Gerstner and D. V. Day, "Meta-analytic review of leader-member exchange theory: Correlates and construct issues," <i>J. Appl. Psychol.</i> , vol. 82, pp. 827–844, 1997. G. B. Graen and M. Uhl-Bien, "Relationship-based approach to leadership: Development of leader-member exchange (LMX) theory of leadership over 25 years—Applying a multi-level multi-domain perspective," <i>Leadership Quart.</i> , vol. 6, no. 2, pp. 219–247.	L. Denti and S. Hemlin (2016) J. Du, X. Lin, Y. Cai, F. Sun, and J. Amankwah-Amoah (2022) L. Gritzso, A. Fufeld, and D. Carpenter (2017)
Nurturant-task-participative model of leadership	J. B. P. Sinha, <i>Culture and Organizational Behavior</i> . New Delhi, India, Sage, 2008. P. Singh, "Nurturant task and participative task leaderships: The effective leader behaviours for Indian industries," <i>Indian J. Ind. Relat.</i> , vol. 23, pp. 197–209, 1987. J. B. P. Sinha, <i>Culture and Organizational Behavior</i> . New Delhi, India, Sage, 2008.	V. Gupta and S. Singh (2013) V. Gupta and S. Singh (2015)

APPENDIX E
(CONTINUED)

Theories	References	Author(s) and year of the articles from the SLR
Path goal theory of leadership	R. J. House and T. R. Michell, "Path-goal theory of leadership effectiveness," <i>Admin. Sci. Quart.</i> , vol. 16, no. 3, pp. 321–332, 1971.	C. Darawong (2020)
	R. J. House and T. R. Michell, "Path-goal theory of leadership," <i>J. Contemp. Bus.</i> , vol. 5, pp. 81–94, 1974.	
Relational leadership theory	R. J. House, "A path-global theory of leader effectiveness," <i>Admin. Sci. Quart.</i> , vol. 16, pp. 321–338, 1971.	V. Gupta and S. Singh (2015)
	R. J. House, "A path-global theory of leader effectiveness," <i>Admin. Sci. Quart.</i> , vol. 16, pp. 321–338, 1971.	
Self-sacrificial leadership theory	R. J. House and T. R. Michell, "Path-goal theory of leadership effectiveness," <i>Admin. Sci. Quart.</i> , vol. 16, no. 3, pp. 321–332, 1971.	K. Oh, Y. B. Kim, and J. Lee (1991)
	M. Uhl-Bien, "Relational leadership theory: Exploring the social processes of leadership and organizing," <i>Leadership Quart.</i> , vol. 17, no. 6, pp. 654–676, 2006.	
Shared leadership theory	Y. Choi and R. R. Mai-Dalton, "The model of followers' responses to self-sacrificial leadership: an empirical test," <i>Leadership Quart.</i> , vol. 10, no. 3, pp. 397–421, 1999.	Z. Xu, X. Li, X. Sun, M. Cheng, and J. Xu (2022)
	N. Sivasubramaniam, W. D. Murry, B. J. Avolio, and D. I. Jung, "A longitudinal model of the effects of team leadership and group potency on group performance," <i>Group Org. Manage.</i> , vol. 27, pp. 66–96, 2002.	
Situational leadership theory	C. L. Pearce and C. C. Manz, "The new silver bullets of leadership: The importance of self- and shared leadership in knowledge work," <i>Org. Dyn.</i> , vol. 34, no. 2, pp. 130–140, 2005.	F. S. C. N. Cavazotte and D. d. O. Paula (2021)
	P. Hersey and K. H. Blanchard, "Life-cycle theory of leadership," <i>Training and Development Journal</i> , vol. 23, pp. 26–34, 1969.	
Social identification theory of leadership	P. Hersey and K. H. Blanchard, "Life-cycle theory of leadership," <i>Training and Development Journal</i> , vol. 23, pp. 26–34, 1969.	V. Gupta and S. Singh (2015)
	J. B. Wu, A. S. Tsui, and A. J. Kinicki, "Consequences of differentiated leadership in groups," <i>Acad. Manage. J.</i> , vol. 53, no. 1, pp. 90–106, 2010.	
The full range leadership	M. A. Hoog, "A social identity theory of leadership," <i>Pers. Soc. Psychol. Rev.</i> , vol. 5, pp. 184–200, 2001.	D. Grosse (2007)
	S. A. Haslam, <i>Psychology in Organizations</i> . London, U.K., Sage, 2001.	
Transactional leadership theory	B. M. Bass, <i>Leadership: Good, Better, Best—Organizational Dynamics</i> . New York, NY, USA: Academy of Leadership, 1985.	F. S. Othman, M. S. M. Saad, and A. Robani (2019)
	J. M. Burns, <i>Leadership</i> . New York, NY, USA: Harper & Row, 1978.	
Transformational leadership theory	B. M. Bass, <i>Transformational Leadership: Industry, Military, and Educational Impact</i> . Mahwah, NJ, USA: Lawrence Erlbaum, 1998.	L. Zhou, S. Zhao, F. Tian, X. Zhang, and S. Chen (2018)
	B. M. Bass, <i>Leadership and Performance Beyond Expectations</i> . New York, NY, USA: Free Press, 1985.	
	B. J. Avolio, "Total quality and leadership," in Bass, B. M. and Avolio, B. J. (Eds.), <i>Improving Organizational Effectiveness Through Transformational Leadership</i> . Thousand Oaks, CA, USA: Sage, 1994, pp. 121–145.	N. Paulsen, V. J. Callan, O. Ayoko, and D. Saunders (2013)
	B. J. Avolio, "Leadership development in balance: Made/Born", Lawrence Erlbaum Associates, Mahwah, NJ, USA, 2005.	

APPENDIX F
SYSTEMATIC LITERATURE REVIEW SAMPLE OF SCALES FOR MEASURING LEADERSHIP STYLES

Author(s) and Year of the articles from the SLR	How these authors measure leadership style applied in their studies	Scales References
R. Berger, J. P. Czakert, J. P. Leuteritz, and D. Leiva (2019)	Transformational leadership style was measured by the full-range leadership model (Bass, 1985). Passive-avoidant leadership style was measured by the multifactor leadership questionnaire MLQ-5X-short (Avolio and Bass, 2004).	B. M. Bass, <i>Leadership and Performance BEYOND Expectations</i> . New York, NY, USA: Free Press, 1985 B. J. Avolio and B. M. Bass, <i>Multifactor Leadership Questionnaire</i> . Manual and Sampler Set, 3rd Ed. Redwood City, Mindgarden, 2004.
S. Castellano, K. Chandavimol, I. Khelladi, and M. A. Orhan (2021)	Self-leadership style was measured by Houghton and Neck (2002) scale. Shared leadership style was measured by Avolio et al. (2003) scale.	J. D. Houghton and C. P. Neck, "The revised self-leadership questionnaire: Testing a hierarchical factor structure for self-leadership," <i>J. Manage. Psychol.</i> , vol. 17, no. 8, pp. 672–691, 2002. Avolio, B. J., Sivasubramaniam, N., Murry, W. D., Jung, D., and Garger, J. W. (2003), "Assessing shared leadership: Development and preliminary validation of a team multifactor leadership questionnaire," in Pearce, C.L. and Conger, J. A. (Eds.), <i>Shared Leadership. Reframing the Hows and Whys of Leadership</i> , Sage Publications, Thousand Oaks, CA, 143–172.
F. S. C. N. Cavazotte and D. d. O. Paula (2021)	Shared leadership style was measured by four of the six subscales in the questionnaire of measures of shared leadership (Pearce and Sims, 2002): encouragement, definition of participatory goals, encouragement of independent actions, and encouragement for opportunities.	C. L. Pearce and H. P. Sims, "Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational, and empowering leader behaviors," <i>Group Dyn.-Theory Res. Pract.</i> , vol. 6, no. 2, pp. 172–197, 2002.
L. Chen, K. A. Wade, S. Bai, and J. Liu (2020)	Participative leadership style was measured using a six-item scale developed by Arnold et al. (2000).	J. Arnold, S. Arad, J. Rhoades, and F. Drasgow, "The empowering leadership questionnaire: The construction and validation of a new scale for measuring leader behaviors," <i>J. Org. Behav.</i> , vol. 21, no. 3, pp. 249–269, 2000.
C. H. Chuang, S. E. Jackson, and Y. Jiang (2016)	Empowering leadership style was measured by Arnold et al. (2000) and Srivastava et al. (2006) scales.	J. Arnold, S. Arad, J. Rhoades, and F. Drasgow, "The empowering leadership questionnaire: The construction and validation of a new scale for measuring leader behaviors," <i>J. Org. Behav.</i> , vol. 21, no. 3, pp. 249–269, 2000. A. Srivastava, K. M. Bartol, and E. A. Locke, "Empowering leadership in management teams: Effects on knowledge sharing, efficacy, and performance," <i>Acad. Manage. J.</i> , vol. 49, pp. 1239–1251, 2006.
D. S. Chung and J. M. Li (2018)	Transformational leadership style was measured by Bycio et al. (1995) scale.	P. Bycio, R. D. Hackett, and J. S. Allen, "Further assessments of Bass's (1985) conceptualization of transactional and transformational leadership," <i>J. Appl. Psychol.</i> , vol. 80, no. 4, pp. 468–478, 1995.
C. Darawong (2020)	Transformational leadership style (Bass, 1990). Transactional leadership style (Hartog et al., 1997).	B. M. Bass, <i>Bass and Stogdill's Handbook of Leadership: Theory, Research and Managerial Applications</i> . Free Press, New York, NY, 1990. D. N. D. Hartog, J. J. V. Muijen, and P. L. Koopman, "Transactional versus transformational leadership: An analysis of the MLQ," <i>J. Occup. Org. Psychol.</i> , vol. 70, no. 1, pp. 19–34, 1997.
L. Denti and S. Hemlin (2016)	Leader-member exchange leadership style was measured using the four-dimensional, 12-item leader-member exchange measure developed by Liden and Maslyn (1998).	R. C. Liden and J. M. Maslyn, "Multidimensionality of leader-member exchange: An empirical assessment through scale development," <i>J. Manage.</i> , vol. 24, no. 1, pp. 43–72, 1998.
J. Du, X. Lin, Y. Cai, F. Sun, and J. Amankwah-Amoah (2022)	Leader-member exchange leadership style was measured using the seven-item scale developed by Wang et al. (2005).	H. Wang, K. S. Law, R. D. Hackett, D. Wang, and Z. X. Chen, "Leader-member exchange as a mediator of the relationship between TFL and followers' performance and organizational and followers' performance and organizational citizenship behavior," <i>Acad. Manage. J.</i> , vol. 48, no. 3, pp. 420–432, 2005.
S. A. Eisenbeiß and S. Boerner (2010)	Transformational leadership style was measured using a 20-item scale from the multifactor leadership questionnaire developed by Bass and Avolio (1995).	B. M. Bass and B. J. Avolio, <i>MLQ Multifactor Leadership Questionnaire</i> , Technical Report. Redwood City, CA, USA: Mind Garden, 1995.
L. Gumusluoglu, Z. Karakitapoğlu-Aygün and T. A. Scandura (2017)	Benevolent leadership style was measured using eight items from Aycan (2006) and Aycan et al. (2013) scales.	Z. Aycan, "Paternalism: Towards conceptual refinement and operationalization," in U. Kim, K. Yang, and K. K. Hwang (Eds.), <i>Indigenous and Cultural Psychology: Understanding People in Context</i> . New York, NY, USA: Springer, 2006, pp. 445–466. Z. Aycan, B. Schyns, J. M. Sun, J. Felfe, and N. Sabher, "Convergence and divergence of paternalistic leadership: A cross-cultural investigation of prototypes," <i>J. Int. Bus. Stud.</i> , vol. 44, pp. 962–969, 2013.
G. Hirst, L. Mann, P. Bain, A. Pirola-Merlo, and A. Richver (2004)	They measure facilitative leadership style with these three items: ensuring all team members have the opportunity to express their ideas and opinions, acting to ensure that conflicts are not adversely affecting the team or its members and engaging in activities to build relationships within the team.	

APPENDIX F
(CONTINUED)

Author(s) and Year of the articles from the SLR	How these authors measure leadership style applied in their studies	Scales References
J. Ishikawa (2012a)	Transformational leadership style was measured by 20 items adapted from Bass's multifactor leadership questionnaire form 5X (Bass and Avolio, 2004). Gatekeeping leadership style was measured by five items adapted from Hirst and Mann (2004).	B. M. Bass and B. J. Avolio, <i>Multifactor Leadership Questionnaire – Form 5x – Short</i> , 3rd ed. Menlo Park, CA, USA: Mind Garden, 2004. G. Hirst and L. Mann, "A model of R&D leadership and team communication: The relationship with project performance," <i>R&D Manage.</i> , vol. 34, no. 2, pp. 47–160, 2004.
J. Ishikawa (2012b)	Transformational leadership style was measured by 20 items adapted from Bass's multifactor leadership questionnaire form 5X (Bass and Avolio, 2004). Gatekeeping leadership style was measured by five items adapted from Hirst and Mann (2004).	B. M. Bass and B. J. Avolio, <i>Multifactor Leadership Questionnaire – Form 5x – Short</i> , 3rd ed. Menlo Park, CA, USA: Mind Garden, 2004. G. Hirst and L. Mann, "A model of R&D leadership and team communication: The relationship with project performance," <i>R&D Manage.</i> , vol. 34, no. 2, pp. 47–160, 2004.
J. Kim and C. Song (2020)	Transformational leadership style was measured by Bass and Avolio (1994) scale.	B. M. Bass and B. J. Avolio, <i>Improving Organizational Effectiveness Through Transformational Leadership</i> . Thousand Oaks, CA, USA: Sage, 1994.
U. Lenka and M. Gupta (2019)	Resonant leadership style was measured by asking the team members' questions on certain variables, such as vision, compassion, and positive mood (Boyatzis et al., 2013; Goleman et al., 2002).	R. E. Boyatzis, M. L. Smith, E. van Oosten, and L. Woolford, "Developing resonant leaders through emotional intelligence, vision and coaching," <i>Org. Dyn.</i> , vol. 42, no. 1, pp. 17–24, 2013. D. Goleman, R. Boyatzis, and A. McKee, "The emotional reality of teams," <i>J. Org. Eff.</i> , vol. 21, no. 2, pp. 55–65, 2002.
C. P. Lin, Y. H. Tsai, and M. L. Liu (2016)	Inclusive leadership style was measured using the nine-item scale developed by Carmeli et al. (2010).	A. Carmeli, R. Reiter-Palmon, and E. Ziv, "Inclusive leadership and employee involvement in creative tasks in the workplace: The mediating role of psychological safety," <i>Creat. Res. J.</i> , vol. 22, pp. 250–260, 2010.
Y. Liu and R. S. DeFrank (2013)	Transformational leadership style was measured using multifactor leadership questionnaire (form 5x) (Bass and Avolio, 1995).	B. M. Bass and B. J. Avolio, <i>MLQ Multifactor Leadership Questionnaire</i> , 2nd ed. Redwood City, CA, USA: Mind Garden, 1995.
Y. Liu and J. S. Phillips (2011)	Transformational leadership style was measured using multifactor leadership questionnaire (form 5X) (Avolio and Bass, 1995)	B. J. Avolio and B. M. Bass, "Individual consideration viewed at multiple levels of analysis: A multi-level framework for examining the diffusion of transformational leadership," <i>Leadership Quart.</i> , vol. 6, no. 2, pp. 199–218, 1995.
Z. Liu, X. Liu, and X. Zhang (2021)	Team temporal leadership style was measured by the seven-item scale developed on the basis of Ancona et al. (2001) and Mohammed and Nadkarni (2011) scales.	D. G. Ancona, P. S. Goodman, B. S. Lawrence, and M. L. Tushman, "Time: A new research lens," <i>Acad. Manage. Rev.</i> , vol. 26, no. 4, pp. 645–663, 2001. S. Mohammed and S. Nadkarni, "Temporal diversity and team performance: The moderating role of team temporal leadership," <i>Acad. Manage. J.</i> , vol. 54, no. 3, pp. 489–508, 2011.
F. S. Othman, M. S. M. Saad, and A. Robani (2019)	Transformational leadership style and transactional leadership style were measured using multifactor leadership questionnaire (2006)	B. M. Bass and R. E. Riggio, <i>Transformational Leadership</i> , 2nd ed. Mahwah, NJ, USA: Lawrence Erlbaum Associates, 2006.
N. Paulsen, D. Maldonado, V. J. Callan, and O. Ayoko (2009)	Charismatic leadership style was measured by combining the idealized attributes and the idealized behaviors scale in the multifactor leadership questionnaire (Form 5x) (Bass and Avolio, 1995).	B. M. Bass and B. J. Avolio, <i>MLQ Multifactor Leadership Questionnaire</i> , 2nd ed. Redwood City, CA, USA: Mind Garden, 1995.
N. Paulsen, V. J. Callan, O. Ayoko, and D. Saunders (2013)	Transformational leadership style was measured using multifactor leadership questionnaire (form 5x) (Bass and Avolio, 1995).	B. M. Bass and B. J. Avolio, <i>MLQ Multifactor Leadership Questionnaire</i> , 2nd ed. Redwood City, CA, USA: Mind Garden, 1995.
J. Peng, Z. Wang, and X. Chen (2019)	Self-serving leadership style was measured using the four-item scale developed by Camps et al. (2012)	J. Camps, S. Decoster, and J. Stouten, "My share is fair, so I don't care: The moderating role of distributive justice in the perception of leaders' self-serving behavior," <i>J. Pers. Psychol.</i> , vol. 11, no. 1, pp. 49–59, 2012.
A. Pirola-Merlo, C. Härtel, L. Mann, and G. Hirst (2002)	Two aspects of team leadership (facilitative leadership style and transformational leadership style) were measured using the project leadership questionnaire (Bain and Mann, 1997).	P. Bain and L. Mann, "Project leadership in Australian R&D: perceptions of performance and effectiveness," in P. Tharenou (Ed.), <i>Best paper and abstract proceedings, 2nd Australian Industrial and Organisational Psychology Conference</i> , p. 48, Melbourne, Australian Psychological Society, (1997)
S. H. Schroeder and U. Baldeger (2020)	Empowering leadership style was measured by Arnold et al. (2000) scale. Transformational leadership style, transactional leadership style, and passive-avoidant leadership style were measured using multifactor leadership questionnaire (Form 5X) (Bass and Avolio, 1995)	J. Arnold, S. Arad, J. Rhoades, and F. Drasgow, "The empowering leadership questionnaire: the construction and validation of a new scale for measuring leader behaviors," <i>J. Org. Behav.</i> , vol. 21, no. 3, pp. 249–269, 2000. B. M. Bass and B. J. Avolio, <i>MLQ Multifactor Leadership Questionnaire</i> , 2nd ed. Redwood City, CA, USA: Mind Garden, 1995.
Z. Song and Q. Gu (2020)	Moral leadership style was measured using the six-items scale developed by Cheng et al. (2000). Shared leadership style was measured using a seven-item scale developed by Muthel et al. (2012).	B. S. Cheng, L. F. Chou, and J. L. Farh, "A triad model of Paternalistic leadership: the constructs and measurement," <i>Indigenous Psychol. Res. Chin. Soc.</i> , vol. 14, no. 1, pp. 3–64, 2000. M. Muthel, S. Gehrlein, and M. Hoegl, "Socio-demographic factors and shared leadership behaviors in dispersed teams: implications for human resource management," <i>Human Resour. Manage.</i> , vol. 51, no. 4, pp. 525–548, 2012.
R. M. Stock, F. Totzauer, and N. A. Zacharias (2014)	Innovation-oriented leadership style was measured adapting the scale from Stock and Zacharias (2011)	R. M. Stock and N. A. Zacharias "Patterns and performance outcomes of innovation orientation," <i>J. Acad. Market. Sci.</i> , vol. 39, no. 6, pp. 870–888, 2011.
W. Wei and Y. Tang (2022)	Shared leadership style was measured based on the research of Hiller et al. (2006).	N. J. Hiller, D. V. Day, and R. J. Vance, "Collective enactment of leadership roles and team effectiveness: A field study," <i>Leadership Quart.</i> , vol. 17, no. 4, pp. 387–397, 2006.
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J. Xu, Y. Z. Li, D. Q. Zhu, and J. Z. Li (2022)	Team authoritarian leadership style was measured with an adapted five-item scale from the nine-item scale of Cheng et al. (2004)	B. S. Cheng, L. F. Chou, T. Y. Wu, M. P. Huang, and J. L. Farh, "Paternalistic leadership and subordinate responses: Establishing a leadership model in Chinese organizations," <i>Asian J. Soc. Psychol.</i> , vol. 7, no. 1, pp. 89–117, 2004.
J. Zhou, S. Liu, X. Zhang, and M. Chen (2016)	Differential leadership style was measured using the nine-item scale developed by Xu (2004)	W. Xu, <i>Chinese Cross-Strait Business Executive's Differential Leadership—A Course Study</i> , National Taiwan University, Taipei, Taiwan, 2004.
L. Zhou, S. Zhao, F. Tian, X. Zhang, and S. Chen (2018)	Visionary leadership was measured with the responses to five questions, based on questions that have been used in previous studies (Conger and Kanungo, 1994).	J. Conger and R. N. Kanungo, "Charismatic leadership in organizations: Perceived behavioral attributes and their measurement," <i>J. Org. Behav.</i> , vol. 15, no. 5, pp. 439–452, 1994.
Y. Q. Zhu and H. G. Chen (2016)	Group-focused empowering leadership style was measured using five items from Faraj and Sambamurthy (2006). Differentiated individual-focused empowering leadership style has two dimensions: differentiation in encouraging self-development (five items) and differentiation in participative goal setting (three items). Both dimensions (eight items) were measured using the scale of Faraj and Sambamurthy (2006).	S. Faraj and V. Sambamurthy, "Leadership of information systems development projects," <i>IEEE Trans. Eng. Manage.</i> , vol. 53, no. 2, pp. 238–249, 2006.

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