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# Leadership Styles, Bootlegging Innovation, and Innovation Performance of Knowledge Workers: A Structural Equation Model Analysis

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## Abstract

Leadership styles have great influence on innovation performance. Therefore, this paper studies the influence of leadership styles on bootlegging innovation and innovation performance from the perspective of social cognitive theory (SCT). The research targets knowledge workers employed in high-tech companies in Guangxi as the respondents, and a total of 522 valid questionnaires are collected through a survey. The hypotheses are tested with a structural equation model.

The hypotheses testing results reveal that leadership styles affect the bootlegging innovation and innovation performance; Both transformational leadership and empowering leadership are found to have significant positive effects; the results further demonstrate that bootlegging innovation positively affects innovation performance and serves as a mediator in the relationship between leadership styles and innovation performance.

This paper introduces bootlegging innovation as a loyal deviance, which provides an theoretical perspective for the process of leadership styles to innovation performance. By reproducing this study in high-tech enterprises, our results would be very helpful to develop a new model of leadership styles and innovation performance that can help enterprises to manage employees' bootlegging innovation behavior more effectively.

**Keywords:** Transformational leadership, Empowering leadership, Bootlegging innovation, Innovation performance, Structural equation model

# Introduction

The innovative capability of knowledge workers has long been regarded as the core competitiveness of enterprise development. To maximize the innovation potential of these employees, firms often rely on formal innovation management systems and processes. As it turns out, the side effect of this attempt is to stifle many valuable innovations (Eicher, 2021). Due to the high risk and uncertainty associated with innovation, organizations often exhibit a lack of support when employees encounter issues like resource shortage during the innovation process, which prompts some employees to engage in bootlegging innovation activities, concealing their efforts from higher-level leadership. Within the organizational context, innovation often faces considerable resistance due to its potential to disrupt or even overturn traditional practices and models (Mainemelis, 2010). Bootlegging innovation occurs when individuals insist that an innovation will bring the expected benefits to themselves or the organization, even if it conflicts with the organization's policies or the wishes of their superiors (Huang, et al., 2017). Surveys indicate that although bootlegging innovation violates the rules and regulations of the enterprise, a majority of R&D personnel have engaged in such activities (Augsdorfer, 2005). Notable success stories include Sogou (China) and LED technology.

The prevalence of bootlegging innovation within organizational contexts stands as an inexorable phenomenon, a fact that gains intensified relevance particularly in the era of innovation (Wang & Zou, 2019). Existing research has confirmed that bootlegging innovation activities, undertaken by employees, will help improve the individual innovation performance, thereby improving the competitive advantage of the enterprise. Previous studies on bootlegging mainly focus on structural determinants, but little is known about individual determinants of bootlegging innovation behavior (Krueger & Buchwald, 2022). Given the increasing emergence of bootlegging innovation behaviors and the dual complex attributes of such behaviors being "rationally purposed" but "procedurally non-compliant", both academic circles and managers have been showing growing concern and reflection on this issue (Wang & Zou, 2019).

The existing studies mainly focus on the relationship between leadership styles and individual performance. For instance, leadership styles are found to be key determinants of leadership effectiveness and can have direct or indirect influence on employees' innovation behavior and suggestion-making activities (Starbalamaksymiuk & Wodzinska, 2007). Bootlegging innovation has not yet been incorporated into this framework. Therefore, to fill in the research gap, it is of great interest to study whether leadership styles will influence employees' bootlegging innovation and hence their innovation performance. Therefore, the first objective of this paper is to examine how leadership styles affect bootlegging innovation and innovation performance of knowledge workers within organizations. In addition, the second objective of the study is to explore whether bootlegging acts as a mediator in the relationship between the innovation performance of knowledge workers and leadership styles.

The main contribution of this paper is incorporating bootlegging innovation into the integrated framework of leadership styles and individual performance. The introduction of bootlegging innovation provides an unconventional theoretical perspective for leaders to activate subordinates' performance, enriching the development of innovation theory. Bootlegging innovation behavior plays an mediation role in the influence of leadership style on the innovation performance of knowledge employees. Therefore, it is of great significance for organizational leaders or managers to further improve the innovation performance of knowledge employees through the implementation of effective leadership styles.

# Literature review

## Four-factor leadership theory (FLT)

A summary of previous research results shows that there are many types of leadership styles, but there is no unified standard. Burns et al. (1978) create the leadership styles theory. Bass (1985) regards transformational leadership and transactional leadership as complementary structures rather than bipolar structures. On the basis of Bass's research, Pearce et al. (2003) extend the leadership model to a broader level by integrating the main historical findings in the field of leadership and call it the four-factor leadership theory. According to the degree of direct intervention of leaders in the work of subordinates, it can be categorized into four leadership types: transactional leadership, empowering leadership, transformational leadership,, and directive leadership. Houghton and Yoho (2005) put forward a contingency model of four kinds of leadership behaviors, which is a more intuitive presentation of the characteristics of the four kinds of leadership behaviors and provides a valuable reference for management practice.

## Social cognitive theory (SCT)

Social cognitive theory (SCT) consists of three parts: triadic interaction determinism, observational learning, and self-efficacy. Social cognitive theory explains human behavior by adopting ternary interaction determinism and negates the single deterministic model of individual determinism or environmental determinism. There is a dynamic and mutually determined relationship among the social environment, agents and their behaviors, which are independent and interact with each other, which is a mutually determined complex relationship (Bandura, 1977). Transformational leadership and empowering leadership, as leadership styles that fully stimulate employees' intrinsic motivation and self-efficacy, are more relaxed in coping with the pressure of uncertain environment inside and outside the organization. Therefore, they have become the leadership styles concerned by researchers in recent years. Carmeli et al. (2011) found that transformational leadership style and empowering leadership style have a positive impact on employees' innovation performance and self-efficacy.

## Bootlegging innovation

Innovative individual activity known as "bootlegging" is seen to have positive

effects on an organization's growth. One useful strategy for removing "The Innovator's Dilemma" and the innovation bottleneck is bootleg innovation (Wang et al., 2019). Bootlegging innovation behavior emphasizes privacy, and it has a form of underground innovation. In this paper, bootlegging innovation behavior is defined as "the innovative trend and behavior that is initiated by an individual, unknown to the outside, and not officially approved by the organization, but expected to be conducive to the improvement of individual or organizational performance" following Augsdorfer (2005) and Criscuolo et al. (2015).

## Innovation performance

The development of innovation performance theory has a history of more than 30 years. Amabile (1988) defines innovation performance as the behavior of employees solving problems in work by using new technologies or methods is innovation performance. Pan et al. (2023) believe that under the digital scenario, the combination of innovation elements has changed, and high-tech companies' innovation success is greatly affected by their investments in R&D and people. Abbas and Raja (2015) believe that employee innovation performance is not a single behavior of employees but runs through the entire work life cycle of employees. Han et al. (2007) divide employee innovation performance into three dimensions of innovation intention, innovation behavior and innovation outcome, and developed a measurement scale with eight items, and the whole scale will be answered by five-point Likert scale.

### Leadership styles and innovation performance

Leadership styles are important factors affecting how well knowledge workers innovate. In terms of influencing creativity, Houghton and Yoho (2005) believe that empowering leadership and transformational leadership have a significant positive impact on creativity, while directive leadership and transactional leadership have no significant impact on creativity. The subsequent researches of Chen (2014) and Lin et al. (2015) further support the influence of leadership styles on innovation ability and conclude that transformational leadership and empowering leadership have positive influences on innovation ability and innovation performance of employees. Transformational leadership encourages subordinates through internal channels, guides and helps employees to realize self-supervision and management and enables employees to realize the importance of the organization's common goals from the heart, which is conducive to stimulating their spiritual needs at a higher level and inspiring employees' individual innovative behaviors (Li & Wei, 2010). Thoopkerd and Apisakkul (2022) studied Small and Medium Enterprises (SMEs) in Thailand and found that under the global conditions of economic crisis and COVID-19 pandemic, transformational leadership combined with core digital technology can help improve the innovation performance of Thailand SMEs business firm. Xia and Li (2022) study the influence of transformational leadership on workers' innovative activities from four dimensions: intellectual stimulation,

leadership charm, inspirational motivation, and personality care. The findings demonstrate that all four factors have a positive influence on innovative performance and that transformational leadership positively affects employees' innovative behavior. Consequently, the study puts forth the following hypothesis:

H1a: Transformational leadership has a positive impact on the knowledge workers' innovation performance.

Previous studies have shown a strong positive correlation between an innovation performance and an empowering leadership style (Mo et al., 2015; Tang et al., 2016). When knowledge workers realize that their work is not only interesting but also meaningful, they will seek for solutions by increasing their input and gain satisfaction from it (Mathieu et al., 2006), which may lead to higher work performance. When knowledge workers realize that their work will have a significant impact on organizational decisions, they will take it as their responsibility to pursue their own high-performing work and creative working methods, constantly seek to improve their work and innovative performance, and expand and improve their performance through sharing (Chen & Chen, 2017). In order to investigate the effect of empowering leadership on workers' innovation performance, Kundu et al. (2019) gathered data from 418 Indian bank employees, utilizing psychological empowerment as the mediation. The results of multiple regression analysis demonstrate that innovation performance and psychological empowerment of subordinates are positively impacted by empowering leadership behavior.

Empowered leadership guides employees to self-lead, manage and make decisions through matching with knowledge employees' psychological expectations, and creates higher innovation performance through mutual cooperation and team learning (Conger & Kanungo, 1988). Accordingly, the following hypothesis is proposed in this study:

H1b: The innovation performance of knowledge workers is positively impacted by empowered leadership.

**Leadership styles and bootlegging innovation**

Transformational leadership has four dimensions (Morale modeling, Charisma of leadership, Visionary vision, Individualized consideration), and each dimension promotes bootlegging innovation behaviors among knowledge workers, thereby improving innovation performance (Li et al, 2019; Li & Mao, 2018; Hamstra et al, 2014). When transformational leadership adopts personalized care, building a common vision and other methods to increase the work input of subordinates, it will pay more attention to the work goals and positive results, but pay less attention to the channels and methods to achieve the goals, to encourage employees to dare to take risks and then carry out bootlegging innovation behaviors. When employees feel constrained by the rules of the organization but have a strong desire to achieve organizational goals, they may engage in bootlegging innovation behavior to achieve those goals, believing that the transformational leader will support proactive actions to improve the current situation and advocate critical thinking. Zhang and Liu (2020) conducted

an empirical analysis using 288 samples from various regions of China, and the research results indicate that transformational leadership significantly improves the bootlegging innovation behavior of employees. Based on these, the following hypothesis is put forward:

H2a: Transformational leadership positively affects bootlegging innovation.

Encouraging participation in decision-making, enhancing the meaningful of work, expressing confidence in high performance, and granting autonomy from bureaucratic constraints are the four dimensions of empowerment leadership, and each one significantly improves employees' performance in terms of innovation (Griffin et al., 2010; Grille et al., 2015; Judge & Zapata, 2015; Wang et al. 2018). According to social cognitive theory, individual behavior and the external environment are molded through a bidirectional interactive process (Lv et al., 2018). Under the shaping of leaders' performance expectations, individuals may attempt to achieve higher performance and create a better organizational environment through challenging and risky extra-role behaviors or special means, such as bootlegging innovation. Therefore, this study believes that empowering leadership and the relaxed organizational environment it constructs can activate employee traits and encourage employees to take the initiative to carry out bootlegging innovation. Accordingly, the following hypothesis is proposed in this study.

H2b: Empowering leadership positively affects bootlegging innovation.

**Bootlegging innovation and innovation performance**

The mainstream perspective discusses about how innovation performance is improved via bootlegging from the perspective of exploring learning advantages (Masoudnia & Szwejczewski, 2012; Criscuolo et al., 2015), resource integration advantages (Jiang, 2018; Wang et al., 2018) and delayed disclosure advantages (Mainemelis, 2010; Huang et al., 2017). Based on the local context, the study focuses on non-confrontational bootlegging innovation emphasizing the autonomy, loyalty, and creativity of employees. Therefore, this research posits that bootlegging innovation plays a role in promoting innovation performance. Huang et al. (2017) used survey data from 456 employees in 10 high-tech enterprises across 5 cities in China to analyze the impact of individual bootlegging innovation behavior on innovation performance. The findings suggest that individual innovation performance is positively impacted by bootlegging innovation. Savetpanuvong (2023) used qualitative research methods to present a house of management innovation for family business based on the theory of organizational creativity, and concluded that family enterprises, affected by external and internal factors, have their own characteristics, especially internal deviant innovation and other factors, which can effectively improve the innovation performance of enterprises. Zhao et al. (2020) conducted research based on the paired survey data from 561 subordinates and leaders across 24 companies. The results show that employee innovation performance is significantly enhanced by bootlegging innovation. In light of this, the following hypotheses are put out in this research:

H3: bootlegging innovation positively affects the innovation performance of knowledge workers.

**Bootlegging innovation's mediating role**

Based on the above literature review, it is believed that leadership styles affect the knowledge workers' bootlegging innovation, and bootlegging innovation affect the knowledge workers' innovation performance. Therefore, it is possible to suggest that bootlegging innovation might positively mediate the relationship between leadership style and innovation performance. As a result, the following two hypotheses can be expressed:

H4a: Employee innovation performance and transformative leadership style are mediated via bootlegging innovation.

H4b: Employee innovation performance and an empowering leadership style are mediated by bootlegging innovation.

# Research model

All variables and hypotheses in this study are summarized in Figure 1. There are four variables: transformational leadership, empowering leadership, bootlegging innovation, and innovation performance. Four hypotheses are being tested to assess how leadership styles affect both bootlegging innovation and innovation performance: H1a, H1b, H2a, and H2b. H3 will test the impact of bootlegging innovation on innovation performance. And the mediating effect of bootlegging innovation will be tested by H4a and H4b.

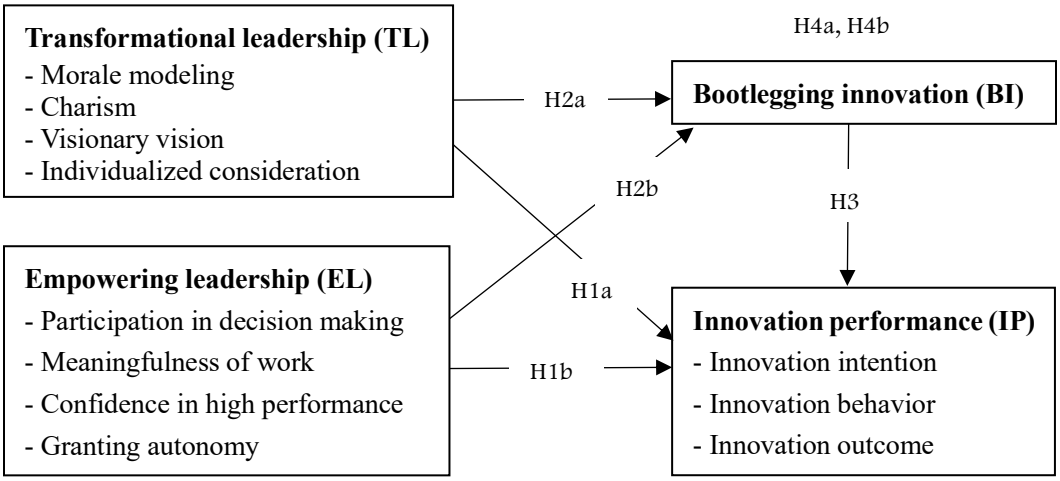


**Figure 1** Research model

# Methodology

## Research design

This study examines how leadership styles affect knowledge workers' bootlegging innovation and innovation

performance. Quantitative research method and questionnaire survey are used. The hypotheses are tested structural equation model analysis. R&D personnel of high-tech enterprises are typical representatives of knowledge workers, and there are a lot of bootlegging innovation behaviors among these employees (Augsdorfer, 2005; Jiang, 2018). Therefore, the target population is conveniently chosen as the R&D personnel in high-tech enterprises in Guangxi, China. Based on the statistics from "Guangxi Science and Technology Statistics 2021" released by Guangxi provincial government, there are 7,044 R&D personnel in the 10 most innovative high-tech enterprises in Guangxi in year 2021. The stratified random sampling method is used to select the respondents from the 10 enterprises.

## Data collection

The research object of this study is knowledge workers. Therefore, the paper has screened the research objects, only employees of business departments directly related to innovation are retained. The formal questionnaire survey for this study was conducted online through the website www.wjx.cn between February 2023 and March 2023. In order to collect data, invitation letters and questionnaire information were sent to the managers of human resource department of the 10 most innovative high-tech enterprises in Guangxi. The required subsample size for each enterprise was determined by the stratified random sampling method. Then following the informed subsample size, the human resources manager of each enterprise invited the R&D personnel randomly to complete the online survey by sending emails or WeChat to inform the QR codes for websites and online questionnaires. Human resource managers have sent out a total of 610 invitations and 539 questionnaire were collected. After eliminating invalid questionnaires according to the standard, 522 valid questionnaires were obtained, thud the actual response rate is 85.57%.

# Research results

## Reliability and validity tests

In this study, SPSS27 was utilized to determine each dimension's reliability coefficients. In addition to the calculation of the constructional reliability mentioned above, the confirmatory factor analysis based on structural equation model is also required to analyze the convergent and discriminative validity of the latent variables. This serves to comprehensively assess the inherent quality of the constructed model. The findings of the validity and reliability tests are displayed in Table 1. The mean variance of all constructs extracted is higher than 0.50, indicating that all constructs used in this study are valid (Fornell & Larcker, 1981). Composite reliability levels were higher than 0.7 for all constructs, and Cronbach's alpha was also higher than 0.70. Therefore, the questionnaire used in the study is reliable because it shows good consistency and accuracy (Hair et al., 2009).

**Table 1** Results of reliability and validity tests

| Variable | Cronbach's α | CR | AVE |
|---|---|---|---|
| **Transformational leadership** | **0.940** | | |
| Morale modeling | 0.929 | 0.929 | 0.621 |
| Charisma | 0.885 | 0.886 | 0.564 |
| Visionary vision | 0.896 | 0.898 | 0.596 |
| Individualized consideration | 0.919 | 0.920 | 0.658 |
| **Empowering leadership** | **0.889** | | |
| Participation in decision making | 0.875 | 0.875 | 0.700 |
| Meaningfulness of work | 0.793 | 0.794 | 0.563 |
| Confidence in high performance | 0.863 | 0.864 | 0.678 |
| Granting autonomy | 0.822 | 0.823 | 0.607 |
| **Bootlegging innovation** | **0.869** | **0.871** | **0.576** |
| **Innovation performance** | **0.907** | | |
| Innovation intention | 0.882 | 0.884 | 0.717 |
| Innovation behavior | 0.891 | 0.894 | 0.804 |
| Innovation outcome | 0.898 | 0.899 | 0.747 |

Table 2 shows that the majority of the latent variables have a substantial association with one another, and the correlation coefficients are all lower than the upper limit of 0.85. This suggests that while there is some degree of correlation, there is no obvious multicollinearity. The variables of the scale are found to have strong discriminative validity, as shown by the square root of AVE being greater than the correlation coefficient among the variables. This allows for subsequent hypothesis testing regarding their relationship.

**Table 2** Correlation, and discriminant validity of first-order constructs

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Morale modeling | **0.788** | | | | | | | | | | | |
| Charisma | 0.368 | **0.751** | | | | | | | | | | |
| Visionary vision | 0.410 | 0.494 | **0.772** | | | | | | | | | |
| Individualized consideration | 0.520 | 0.477 | 0.579 | **0.811** | | | | | | | | |
| Meaningfulness of work | 0.239 | 0.249 | 0.331 | 0.219 | **0.750** | | | | | | | |
| Participation in decision making | 0.303 | 0.428 | 0.313 | 0.270 | 0.384 | **0.837** | | | | | | |
| Providing autonomy | 0.366 | 0.296 | 0.524 | 0.334 | 0.471 | 0.519 | **0.779** | | | | | |
| Confidence in high performance | 0.277 | 0.113 | 0.312 | 0.231 | 0.355 | 0.531 | 0.526 | **0.823** | | | | |
| Bootlegging innovation | 0.373 | 0.343 | 0.467 | 0.396 | 0.429 | 0.435 | 0.487 | 0.411 | **0.759** | | | |
| Innovation intention | 0.383 | 0.374 | 0.376 | 0.385 | 0.386 | 0.427 | 0.500 | 0.361 | 0.543 | **0.847** | | |
| Innovation behavior | 0.303 | 0.294 | 0.344 | 0.312 | 0.298 | 0.377 | 0.401 | 0.311 | 0.475 | 0.559 | **0.897** | |
| Innovation outcome | 0.362 | 0.354 | 0.349 | 0.345 | 0.296 | 0.368 | 0.434 | 0.340 | 0.485 | 0.614 | 0.534 | **0.864** |

*Note: The square roots of AVE are on the diagonal, and the correlation coefficients between variables are below the diagonal*

As seen in Table 3, each pair of the four latent variables included in this study has a correlation coefficient with a p-value less than 0.05, indicating statistical significance. This indicates that the four latent variables are significantly correlated with each other. Moreover, the correlation coefficients between the pairings are all lower than 0.8, which initially excluded the collinearity problem.

**Table 3** Correlation, and discriminant validity of second-order constructs

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Transformational leadership | 1 | | | |
| Empowering leadership | 0.503** | 1 | | |
| Bootlegging innovation | 0.506** | 0.570** | 1 | |
| Innovation performance | 0.535** | 0.577** | 0.594** | 1 |

*Note: ** indicates the significance at the 1 percent level (both sides)*

## Hypothesis testing results

In this study, confirmatory factor analysis (CFA) analysis was performed for the four variables: transformational leadership, empowering leadership, bootlegging innovation and innovation performance. The standardized factor load of all dimensions ranges from 0.698 to 0.904, and the non-standardized factor load is significant. There is a range of 0.851 to 0.929 for component reliability (CR) and 0.564 to 0.804 for average variance extraction (AVE). These all conform to the criteria of Hair et al. (2009) and Fornell and Larcker (1981), so all four variables have convergence effect and can be evaluated by the SEM completely.

The study employs statistical analysis software AMOS 21.0 to test the structural model as well as Hypothesis 1 to 3, using the Maximum Likelihood method for parameter estimation. The theoretical model of this study consists of three parts: antecedent variable, mediating variable and result variable, involving a total of four latent variables. The antecedent variables refer to transformational leadership and empowering leadership, the mediating variable is bootlegging innovation, and the result variable is employees' innovation performance. This study's primary structural model is depicted in Figure 2.

According to Table 4, a decent fit is shown by the RMSEA of 0.059, which is less than the required level of 0.08, and the $\chi 2/df$ value of 2.841, which is less than 3 and falls within the acceptable range. The scores for the various fit indices are as follows: 0.943 for the Goodness-of-Fit Index, 0.920 for the Adjusted Goodness-of-Fit Index, 0.951 for the Comparative Fit Index, and 0.940 for the Tucker-Lewis Index, 0.927 for the Normed Fit Index, 0.952 for the Incremental Fit Index. The fact that every fit index satisfies the overall requirements suggests that the structural equation model developed for this investigation is efficient and provides a good match for the data gathered (Hair et al., 2009; Fornell & Larcker, 1981). Thus, there is no need for model modification in this study.

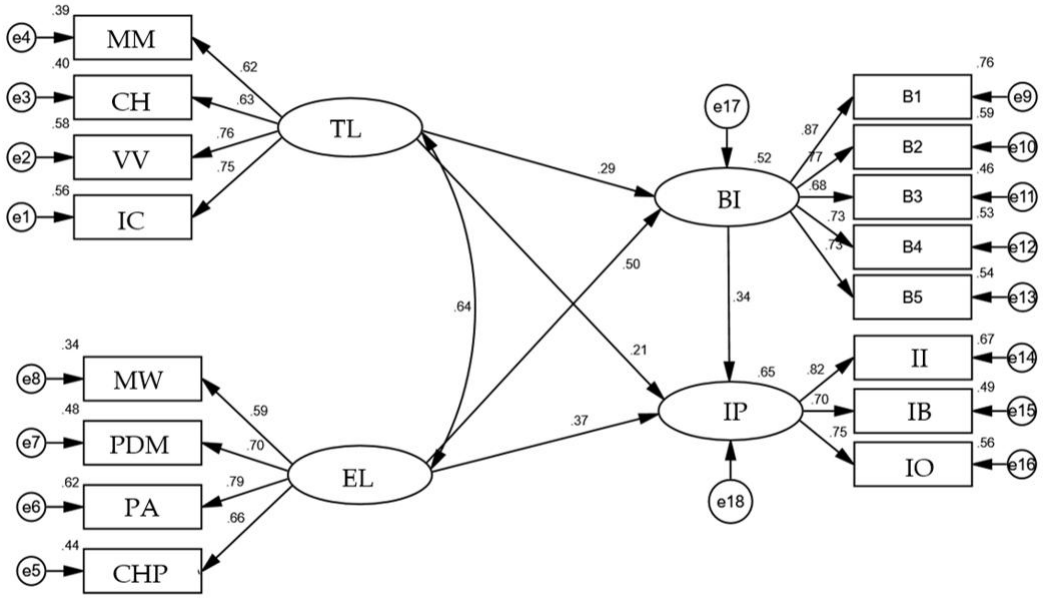


**Figure 2** Structural equation model

*Note. TL= Transformational leadership; MM= Morale modeling; CH= Charisma; VV= Visionary vision; IC= Individualized consideration. EL= Empowering leadership; MW= Meaningfulness of work; PDM= Participation in decision making; PA= Providing autonomy; CHP= Confidence in high performance. BI= Bootlegging innovation. IP= Innovation performance; II= Innovation Intention; IB= Innovation Behavior; IO= Innovation Outcome.*

**Table 4** Structural equation model fitting indexes

| Index of fit | $\chi^2/df$ | *AGFI* | *GFI* | *CFI* | TLI | *NFI* | IFI | *RMSEA* |
|---|---|---|---|---|---|---|---|---|
| Reference value | ＜5 | ＞0.8 | ＞0.9 | ＞0.9 | ＞0.9 | ＞0.9 | ＞0.9 | ＜0.08 |
| Measured value | 2.841 | 0.920 | 0.943 | 0.951 | 0.940 | 0.927 | 0.952 | 0.059 |

As revealed by Table 5, all the standardized path coefficients among latent variables are significant. As a result, Hypothesis H1a is supported by the coefficient of standardized path 1 of 0.294 (t=4.697, p=.000 < 0.01). In support of Hypothesis H1b, the coefficient of standardization for path 2 is 0.496 (t=7.362, p= 0.000 < 0.01). The hypothesis H2a is supported for path 3, as indicated by the coefficient of standardized data of 0.21 (t=3.387, p= 0.000 < 0.01). Path 4 has a coefficient of standardization of 0.369 (t=5.092, p= 0.000 < 0.01), indicating the validity of H2b. Finally, the standardized path coefficient for path 5 is 0.335 (t=5.344, p= 0.000 < 0.01), indicating that Hypothesis H3 is validated.

**Table 5** Path analysis results

| | Path relationship | | | Standardized path coefficients | Non-standardized path coefficients | S.E. | t | P | SMC ($R^2$) |
|---|---|---|---|---|---|---|---|---|---|
| H1a | Innovation performance | ← | Transformational leadership | 0.294 | 0.431 | 0.092 | 4.697 | 0.000 | 0.520 |
| H1b | Innovation performance | ← | Empowering leadership | 0.496 | 0.761 | 0.103 | 7.362 | 0.000 | |
| H2a | Bootlegging innovation | ← | Transformational leadership | 0.21 | 0.272 | 0.08 | 3.387 | 0.000 | 0.650 |
| H2b | Bootlegging innovation | ← | Empowering leadership | 0.369 | 0.499 | 0.098 | 5.092 | 0.000 | |
| H3 | Innovation performance | ← | Bootlegging innovation | 0.335 | 0.295 | 0.055 | 5.344 | 0.000 | |

The study utilizes Amos 21.0 software for data analysis and employs the bootstrap method for testing the mediation effects through 2000 iterations. Table 6 shows that the effect value of mediating path 1 is 0.099, and that the P value is less than the significant threshold 0.05, and the upper and lower interval of 95% confidence is [0.043- 0.179], excluding 0, demonstrating the existence of a mediating effect and the validity of hypothesis H4a. Similar to the first mediating pathway, the second has an effect value of 0.166, the P-value is less than the significant level 0.05, and the upper and lower 95% confidence intervals of [0.082-0.272] do not contain 0. These data confirm the existence of a mediating effect and the hypothesis H4b.

**Table 6** Result of the mediation effect by bootstrap method

| Mediating effect | Point Estimate | 95% Confidence interval | | P |
|---|---|---|---|---|
| | | Lower | Upper | |
| Path 1 (H4a): Transformational leadership – Bootlegging innovation – Innovation performance | 0.099 | 0.043 | 0.179 | 0.000 |
| Path 2 (H4b): Empowering leadership – Bootlegging innovation – Innovation performance | 0.166 | 0.082 | 0.272 | 0.001 |

# Conclusion and discussion

## Conclusion

This study clarifies the internal mechanism of how knowledge workers' innovation performance would affected by the leadership styles. From the perspective of social cognitive theory, this paper introduces bootlegging innovation, a loyal rebellious behavior, which provides a theoretical perspective for the process of leadership style and innovation performance. 522 valid questionnaires were collected online from the R&D employees of the 10 most innovative high-tech enterprises in Guangxi, China. To test the hypotheses, a structural equation model was employed. The results of this study show that knowledge workers' bootlegging innovation and innovation performance are influenced by the leadership styles; both transformational leadership and empowering leadership have significant positive effects; innovation performance is found to be significantly positively affected by bootlegging innovation, and bootlegging innovation is found to act as a mediating factor in the relationship between leadership styles and innovation performance. It can be seen that through adopting effective leadership styles (transformational leadership or empowering leadership), bootlegging innovation behaviors can be guided and managed, so as to achieve the goal of raising the effects of leadership style on innovation performance and raise the level of innovation performance among knowledge workers.

## Discussion

The results of this paper indicate that leadership styles can affect knowledge workers' innovation performance and their bootlegging innovation, which is basically consistent with the existing literature (Chen, 2014; Huang, 2014; Criscuolo et al., 2015; Mainemelis, 2010).

It has been proven in this study that innovation performance and bootlegging innovation are significantly boosted by transformational leadership. And bootlegging innovation behavior. This result is consistent with the research results of Song (2019) and Kahn (1990). Judge and Piccolo (2004) point out that transformational leadership can positively affect employees' confidence in work and leadership satisfaction, thereby improving work motivation. With less psychological burden and pressure, employees' sense of belonging to the enterprise will be enhanced, and they will be more inclined to take bootlegging innovation behaviors. Therefore, through their personality charm, transformational leadership influences the relationship between supervisors and subordinates, and the atmosphere of the enterprise will be more friendly and positive. Transformational leadership provides enough psychological safety, and employees will make positive responses in behavior when they perceive the support from the organization. In other words, employees are more likely to produce bootlegging innovation behavior.

Similarly, knowledge workers' innovation performance and bootlegging innovation behavior have been found to be significantly enhanced by empowering leadership. This outcome is in line with Wei et al. (2020) and Huang's (2014)

research findings. Individual behavior and the external environment are shaped through a two-way interacting process, according to the social cognitive theory. Under the shaping of leaders' performance expectations, individuals will try to achieve higher performance and create a better organizational environment through challenging and risky extra-role behaviors or special means, such as bootlegging innovation (Lv et al., 2018). Therefore, in the unique cultural context of China, this study believes that empowering leadership and the relaxed organizational environment constructed by empowering leadership can activate employees' characteristics and encourage employees to take the initiative to carry out bootlegging innovation.

Additionally, the study's findings demonstrate that bootlegging innovation both mediates the effect of leadership styles on innovation performance and significantly improves innovation performance. The mainstream view discusses the benefit of bootlegging innovation on innovation performance while considering exploring learning advantage (Criscuolo et al., 2015), resource integration advantage (Jiang, 2018), and delayed disclosure advantage (Mainemelis, 2010). The empirical test preliminarily confirms the existence of mediating effects. Therefore, it can be finally confirmed that the mediation mechanism of transformational and empowering leadership behavior affecting employees' innovation performance, that is, transformational leadership styles and empowering leadership styles are conducive to knowledge employees' bootlegging innovation behavior, thereby improving employees' innovation performance. Knowledge workers under transformational leadership and empowering leadership styles will selectively abide by rules and try to bring innovative results to the organization through bootlegging innovation behavior. Such bootlegging innovation behavior not only enriches the theoretical connotation of bootlegging innovation under Chinese context, but also represents the deepening and development of the bootlegging innovation theory in the post-COVID-19 era.

# Management implications

In recent years, the staff innovation research results is relatively abundant. However, leadership styles affect the internal mechanism of knowledge staff innovation research was inadequate. Therefore, the introduction of bootlegging innovation provides an unconventional theoretical perspective for leaders to activate subordinates' innovation performance, enriches the development of constructive bootlegging theory and innovation theory and fills the research gap.

Since it is found that leadership styles would positively affect knowledge employees' bootlegging innovation and improve innovation performance, therefore, leaders or managers can implement effective leadership styles for knowledge workers in the organization. Transformational leadership can establish and describe clear and exciting goals and visions for employees and stimulate subordinates' internal motivation. Empowering leadership empowers knowledge workers by sharing

information, demonstrating confidence in outstanding accomplishments, taking part in decision-making, and allowing autonomy, etc., to meet their reasonable management demands; Additionally, consideration ought to be given to the bootlegging innovation in informal channels, and active guidance should be given to promote its healthy development.

The implications of this study for enterprises are that, on the one hand, enterprise managers should recognize the potential value of employees' bootlegging innovation, and leaders can change management methods to flexibly manage employees' bootlegging innovation behavior; On the other hand, the management of enterprises should help employees actively find the meaning of work and stimulate the self-efficacy of innovation, to improve their innovation performance.

# Limitation and future research

There are three limitations to this study. There are two limitations from the practical perspective. First, since only high-tech enterprises in Guangxi are selected as samples, regional limitations affect the universality of the conclusion. Therefore, enterprises in other provinces of China can be selected as samples for future research to get more general results. Second, the questionnaire data in this paper is obtained from the self-evaluation of enterprise employees, and individual subjectivity may bias the research results and affect the validity of the research results to a certain extent. In the future, the sample scope could be broadened, cross-layer research could be adopted, longitudinal data could be collected, and the internal mechanism of various variables could be revealed more comprehensively and objectively. Thirdly, from the theoretical perspective, this paper studied only transformational leadership and empowering leadership, there are many other types of leadership styles, such as charismatic leadership, humble leadership, humorous leadership, gentle leadership, sharing leadership, and servant leadership. Future studies could analyze the impact mechanism of various leadership styles on innovation performance and bootlegging innovation.

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