ZESZYTY NAUKOWE POLITECHNIKI POZNAŃSKIEJ
Nr 91 Organizacja i Zarządzanie 2025

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UNLOCKING MOTIVATION: KEY DRIVERS OF KNOWLEDGE WORKERS IN PAKISTAN'S HIGH-TECH INDUSTRY

DOI: 10.21008/j.0239-9415.2025.091.04

This study explores the key factors influencing the motivation of knowledge workers (KWs) in Pakistan's high-tech industry. As knowledge-intensive roles become increasingly vital in today's competitive business landscape, understanding the motivators driving KWs is crucial for enhancing organizational performance and talent retention. Grounded in self-determination theory (SDT), this research examines the impact of five core motivational factors – autonomy, meaningful work, learning and development, recognition of achievement, and physical work environment – on KW motivation. Using a structured questionnaire, data were collected from 301 KWs across various roles in Pakistan's high-tech sector. Structural equation modeling (SEM) was employed to analyse the relationships among these factors. The findings reveal that all five motivational elements significantly and positively influence KW motivation, with learning and development emerging as the strongest predictor. These results contribute to the existing literature by offering empirical evidence on KW motivation within an emerging economy context. The study also provides practical insights for managers and policymakers seeking to foster an environment that enhances engagement, innovation, and productivity among KWs.

Keywords: Pakistan, knowledge workers, self-determination theory, high-tech industry, motivation

1. INTRODUCTION

In the contemporary economy, there is a notable decline in the prevalence of manual skills typically associated with mass production, increasingly making way for intellectual skills that are essential in today's knowledge-driven environment

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(Yan, Davison, 2013). Knowledge workers (KWs), characterised by their unique predispositions towards intellectual capabilities, exhibit competencies that differentiate them from other employee groups (Muzam, 2022). These differences encompass specialised knowledge and extensive experience, making KWs crucial to organizational innovation and sustainability (Zaytsev et al., 2021). As high-tech industries navigate a rapidly evolving competitive landscape marked by ongoing reforms and uncertainties, the demand for high-quality, competent employees becomes essential for maintaining operational viability and fostering growth (Naumov, 2024). KWs serve as a primary competitive advantage in this sector, since they drive the development of new services and products, novel marketing strategies, and innovative business models, thereby becoming integral to the productivity and effectiveness of high-tech organizations (Zaytsev et al., 2021).

As an emerging segment of the workforce, KWs hold distinct priorities compared to previous generations (Kucharska, 2024). The traditional motivating factors that once governed employee engagement have shifted to align more closely with the dynamics of modern workplaces (Amhar et al., 2022). Consequently, organizations face substantial risks regarding employee performance, retention, and creativity in the absence of sufficient motivation (Noor, Minai, 2019). The significance of motivation extends into the realms of industrial psychology and organizational behaviour, where it plays a critical role in various management studies, including performance management, leadership, and organizational change (Vătămănescu et al., 2019). By leveraging their expertise, KWs significantly enhance the value of an organization's offerings, as they encompass diverse roles such as scientists, engineers, and IT professionals (Zaytsev et al., 2021).

A robust theoretical framework is essential for understanding the motivational dynamics of KWs. Self-determination theory (SDT), proposed by Deci and Ryan (2013), provides a comprehensive approach to intrinsic and extrinsic motivation. SDT posits that three core psychological needs – autonomy, competence, and relatedness – motivate individuals. When these needs are met, employees experience increased intrinsic motivation, leading to greater engagement, creativity, and productivity (Ryan, Deci, 2000). These elements are particularly relevant to KWs, whose roles demand intellectual autonomy, opportunities for skill enhancement, and collaborative environments (Gagné, Deci, 2005). Understanding SDT within the context of KWs is crucial for designing motivational strategies that align with their intrinsic drivers.

Pakistan's burgeoning tech industry presents a unique opportunity for economic enhancement, particularly given the prevailing fiscal constraints (Kianto et al., 2018). This high-tech industry is characterised by a high degree of specialization and knowledge intensity; however, it grapples with a lack of mature managerial practices, which induces management challenges – particularly in employee management (Appuhami, Bhuyan, 2015). Effective management of KWs is vital to catalysing growth in this sector (Shujahat et al., 2018). Acknowledging the importance of such management has led researchers to focus their studies increasingly on KWs,

with retainability representing a significant topic within this discourse. The rising incidence of job-hopping poses a challenge to the high-tech industry, making motivation – a core principle of human resource management – even more critical for ensuring knowledge retention and continuity (Anikina, Дмитриенко, 2023).

Despite existing research on KWs, there remains a gap in the literature specifically addressing their motivational factors within the context of Pakistan's high-tech industry. Most studies focus primarily on developed economies and their implications for KWs, leaving a significant gap in understanding how these motivations manifest and change in emerging markets such as Pakistan (Tiwari et al., 2023; Hussain, Shafiq, 2023). Moreover, the growing body of knowledge on motivation also identifies gaps regarding specific strategies that align with the unique needs of knowledge workers in high-tech environments, particularly in emerging economies, where traditional motivation frameworks may not fully apply (Gagné et al., 2019; Yen et al., 2024).

Understanding the motivational drivers for this specific cohort within an emerging economy like Pakistan is therefore a timely and critical research endeavour. The purpose of this study is to analyse various factors that influence the motivation of KWs within Pakistan's high-tech industry. By applying SDT as a guiding framework, this study aims to examine how autonomy, meaningful work, learning and development, recognition of achievement and the physical work environment influence the motivation of KWs in this sector. By providing localised insights into the motivations of KWs, this research enriches the existing literature and facilitates the development of tailored managerial strategies. In doing so, it aims to address the urgent need for effective motivational frameworks that align with the distinct characteristics of KWs in emerging economies, thus contributing to enhanced organizational performance. The paper includes a literature review followed by hypotheses formulation and methodology, culminating in a presentation of research findings, discussions, and conclusions.

2. LITERATURE REVIEW AND HYPOTHESES FORMULATION

2.1. Knowledge workers

Knowledge workers are defined as individuals whose primary job involves handling and processing information using their intellectual capabilities rather than physical skills (Acsente, 2010). They play a crucial role in the success of organizations, particularly in knowledge-intensive industries, where their analytical problem-solving and creative capacities are vital (Noor, Minai, 2019). The increasing reliance on knowledge workers influences workplace dynamics and organizational strategies aimed at optimizing their contributions (Razmerita et al., 2016). Research indicates that the nature of work is fundamentally changing due to the rising emphasis on

knowledge management, making the understanding of knowledge workers essential for effective workforce management (Dierdorff, Morgeson, 2013).

Furthermore, the specific context of high-tech industries amplifies the need for knowledge workers, as these sectors thrive on continuous innovation and rapid technological advancements (Noor, Minai, 2019). Additionally, understanding the motivational dynamics of knowledge workers is particularly relevant in developing economies, where traditional management practices may not fully align with contemporary cognitive work requirements (Saleh et al., 2023). Furthermore, while the characteristics and importance of KWs are well documented, the interplay of specific motivational factors, when viewed through the lens of SDT in an emerging economy's high-tech industry, represents an underexplored research gap. This study seeks to address this gap by providing empirical evidence from Pakistan.

2.2. Characteristics of knowledge workers

The characteristics of knowledge workers include a high level of education, advanced expertise, and a preference for autonomy in their roles (Acsente, 2010). They are recognised for their ability to solve complex problems autonomously, which requires an environment that fosters creativity and provides sufficient resources (Al-beity et al., 2019). They exhibit motivation beyond monetary rewards, often valuing intrinsic factors such as autonomy, challenge, and opportunities for personal growth (Dagne et al., 2015; Gambardella et al., 2013). Furthermore, knowledge workers prefer roles that are intellectually stimulating and offer opportunities for growth and learning (Noor, Minai, 2019).

Research suggests that knowledge workers exhibit a strong inclination towards collaborative environments, emphasising the importance of effective communication and interpersonal relationships in fostering their engagement and productivity (Razmerita et al., 2016). Additionally, studies have highlighted that the motivation of knowledge workers can be significantly influenced by their work design, including task variety and the degree of autonomy granted to them (Gagné et al., 2019). This leads to a re-evaluation of traditional job design theories, as it becomes evident that incorporating knowledge worker characteristics is essential for optimizing organizational performance (Noor, Minai, 2019).

2.3. Autonomy

The link between job autonomy and motivation is well-documented. Zhang & Khan (2024) provide empirical evidence indicating that higher job autonomy positively influences knowledge workers' innovative behaviour, directly correlating with increased motivation. Autonomy empowers workers to take ownership of their tasks, leading to enhanced engagement and proactive behaviour, thus fostering a creative and motivating work environment. Hassi et al. (2021) also highlight that employee

autonomy in their approach to completing tasks cultivates a climate for initiative, enhancing their motivation to innovate. Buch et al. (2014) further explain that such autonomy allows individuals to experiment with different approaches and be intrinsically motivated, which enhances their overall job satisfaction and productivity.

The relationship between autonomy and motivation can also be explained through self-determination theory, which posits that autonomy, competence and relatedness are core psychological needs that foster intrinsic motivation (Teixeira et al., 2012). In knowledge-intensive work, autonomy allows workers to fulfil these needs effectively, leading to stronger intrinsic motivation. Standage et al. (2012) demonstrate that greater autonomy predicts motivation across various contexts, reinforcing the importance of feeling autonomous as a driver of engagement. Moreover, evidence from the literature shows that job autonomy significantly influences workers' interactions with their organizational environment. Wang & Hong (2020) find that knowledge workers typically seek high levels of autonomy, which enhances their control over work processes and correlates with decreased workplace loneliness, thereby fostering motivation. Insights from the job characteristics model support the notion that autonomy is a motivating job dimension (Wan et al., 2024). Given the reasoning discussed above, we hypothesise that

H1: Autonomy is positively related to KW's motivation.

2.4. Meaningful work

A prevailing theme across the literature is that when employees perceive their work as meaningful, it enhances their motivation to perform their jobs effectively (Shellhouse et al., 2019; Wingerden, Stoep, 2018). Pouragha et al. (2021) emphasise that meaningful work fosters lasting motivation for employees, indicating that a strong understanding of one's role leads to increased job engagement. This is consistent with Gagné et al. (1997), who argue that meaningful work, as a vital component of empowerment, directly influences intrinsic motivation by fulfilling employees' psychological needs for autonomy, competence, and relatedness. Additionally, Lai et al. (2022) show that fulfilling design elements in work contexts, which contribute to a sense of meaningfulness, align with motivational theories advocating for meeting psychological requirements to sustain motivation and job satisfaction.

The work of Wingerden and Stoep demonstrates that meaningful work contributes positively to both work-related and general well-being, suggesting that employees who find significance in their roles tend to exhibit higher levels of engagement and lower burnout rates (Wingerden, Stoep, 2017). Similarly, Kaur & Mittal (2020) show that when employees perceive high levels of meaning in their work, they are more likely to experience greater engagement and self-efficacy. This is vital in knowledge work, where proactive engagement and a strong internal drive significantly affect productivity and job performance.

Moreover, research by Shim et al. (2022) highlights how self-efficacy, stimulated by a sense of control and perceived impact within the workplace, can enhance the sense of meaningfulness among workers, thereby increasing their motivation. This dynamic is reflected in the work of Frémeaux & Pavageau (2020), who explore how leader behaviours can shape employees' perceptions of meaningfulness and boost motivation within teams. In the context of knowledge workers, where tasks often involve problem-solving and innovation, the critical nature of feeling connected to one's work is supported by findings from Ali et al. (2023), which affirm that meaningful work is integral to an employee's sense of calling and intrinsic motivation. The integration of meaningfulness within workplace culture not only enhances motivation but can also lead to improved in-role performance and overall job satisfaction (Wingerden, Stoep, 2018; Ali et al., 2023). Building on the preceding discussion, we propose the hypothesis that

H2: Meaningful work is positively related to KW's motivation.

2.5. Learning and development

Numerous studies indicate that structured training programmes significantly enhance employee motivation. For instance, Al-Kazlah & Badkook (2022) find that organizational training effectively boosts individual motivation levels, thereby improving overall performance in the workplace. This is consistent with the findings of Al-Kharabsheh et al. (2023), who demonstrate that employee motivation mediates the effects of digital training on performance, highlighting the importance of continuous learning opportunities. Similarly, Jaya & Nasution (2024) report a positive correlation between training interventions and employee performance, affirming that effective training leads to increased motivation among staff.

Moreover, there is evidence indicating that the combination of training, leadership, and job satisfaction significantly impacts work motivation. Raharjo's (2023) research reveals that effective leadership and training, coupled with job satisfaction, have a more profound effect on employee motivation than any of these elements individually. This multifaceted approach suggests that fostering a culture of learning and development can create an environment that nurtures employee motivation. Additionally, the role of motivation in the context of training is further reflected in studies discussing various training methods. For example, Riani et al. (2017) affirm that training has a significant positive influence on work motivation, which, in turn, enhances job performance. This relationship is supported by findings indicating that employees who engage in learning opportunities tend to be more motivated to apply their skills in the workplace, leading to improved performance outcomes (Massenberg et al., 2016). Building on the discussion above, we hypothesise that

H3: Learning and development are positively related to KW's motivation.

2.6. Recognition of achievement

Recognition of achievement plays a crucial role in enhancing motivation across various contexts, aligning significantly with self-determination theory as proposed by Deci & Ryan (2012). This theory suggests that fulfilling fundamental psychological needs – competence, autonomy, and relatedness – fosters intrinsic motivation (Wang et al., 2019). Recognizing achievements fulfils the need for competence and reinforces self-efficacy, a key component of motivation. Wang et al. (2019) emphasise that positive work events, such as recognition, lead to enhanced work engagement by satisfying psychological needs related to competence. This correlation illustrates how acknowledgment of individual milestones directly boosts motivation levels. Additionally, recognition functions as an intrinsic reward, promoting engagement and persistence (Bliven, Jungbauer, 2021). This is evident in educational settings where recognition of excellence correlates with improved student outcomes and heightened motivation. Bliven, Jungbauer's (2021) research highlighted that formal recognition programmes can significantly impact students' motivation and self-efficacy, illustrating that acknowledgment is essential for sustaining engagement and performance in competency-based educational models. In work environments, Özek (2018) found that students' motivation levels increased when recognised through systems integrating emotional feedback, linking emotional engagement to academic success and satisfaction.

Furthermore, the dual nature of motivation – both intrinsic and extrinsic – can be enhanced through recognition. Intrinsic motivation is derived from internal satisfaction gained from achieving personal goals, while extrinsic motivation often arises from recognition and rewards from external sources like supervisors or organisations (Kalogiannidis, 2021). The latter is highlighted in contexts where self-efficacy is propelled by acknowledgment, leading to greater overall performance (Mulegi, 2023). Moreover, various studies have confirmed that different levels and types of recognition can cultivate a sense of belonging and security, fostering an atmosphere conducive to enhanced motivation (Liao et al., 2024). Whether through formal recognition programmes in educational institutions or gamification strategies in organisational settings, the positive relationship between recognition of achievement and motivational outcomes is well-supported by empirical evidence, suggesting that organisations and educational systems alike may benefit from implementing recognition frameworks to boost motivation and performance (Jansen, Samuel, 2014; Deutsch et al., 2019; Ejigu et al., 2023). The findings from these studies provide compelling evidence that achievement recognition aligns closely with individuals' motivational frameworks and influences their engagement levels. In light of the preceding discussion, we hypothesise that

H4: Recognition of achievement is positively related to KW's motivation.

2.7. Physical work environment

The physical characteristics of a workspace significantly influence employees' motivation levels. For instance, research by Bashir et al. (2020) highlights the relationship between adaptable work conditions and employee performance, suggesting that flexible work environments aid employees in performing tasks efficiently and without undue stress, thus enhancing their motivation levels. The authors assert that neglecting the importance of the work environment could lead to decreased motivation and job performance. This idea is supported by Heriyanto et al. (2018), who found that improved work environments positively correlate with increased employee motivation, contributing to enhanced job performance.

Furthermore, the role of the work environment in shaping motivation has been empirically supported by Handoko (2023), who connects a comfortable and adequately equipped work environment with higher employee engagement levels. His study demonstrates that when employees perceive their physical environment as supportive, their intrinsic motivation tends to increase, resulting in improved performance metrics. Along similar lines, Yulia & Lahindah (2024) emphasise that poor working conditions can reduce motivation and performance, thus highlighting the necessity of a conducive work environment to boost knowledge workers' productivity.

Moreover, the relationship between work motivation and the physical environment is further evidenced in studies addressing collective workplace conditions. For instance, a study by Febrilita et al. (2021) demonstrates that various factors related to the work environment, including physical comfort and organisational factors, affect employee motivation, indicating a comprehensive approach to understanding how different environmental elements influence performance outcomes. Additionally, Mubarok's (2022) analysis of the impact of leadership style and organisational culture on employee motivation reinforces the notion that an enriching work environment fosters motivation, thereby emphasising the importance of organisations focusing on both physical and non-physical aspects to optimise worker engagement. Drawing from the aforementioned discussion, we hypothesise that

H5: Physical work environment is positively related to KW's motivation.

3. METHODOLOGY

3.1. Methodological assumptions of the research

The primary purpose of this research is to analyse the various factors that influence the motivation of Knowledge Workers (KWs) within Pakistan's high-tech industry by utilising Self-Determination Theory (SDT) as a guiding framework.

Based on the literature review and the theoretical framework of SDT, five hypotheses (H1, H2, H3, H4, H5) were formulated (see fig. 1).

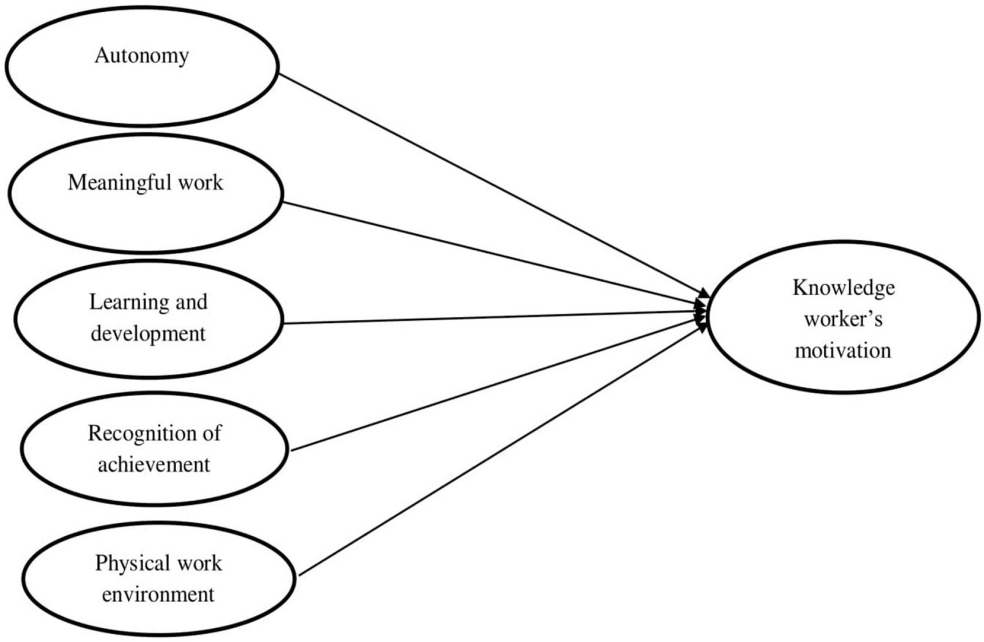

Fig. 1. Research model

3.1.1. Research Tools

To measure the key constructs of this study, established scales were adapted. Autonomy is measured using nine items adapted from Morgeson & Humphrey (2006). A sample survey item is "The role allows me to exercise my own initiative and judgment in performing the tasks". Meaningful work is measured using ten items obtained from Steger et al. (2012). A sample survey item is "I have discovered work that has a satisfying purpose". Learning and development is measured using ten items derived from Garvin et al. (2008), with a sample survey's item being "In this unit, time is made available for education and training activities". Recognition of achievement is measured with five items adapted from Cannon (2015). A sample item from this survey is "I receive congratulations from my supervisor when I reach specific goals". Finally, the physical work environment is measured using five items extracted from Morgeson & Humphrey (2006). A sample survey item is "The climate at the workplace is pleasant regarding temperature and humidity".

A structured, self-reported, and online questionnaire was used to collect responses. The questionnaire began with a brief introduction outlining the study

objectives and general instructions. It was divided into two sections: Section A comprised five items concerning the respondents' backgrounds and profiles. In particular, participants were asked to specify their gender, age, designation, years of work experience, and their top qualifications. In Section B, participants were requested to use a five-point Likert scale to assess all variable items in the survey, where 1 represents strongly disagree, and 5 represents strongly agree. In total, the survey consisted of 39 items, presented in a structured order.

3.1.2. Justification for the choice of tools

The selected measurement scales were chosen based on their established validity and reliability in previous organisational behaviour and motivation research, and their relevance to the constructs defined within the Self-Determination Theory framework. For instance, the Work Design Questionnaire (Morgeson, Humphrey, 2006), from which the autonomy and physical work environment items were adapted, is a comprehensive and widely validated measure for assessing job design. The Work and Meaning Inventory (Steger et al., 2012) is recognised for its robust measurement of meaningful work. The chosen scales for learning and development (Garvin et al., 2008) and recognition (Cannon, 2015) are also well regarded in their respective domains, ensuring that the data collected is both relevant and psychometrically sound for addressing the research hypotheses.

3.2. Sample and data collection

The research was carried out among KWs, including programmers (16.2%), design thinkers (11.9%), financial analysis (13.2%), researchers (13.9%), technical writers (11.9%), web designers (16.6%), and system analysts (15.9%) working in high-tech industry (see tab. 1). A total of 800 questionnaires were emailed to KWs from the high-tech industry in Pakistan selected using a simple random sampling technique. The responses of 484 employees over a time span of one month were received, which yielded a response rate of 60.5%. An additional 183 were discarded because they either displayed discrepancies in responding to the reverse statements, or all the questions were answered in the same way. Thus, only 301 valid questionnaires were retained for analysis in this study. The demographic profile of the 301 participants indicates a diverse sample, consisting of a wide variety of age, education, and experience, with an almost equal gender representation as seen in table 1.

Table 1. Demographic characteristics

	Demographic variables	Frequency	Percentage
Gender	Male	154	51.1
	Female	147	48.8
Age in years	20-25	3	1.0
	26-30	50	16.6
	31-35	105	34.9
	36-40	48	15.9
	41-45	31	10.3
	46-50	36	12.0
	51 and over	28	9.3
Education	Bachelor's Degree	97	32.2
	Master's Degree	137	45.5
	PhD	67	22.3
Working years	0-3 years	66	21.9
	4-5 years	92	30.6
	6-15 years	119	39.5
	16-20 years	20	6.6
	21 and over	4	1.3
Designation of respondents	Design thinker	36	11.9
	Financial analyst	40	13.2
	Programmer	49	16.2
	Researcher	42	13.9
	System analyst	48	15.9
	Technical writer	36	11.9
	Web designer	50	16.6

Source: own elaboration.

4. ANALYSIS AND RESULTS

This study applies structural equation modelling (SEM) to explore the causal relationships between latent variables within the research framework. SEM is a multivariate analysis technique that allows for the simultaneous evaluation of all factors and relationships within a research model (Almeida, 2024). It is particularly useful for estimating models that include latent variables assessed by multiple items, as is the case in this study. Following the recommendation of Anderson and Gerbing (1988), a two-stage analytical method was adopted. In the first stage, confirmatory factor analysis (CFA) was performed to assess the validity and reliability of the variables. In the second stage, SEM was performed to test the proposed hypotheses. The statistical analysis was carried out using IBM SPSS 25.0 and LISREL 10.20. A descriptive analysis in SPSS was first applied to examine the key attributes of the

dataset. The results of the questionnaire were then analysed in relation to insights gained from the literature, ensuring comprehensive interpretation of the findings.

4.1. Measurement model

CFA was conducted to analyse whether the observed variables are related to their corresponding latent variables. The measurement model was evaluated using standardised solutions. Preferably, the fit indices must match the suggested values while using LISREL (for the suggested fit indices values; see tab. 2). To assess model fit, these indices were evaluated based on researchers' recommended values (Hu, Bentler, 1999; Schumacker, Lomax, 2004). However, the fit indices for the scales – AUTONOMY, MWORK (meaningful work), LND (learning and development), RECOG (recognition of achievement), and WE (physical work environment) – did not meet acceptable thresholds, indicating a lack of unidimensionality. As a result, it was determined that purified scales should be acquired through the process of item reduction. This approach is a well-established practice in the field of management research (Bawa, 2004; Churchill Jr, 1979). To achieve a unidimensional model, CFA was conducted repeatedly. The standardised residual method was used for scale purification to obtain unidimensionality, following researchers' recommendations (Anderson, Gerbing, 1988; Yelkur et al., 2006). During each iteration, one item was eliminated based on the highest standardised residuals until an optimal model was obtained.

Table 2. Fit indices of CFA model for the original scales (AUT = 9 items, MW = 10 items, LD = 10 items, RA = 5 items, WE = 5 items)

Fit Indices	Ideal value	Developed model
Chi-square/Degree of freedom	< 3.00	3.78
NFI	> 0.90	0.80
NNFI	> 0.90	0.83
CFI	> 0.90	0.84
GFI	> 0.90	0.66
AGFI	> 0.90	0.62
IFI	> 0.90	0.84
RMSEA	< 0.08	0.096
SR	< 2.58	3.70

Source: own elaboration. Notes: NFI "normed fit index", NNFI "non-normed fit index", CFI "comparative fit index", GFI "goodness of fit index", AGFI "adjusted goodness of fit index", RMSEA "root mean square error of approximation", IFI "incremental fit index", and SR (standardised residual).

The above method of item reduction led to purified scales, indicating the attainment of unidimensionality. Since each item that is deleted impacts all other items, a prudent tactic was adopted, removing one item per process. With the help of an iterative process, stronger single-factor models were achieved. After refining the scale, the fit indices provided satisfactory values. Tables 2 and 3 present the fit indices for both the original and purified scales. In refined scales, the improved fit indices confirm the case of unidimensionality. The cumulative measurement model for the refined scales – AUTONOMY, MWORK, LND, RECOG, and WORKEN – is illustrated in figure 2. Once unidimensionality was determined, the scales underwent reliability and validity tests.

Table 3. Fit indices of CFA model for the refined scales (AUT = 4 items, MW = 5 items, LD = 5 items, RA = 4 items, WE = 4 items)

Fit Indices	Ideal value	Developed model
Chi-square/Degree of freedom	< 3.00	2.28
NFI	> 0.90	0.925
NNFI	> 0.90	0.949
CFI	> 0.90	0.956
GFI	> 0.90	0.882
AGFI	> 0.90	0.851
IFI	> 0.90	0.956
RMSEA	< 0.08	0.065
SR	< 2.58	3.51

Source: own elaboration. Notes: NFI "normed fit index", NNFI "non-normed fit index", CFI "comparative fit index", GFI "goodness of fit index", AGFI "adjusted goodness of fit index", RMSEA "root mean square error of approximation", IFI "incremental fit index", and SR (standardised residual).

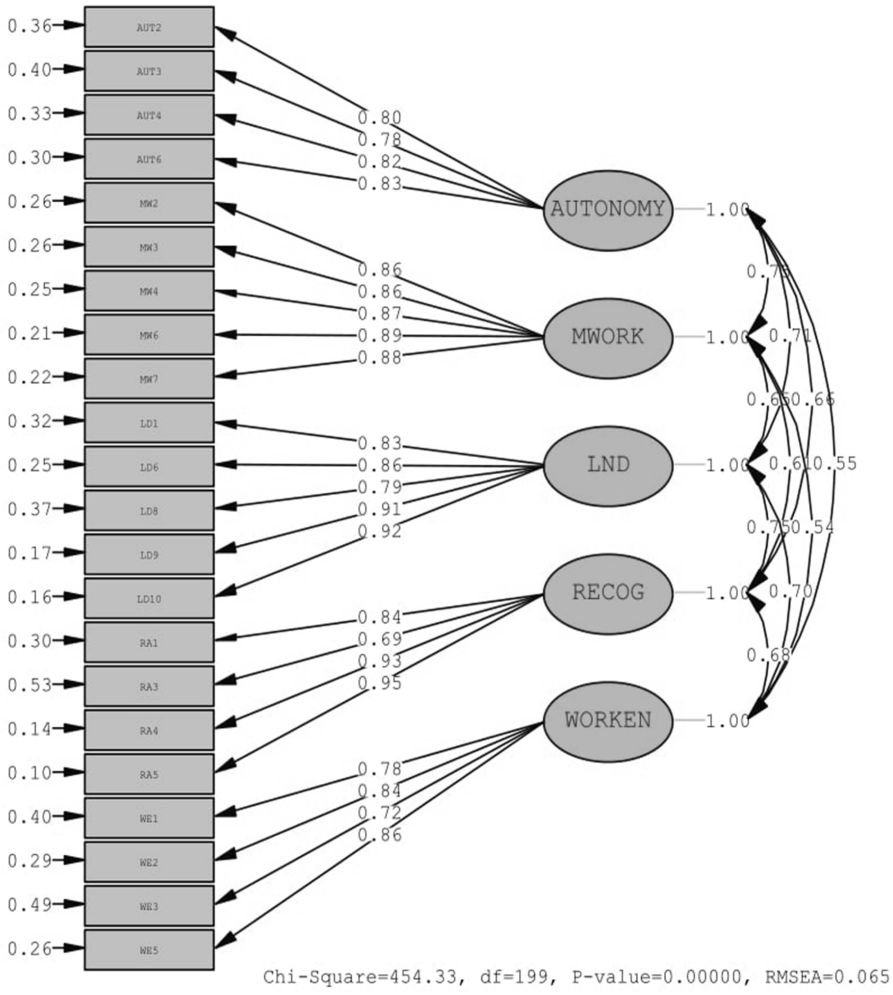

Fig. 2. CFA

4.2. Validity and reliability

The convergent validity signifies the degree to which the theoretically associated items of a scale must correlate strongly, and is measured by the significance and magnitude of the factor loadings of each item of the latent constructs (Anderson, Gerbing, 1988). To establish convergent validity, it is recommended that factor loadings should be equal to or exceed 0.70 (Fornell, Larcker, 1981). All the indicators were loaded on the expected factors at the p-value <0.01, and the standardised factor loadings were between 0.72 and 0.95 (tab. 4). Furthermore, according to Anderson and Gerbing (1988), if all the t-values exceed 2, convergent validity is confirmed.

Notably, the t-values in all cases were greater than 2 (tab. 4), which indicates high convergent validity.

Table 4. Properties of the measurement model

Constructs and Indicators	Completely Standardised loadings	t-value	Cronbach's alpha	Composite reliability	Average variance extracted
Autonomy			0.88	0.88	0.65
AUT2	0.80	16.1			
AUT3	0.78	15.4			
AUT4	0.82	16.6			
AUT6	0.83	17.2			
Meaningful work			0.94	0.94	0.76
MW2	0.86	18.4			
MW3	0.86	18.4			
MW4	0.87	18.7			
MW6	0.89	19.5			
MW7	0.88	19.3			
Learning and development			0.93	0.93	0.74
LD1	0.83	17.3			
LD6	0.86	18.7			
LD8	0.79	16.3			
LD9	0.91	20.4			
LD10	0.92	20.6			
Recognition of achievement			0.90	0.91	0.73
RA1	0.84	17.7			
RA3	0.69	13.3			
RA4	0.93	20.9			
RA5	0.95	21.9			
Physical work environment			0.87	0.87	0.64
WE1	0.78	15.5			
WE2	0.84	17.5			
WE3	0.72	13.8			
WE5	0.86	17.9			

Source: own elaboration.

The reliability of each latent construct was confirmed by Cronbach's alpha and composite reliability. The internal consistency of the variables is determined through Cronbach's alpha. A Cronbach alpha value of 0.7 or higher is considered the standard for a reliable scale (Nunnally, 1994). As shown in table 4, Cronbach's alpha surpassed the recommended threshold of 0.7 for each of the five constructs.

However, the alpha coefficient may sometimes miscalculate the reliability of the scale (Garver, Mentzer, 1999). Therefore, in addition to Cronbach's alpha, the construct-reliability was also calculated. All the constructs had composite reliability values higher than or equivalent to 0.70, which further improves the evaluation of the construct reliability. The construct reliability varied from 0.88 to 0.94 (tab. 4), again surpassing the minimum value of 0.70, which indicates satisfactory reliability (Hair et al., 2010).

For each construct, the average variance extracted (AVE) was calculated to confirm whether it was higher than or equivalent to 0.50, which implies that the variance due to the error of measurement is smaller than the variance described by the latent variable (Fornell, Larcker, 1981). As presented in table 4, the AVE values ranged from 0.64 to 0.94. Since all the values exceeded the 50% rule of thumb, this confirms adequate convergent validity (Hair et al., 2010).

Discriminatory validity demonstrates the degree to which the measure does not represent other variables. To assess this, the discriminatory validity amongst the factors was evaluated using the approach of Fornell and Larcker (1981). This method involves comparing the AVE squared root of each factor, given on the diagonal of table 5, with the correlations acquired from the measurement model, listed below the diagonal. Since the square roots of AVE values for the variables were higher than the correlations between a particular factor and others, discriminant validity was successfully established for all factors.

Table 5. Inter-construct correlations and squared root of AVEs

Constructs	AUT	MW	LD	RA	WE
AUT	0.80				
MW	0.74	0.87			
LD	0.70	0.65	0.86		
RA	0.66	0.60	0.74	0.85	
WE	0.55	0.54	0.69	0.68	0.8

Source: own elaboration. Notes: Square root of average variance extracted (AVE) can be seen in bold and diagonally. In the off-diagonal, correlations coefficients are shown; all correlations are significant at the 0.01 level.

4.3. The structural model and hypotheses testing

The hypothesised research model was evaluated using a structural model. To assess the mode, the maximum likelihood method was adopted. Structural equation modelling was chosen, as it has been shown to provide better results than conventional regression analysis (Iacobucci et al., 2007). For the structural model, the fit statistics appeared almost equal to those produced from the measurement model.

Moreover, the fit indices revealed that the research model was a suitable fit for the data (see tab. 7).

The outcomes of hypothesis testing are outlined in table 6. As shown in the table, the path coefficients for autonomy, meaningful work, learning and development, recognition of achievement, and physical work environment are 0.82, 0.77, 0.88, 0.84, and 0.76, respectively (see fig. 3). Since the t-value is higher than the critical value (1.366, $p < 0.01$, $N = 301$, for one-tailed), the path coefficients are significant. The results suggest that autonomy, meaningful work, learning and development, recognition of achievement, and physical work environment have direct positive effects on knowledge workers' motivation. Therefore, hypotheses 1, 2, 3, 4, and 5 are supported.

Table 6. Hypothesis testing results

Hypotheses	Path coefficient	t-value	Results
H1	0.82	12.79	Supported
H2	0.77	13.13	Supported
H3	0.88	14.69	Supported
H4	0.84	14.12	Supported
H5	0.76	11.61	Supported

Source: own elaboration.

Table 7. SEM goodness of fit statistics

Fit Indices	Ideal value	Developed model
Chi-square/Degree of freedom	< 3.00	2.39
NFI	> 0.90	0.91
NNFI	> 0.90	0.94
CFI	> 0.90	0.95
GFI	> 0.90	0.87
AGFI	> 0.90	0.84
RMSEA	< 0.08	0.068
IFI	> 0.90	0.95

Source: own elaboration. Notes: Notes: NFI "normed fit index", NNFI "non-normed fit index", CFI "comparative fit index", GFI "goodness of fit index", AGFI "adjusted goodness of fit index", RMSEA "root mean square error of approximation", and IFI "incremental fit index".

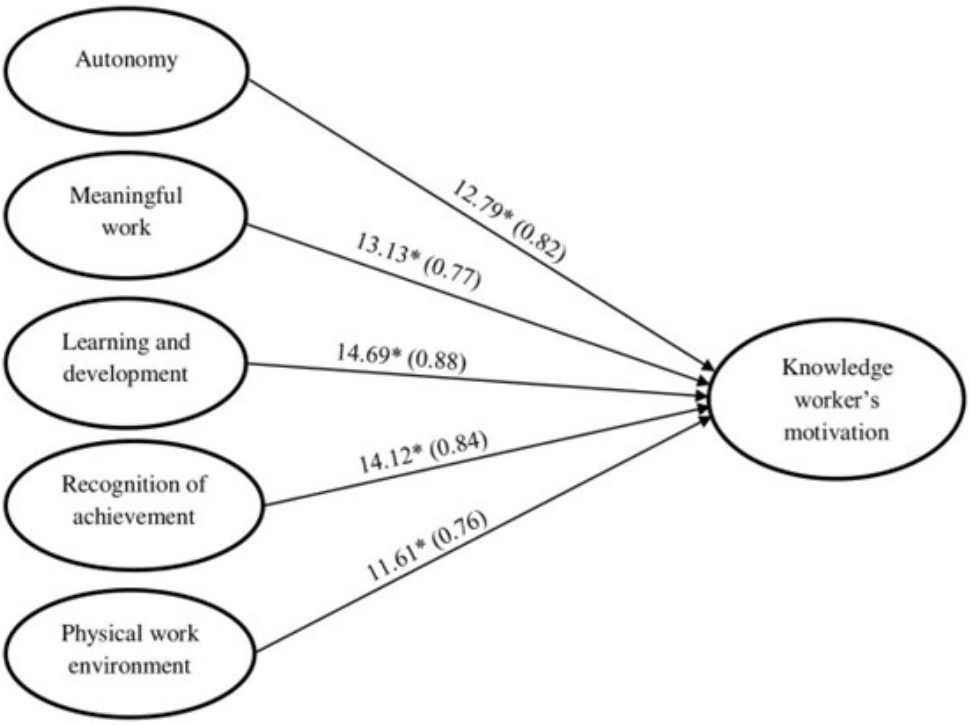

Fig. 3. SEM

5. DISCUSSION

The findings of this study provide critical insights into the motivational dynamics of knowledge workers (KWs) within Pakistan's burgeoning high-tech industry, corroborating and extending the theoretical and practical understanding of motivation in knowledge-intensive work environments. The empirical validation of all five hypotheses (H1-H5) underscores the significance of autonomy, meaningful work, learning and development, recognition of achievement, and physical work environment as pivotal drivers of KWs' motivation. These results align with the tenets of self-determination theory, which posit that fulfilling psychological needs for autonomy, competence, and relatedness fosters intrinsic motivation (Deci, Ryan, 2012).

The strong positive relationship between autonomy and motivation (H1: $\beta = 0.82$) resonates with SDT's emphasis on autonomy as a cornerstone of intrinsic motivation (Ryan, Deci, 2000). This finding aligns with prior studies highlighting that autonomy enables KWs to innovate, experiment, and take ownership of tasks (Zhang, Khan, 2024; Buch et al., 2014). In Pakistan's high-tech sector, where rapid technological advancements demand agility, granting autonomy may empower KWs

to navigate complex problems creatively, thereby enhancing their engagement and productivity. The result also mirrors Wang & Hong's (2020) assertion that autonomy reduces workplace loneliness, a factor particularly relevant in specialised roles, where collaboration and independence must coexist.

Meaningful work (H2: $\beta = 0.77$) emerged as another critical motivator, consistent with research linking perceived meaningfulness to psychological well-being and job satisfaction (Wingerden, Stoep, 2018; Ali et al., 2023). The high-tech industry's focus on innovation and problem-solving likely amplifies KWs' desire for purpose-driven roles. This aligns with Gagné et al.'s (1997) argument that meaningful work fulfils competence and relatedness needs by connecting employees to organisational goals. In emerging economies like Pakistan, where job-hopping is prevalent, fostering meaningfulness could mitigate turnover by strengthening emotional and intellectual ties to work.

The strongest predictor of motivation was learning and development (H3: $\beta = 0.88$), underscoring its centrality in high-tech environments characterised by rapid skill obsolescence. This finding extends Al-Kazlah & Badkook's (2022) and Jaya & Nasution's (2024) work, emphasising that continuous learning opportunities not only enhance competence but also signal organisational investment in KWs' growth. In Pakistan's context, where access to advanced training may be limited, structured development programmes could serve as a strategic tool to retain talent and bridge skill gaps.

Recognition of achievement (H4: $\beta = 0.84$) further validated SDT's competence dimension, as acknowledgment reinforces self-efficacy and validates contributions (Wang et al., 2019; Bliven, Jungbauer, 2021). The cultural context of Pakistan, which emphasises collectivism and social validation, might amplify the impact of recognition compared to individualistic societies. This suggests that formal recognition programmes could be particularly effective in fostering motivation and loyalty among Pakistani KWs.

Finally, the physical work environment (H5: $\beta = 0.76$) demonstrated a robust influence, aligning with studies linking ergonomic and adaptive workspaces to productivity (Bashir et al., 2020; Yulia, Lahindah, 2024). In emerging markets, where infrastructural challenges may exist, ensuring comfortable and resource-rich environments could disproportionately enhance motivation by addressing basic unmet needs, thereby freeing cognitive resources for complex tasks.

5.1. Theoretical and practical implications

The theoretical implications of this study lie in its extension and validation of self-determination theory within the context of knowledge workers in Pakistan's high-tech industry, an emerging economy setting previously underexplored in motivation literature. By empirically confirming that autonomy, meaningful work, learning and development, recognition of achievement, and physical work

environment significantly enhance KWs' motivation, the research reinforces SDT's core tenets – autonomy, competence, and relatedness – while broadening its applicability to non-Western, knowledge-intensive sectors. The findings highlight the critical role of competence-building through continuous learning, positioning it as the strongest motivator, which underscores the dynamic nature of skill demands in high-tech environments and enriches SDT by emphasising context-specific drivers. Furthermore, the integration of environmental and cultural factors, such as the amplified impact of recognition in collectivist settings, suggests that motivational frameworks may require cultural and contextual adaptations, challenging universalist assumptions in existing theories.

The study's findings also offer several important managerial implications for high-tech companies in Pakistan and similar emerging markets. Organisations should focus on enhancing learning opportunities by developing robust training programmes and clear career advancement paths, as these initiatives not only improve skills but also significantly boost motivation among knowledge workers. Moreover, creating job roles that offer a high degree of autonomy can empower employees to exercise personal judgment and foster innovation, thereby leading to increased engagement and proactive behaviour. It is equally important to cultivate an environment where work is perceived as meaningful; when employees understand the broader impact of their roles, they tend to exhibit higher levels of commitment and satisfaction. Regular acknowledgment of individual achievements can further strengthen self-efficacy and drive, contributing to improved overall performance. Lastly, optimising the physical work environment is crucial, since investments in ergonomically sound and flexible workspaces can reduce stress and promote a creative, collaborative atmosphere that supports sustained motivation.

5.2. Limitations and future research

While this study provides valuable insights, it is not without its limitations. Firstly, the study is cross-sectional in nature, which limits the ability to establish causal connections between the constructs. Future studies could adopt a longitudinal design to explore the causal effects of these motivational factors over time. Secondly, the study focuses on KWs in Pakistan's high-tech industry, which may restrict the applicability of the findings to other industries or countries. Future studies could explore the motivational factors of KWs across various industries and cultural contexts to offer a broader insight into the phenomenon. Thirdly, the study is based on self-reported data, which could potentially introduce response bias. Future research could use multiple data sources, such as supervisor ratings or objective performance metrics, to validate the findings.

6. CONCLUSION

This study set out to investigate the key motivational factors for knowledge workers within Pakistan's high-tech industry, an area identified as lacking localised research despite its growing economic importance. The research was premised on the applicability of Self-Determination Theory to understand these drivers. The empirical findings provided compelling support for all five proposed hypotheses, demonstrating that autonomy (H1), meaningful work (H2), learning and development (H3), recognition of achievement (H4), and a supportive physical work environment (H5) are significant positive predictors of KW motivation in this context. These results directly address the initial premises of the study by identifying concrete, actionable factors that align with the core psychological needs of autonomy, competence, and relatedness as outlined by SDT. The findings extend its application within an emerging market, offering valuable insights for both scholars and practitioners. For organisations striving to maintain a competitive edge, the strategic implementation of these motivational factors can lead to enhanced employee performance, increased innovation, and overall organisational success. While the study's limitations highlight the need for further research, the recommendations offered pave the way for future investigations aimed at refining and expanding our understanding of motivation in knowledge-intensive work settings.

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ODBLOKOWANIE MOTYWACJI: KLUCZOWE CZYNNIKI MOTYWUJĄCE PRACOWNIKÓW WIEDZY W PAKISTAŃSKIM PRZEMYŚLE ZAAWANSOWANYCH TECHNOLOGII

Streszczenie

W artykule zanalizowano kluczowe czynniki wpływające na motywację pracowników wiedzy (*knowledge workers*) w pakistańskim przemyśle zaawansowanych technologii. Ponieważ role wymagające dużej wiedzy stają się coraz ważniejsze w dzisiejszym konkurencyjnym środowisku biznesowym, zrozumienie motywatorów napędzających KW ma kluczowe znaczenie dla poprawy wyników firmy i możliwości zatrzymania w niej utalentowanych pracowników. Opierając się na teorii samostanowienia (SDT), w artykule zanalizowano wpływ pięciu podstawowych czynników motywacyjnych – autonomii, znaczącej pracy, uczenia się i rozwoju, uznania osiągnięć i fizycznego środowiska pracy – na motywację KW. Za pomocą ustrukturyzowanego kwestionariusza zebrano dane od 301 KW pełniących różne funkcje w pakistańskim sektorze zaawansowanych technologii. Do analizy związków między tymi czynnikami zastosowano modelowanie równań strukturalnych (SEM). Wyniki pokazują, że wszystkie pięć elementów motywacyjnych znacząco i pozytywnie wpływa na motywację KW, przy czym uczenie się i rozwój okazały się najsilniejszym predyktorem. Wyniki te stanowią wkład w istniejącą literaturę przedmiotu, oferując empiryczne dowody na motywację KW w kontekście gospodarki wschodzącej. Badanie dostarcza również praktycznych wskazówek dla menedżerów i osób tworzących politykę kadrową, którzy starają się kształtować środowisko zwiększające zaangażowanie, innowacyjność i produktywność wśród KW.

Słowa kluczowe: Pakistan, pracownicy wiedzy, teoria autodeterminacji, przemysł high-tech, motywacja