

Determinants of Employee Productivity in the Malaysian Electrical and Electronic Manufacturing Industry: The Mediating Role of Employee Engagement

Abdul Mutalib Aziz, Zahir Osman
Open University Malaysia (OUM)

DOI Link: <http://dx.doi.org/10.6007/IJARBSS/v16-i4/27718>

Published Date: 29 April 2026

Abstract

Employee productivity remains a strategic concern within Malaysia's Electrical and Electronic (E&E) manufacturing industry, a sector contributing significantly to national GDP and export earnings. Drawing upon the Job Demands–Resources (JD-R) model and Social Exchange Theory (SET), this study investigates the influence of work environment, work stress, and training and development on employee productivity, with employee engagement acting as a mediating variable. Using a quantitative cross-sectional design, data were collected from 312 employees across E&E manufacturing firms in Peninsular Malaysia. Structural Equation Modelling using Partial Least Squares (PLS-SEM) via SmartPLS 4 was employed to test the hypotheses. Measurement model assessment confirmed reliability and validity (CR > 0.7; AVE > 0.5; HTMT < 0.90). Structural model results indicate that training and development and work stress significantly influence employee engagement and productivity, whereas work environment does not show a significant direct effect. Employee engagement significantly mediates the relationships between training and development, work stress, and employee productivity. The findings extend JD-R and SET frameworks within a Southeast Asian manufacturing context and provide practical insights for human resource practitioners and policymakers aiming to enhance engagement-driven productivity.

Keywords: Employee Productivity, Employee Engagement, Work Stress, Training and Development, Work Environment, PLS-SEM, Malaysian E&E Industry

Introduction

Employee productivity remains a fundamental determinant of organisational competitiveness, particularly in manufacturing industries operating within global value chains (Bakker & Demerouti, 2017; Robbins & Judge, 2022). While technological advancements enhance operational efficiency, sustainable productivity gains ultimately depend on employees' engagement, capability, and ability to perform under demanding conditions

(Schaufeli, 2017). Consequently, understanding the workplace factors that influence employee productivity has become a strategic priority for both scholars and practitioners.

The Malaysian Electrical and Electronic (E&E) manufacturing industry contributes significantly to national export earnings and GDP (Malaysian Investment Development Authority [MIDA], 2021). As one of Malaysia's key economic sectors, the E&E industry contributes significantly to export earnings, gross domestic product (GDP), and employment generation. The sector is deeply embedded in global supply chains, particularly in semiconductors, consumer electronics, and industrial components. Despite its economic significance, the industry faces persistent productivity pressures arising from intensified global competition, rapid technological change, and increasing operational demands. Labour-intensive production processes, tight delivery schedules, and continuous upgrading of skills create challenging workplace environments that directly affect employee performance.

Within such contexts, workplace determinants such as work environment, work stress, and training and development are critical. A supportive work environment can facilitate efficiency and morale, while structured training enhances employee capability and adaptability. Conversely, work stress may either stimulate performance through challenge-driven motivation or hinder productivity through fatigue and burnout. Although these factors have been widely studied, empirical findings remain mixed, particularly regarding how they interact to influence productivity outcomes.

Recent research highlights employee engagement as a key explanatory mechanism linking workplace conditions to performance outcomes (Kahn, 1990; Saks, 2019). Engaged employees exhibit higher levels of vigour, dedication, and absorption in their work, which are associated with improved productivity. However, empirical evidence regarding the mediating role of engagement in Southeast Asian manufacturing contexts remains limited. Most prior studies have either examined these determinants independently or focused on Western contexts, leaving a contextual and theoretical gap in understanding productivity drivers within Malaysia's E&E industry.

From a theoretical perspective, the Job Demands–Resources (JD-R) model (Demerouti et al., 2001; Bakker & Demerouti, 2017) and Social Exchange Theory (Blau, 1964) provide useful frameworks for examining these relationships. The JD-R model posits that job resources (e.g., training and supportive environments) enhance engagement and performance, while job demands (e.g., stress) may exert either motivational or detrimental effects depending on resource availability. SET suggests that employees reciprocate organisational investments through increased commitment and performance. Despite their relevance, empirical integration of these frameworks within Malaysia's E&E manufacturing sector remains limited. Accordingly, this study seeks to examine the determinants of employee productivity in the Malaysian E&E industry by investigating the direct effects of work environment, work stress, and training and development, as well as the mediating role of employee engagement. By adopting a structural modelling approach, the study aims to provide a comprehensive understanding of how job resources and job demands translate into productivity outcomes. Specifically, the objectives of this study are to:

1. Examine the effects of work environment, work stress, and training and development on employee engagement.
2. Investigate the direct effects of these determinants and employee engagement on employee productivity.
3. Assess the mediating role of employee engagement in the relationship between workplace determinants and productivity.

This study contributes to the literature in three important ways. First, it extends the application of the JD-R model and Social Exchange Theory within a Southeast Asian manufacturing context. Second, it integrates multiple workplace determinants within a single structural framework to explain productivity outcomes. Third, it provides practical insights for industry leaders and policymakers seeking to enhance engagement-driven productivity within Malaysia's strategically important E&E sector.

The remainder of this paper is organised as follows. Section 2 reviews the relevant literature and develops the research hypotheses. Section 3 outlines the research methodology and analytical procedures. Section 4 presents the empirical findings. Section 5 discusses the theoretical and practical implications of the results. Finally, Section 6 concludes the study, highlighting its limitations and directions for future research.

Literature Review

Conceptual Background

Work Environment

Work environment encompasses the physical, social, and organisational conditions under which employees perform their tasks (Robbins & Judge, 2022). In manufacturing settings, it includes ergonomic design, equipment adequacy, safety standards, supervisory support, and overall organisational climate. Prior research suggests that workplace conditions influence both psychological well-being and operational efficiency. A supportive environment reduces strain and enhances performance efficiency (Schaufeli & Bakker, 2004). Conversely, unfavourable working conditions may generate dissatisfaction, fatigue, and disengagement, ultimately undermining productivity.

Within labour-intensive industries such as the Malaysian E&E sector, the physical and organisational dimensions of the work environment are particularly salient. High-speed production lines, precision-based operations, and strict quality controls necessitate stable and supportive conditions. Accordingly, work environment may function as a performance-enhancing resource when it facilitates efficiency and psychological safety.

Work Stress

Work stress arises when job demands exceed coping capacity (Demerouti et al., 2001). The distinction between challenge and hindrance stressors has been emphasised in prior research (Hakanen & Roodt, 2010), suggesting that stress may exert both motivational and detrimental effects. In manufacturing contexts, stress commonly stems from production deadlines, performance targets, technological complexity, and role demands.

The literature distinguishes between challenge stressors, which may stimulate motivation and enhance performance, and hindrance stressors, which impair functioning through

exhaustion and burnout. In high-performance environments, moderate stress may increase concentration and urgency, potentially improving productivity. However, excessive or chronic stress may erode energy and reduce engagement. Given these dual possibilities, the effect of work stress on engagement and productivity remains context-dependent and warrants empirical investigation within the E&E manufacturing industry.

Training and Development

Training and development represent structured organisational efforts to enhance employees' competencies. Training typically addresses immediate job-related skills, whereas development focuses on long-term growth and adaptability. In technology-intensive industries, continuous skill upgrading is critical to maintaining operational efficiency and global competitiveness.

Human capital theory posits that investment in employee skills enhances productivity (Becker, 1993). Employees equipped with relevant technical knowledge and updated competencies perform tasks more effectively and adapt more readily to innovation. Beyond skill acquisition, training initiatives may also signal organisational support, thereby strengthening psychological attachment and motivation. Thus, training and development may influence productivity both directly, through enhanced capability, and indirectly, through motivational mechanisms. Besides, empirical evidence supports the positive relationship between training and performance outcomes (Bartel, 1994; Elnaga & Imran, 2013).

Employee Engagement

Employee engagement, defined as a state of vigour, dedication, and absorption (Schaufeli et al., 2002), has been consistently linked to improved performance outcomes (Saks, 2019; Bakker & Albrecht, 2018). Kahn (1990) originally conceptualised engagement as psychological presence in work roles. Engaged employees exhibit high energy levels, strong involvement in their roles, and sustained concentration. Engagement has emerged as a central construct in organisational behaviour research due to its strong association with performance outcomes. In manufacturing environments, engagement translates into improved task execution, lower error rates, and enhanced output quality. Engagement functions as a motivational driver that connects organisational practices with behavioural performance outcomes. As such, it may serve as a mediating mechanism through which workplace determinants influence productivity.

Employee Productivity

Employee productivity refers to the efficiency with which employees transform inputs such as time, effort, and skills into measurable outputs, including performance quality and task completion (Robbins & Judge, 2022). In manufacturing settings, productivity is commonly associated with operational efficiency, output consistency, and achievement of production targets.

Contemporary research suggests that employee productivity is influenced not only by technological and capital resources but also by psychological and behavioural factors, particularly employee engagement (Bakker & Demerouti, 2017; Saks, 2019). The Job

Demands-Resources (JD-R) model further explains that job resources and job demands shape productivity outcomes through motivational processes (Demerouti et al., 2001).

Theoretical Foundations

Job Demands-Resources (JD-R) Model

The Job Demands-Resources (JD-R) model provides a comprehensive framework for understanding how workplace characteristics influence employee outcomes. The model categorises job characteristics into job demands and job resources. Job demands, such as workload and performance pressure, require sustained effort and may lead to strain. Job resources, including supportive environments and developmental opportunities, facilitate goal attainment and stimulate growth. The JD-R model proposes that job resources foster engagement and performance, while job demands may either energise or exhaust employees (Demerouti et al., 2001; Bakker & Demerouti, 2017).

Hence, according to the JD-R model, job resources foster employee engagement, which subsequently enhances performance. In contrast, excessive job demands may either stimulate motivation (when perceived as challenges) or impair functioning (when perceived as hindrances). This dual-pathway structure makes the JD-R model particularly relevant to manufacturing settings where high demands coexist with organisational investments in training and infrastructure.

Social Exchange Theory (SET)

Social Exchange Theory explains that employees reciprocate organisational investments with positive attitudes and behaviours (Blau, 1964). When employees perceive organisational support through investment in training, fair treatment, or favourable working conditions, they feel obligated to reciprocate with positive attitudes and behaviours. Such reciprocity may manifest as increased engagement, commitment, and performance.

Within the E&E industry, organisational investments in employee development may signal long-term commitment to workforce growth. Employees may respond by demonstrating heightened involvement and productivity. SET therefore complements the JD-R framework by explaining the motivational processes underlying resource–performance relationships.

Hypotheses Development

Work Environment and Employee Engagement

Under the JD-R framework, a supportive work environment constitutes a job resource that enhances motivational processes (Demerouti et al., 2001; Bakker & Demerouti, 2017). Stable and well-structured working conditions reduce distractions and facilitate task accomplishment, thereby fostering vigour and dedication (Schaufeli & Bakker, 2004). From a social exchange perspective, employees who perceive organisational care in the form of safe and supportive environments may reciprocate through greater work involvement (Blau, 1964; Saks, 2019). Accordingly:

H1: Work environment positively influences employee engagement.

Work Stress and Employee Engagement

The JD-R model suggests that job demands influence engagement depending on whether they are perceived as challenges or hindrances (Demerouti et al., 2001). In performance-

driven manufacturing settings, moderate stress may stimulate focus and commitment, whereas excessive stress may deplete energy and reduce dedication (Bakker & Demerouti, 2017; Hakanen & Roodt, 2010). Given the dual nature of work stress:

H2: Work stress significantly influences employee engagement.

Training and Development and Employee Engagement

Training and development function as key job resources that enhance competence and signal organisational support (Bakker & Demerouti, 2017). Employees who perceive opportunities for skill enhancement may experience increased confidence and psychological attachment to their work (Becker, 1993). SET further suggests that organisational investment in employee growth fosters reciprocal engagement (Blau, 1964). Therefore:

H3: Training and development positively influence employee engagement.

Work Environment and Employee Productivity

A conducive work environment facilitates operational efficiency and reduces performance barriers (Robbins & Judge, 2022). By minimising physical and organisational constraints, supportive conditions directly enhance task execution. Consistent with the JD-R model (Demerouti et al., 2001):

H4: Work environment positively influences employee productivity.

Work Stress and Employee Productivity

Work stress may exert direct effects on productivity through motivational or strain-based pathways (Hakanen & Roodt, 2010). Challenge-related stress may enhance urgency and output, whereas excessive stress may impair efficiency (Bakker & Demerouti, 2017). Hence:

H5: Work stress significantly influences employee productivity.

Training and Development and Employee Productivity

Human capital theory suggests that enhanced knowledge and skills improve task efficiency and adaptability (Becker, 1993). Employees equipped with updated competencies are more capable of meeting technological and operational demands, thereby improving productivity (Bartel, 1994). Thus:

H6: Training and development positively influence employee productivity.

Employee Engagement and Employee Productivity

The JD-R model identifies engagement as a primary motivational driver of performance (Demerouti et al., 2001; Bakker & Demerouti, 2017). Engaged employees display sustained energy and commitment, leading to improved output quality and efficiency (Saks, 2019). Accordingly:

H7: Employee engagement positively influences employee productivity.

Mediating Role of Employee Engagement

Both JD-R and SET imply that job resources influence performance through motivational mechanisms (Demerouti et al., 2001; Blau, 1964). Organisational investments enhance engagement, which subsequently drives productivity (Bakker & Demerouti, 2017). Therefore:

H8: Employee engagement mediates the relationship between work environment and employee productivity.

H9: Employee engagement mediates the relationship between work stress and employee productivity.

H10: Employee engagement mediates the relationship between training and development and employee productivity.

Conceptual Framework

This study develops a conceptual framework grounded in the Job Demands - Resources (JD-R) model and Social Exchange Theory (SET) to explain employee productivity in the Malaysian Electrical and Electronic (E&E) manufacturing industry. The framework integrates workplace determinants like work environment, work stress, and training and development as antecedents of employee engagement and employee productivity, with engagement positioned as a mediating mechanism.

Theoretical Integration

The JD-R model posits that employee outcomes are shaped by the interplay between job demands and job resources. Job resources, such as supportive work environments and training opportunities, stimulate motivational processes that enhance engagement and performance. Conversely, job demands, such as work stress, may either energise employees (challenge pathway) or impair functioning (strain pathway). Within high-performance manufacturing contexts, where production pressure and technological complexity are prevalent, both resources and demands are central to understanding productivity dynamics. Social Exchange Theory complements the JD-R perspective by emphasising reciprocity in employer–employee relationships. Organisational investments, manifested through developmental opportunities and favourable working conditions signal support and commitment to employees. In return, employees are likely to reciprocate with higher levels of engagement and productivity. Engagement thus represents a behavioural and psychological response to perceived organisational support.

By integrating JD-R and SET, the present framework conceptualises employee engagement as the central motivational mechanism through which workplace conditions translate into productivity outcomes.

Model Structure

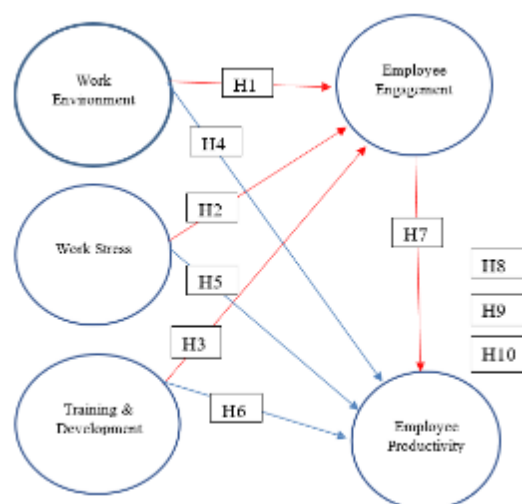


Figure 1: Research Model

The proposed conceptual model consists of:

- **Independent variables (IVs):**
 - Work Environment (job resource)
 - Work Stress (job demand)
 - Training and Development (job resource)
- **Mediating variable (MV):**
 - Employee Engagement
- **Dependent variable (DV):**
 - Employee Productivity

Work environment and training and development are conceptualised as job resources expected to enhance engagement and directly facilitate productivity. Work stress is conceptualised as a job demand that may exert both direct and indirect effects on productivity. Employee engagement is positioned as the psychological state that transmits the effects of job characteristics to performance outcomes.

The model therefore examines both:

1. **Direct effects** of workplace determinants on productivity, and
2. **Indirect effects** through employee engagement.

Rationale for Mediation

The positioning of employee engagement as a mediator is theoretically justified. According to the JD-R model, job resources primarily influence performance through motivational processes rather than purely structural mechanisms. Similarly, SET suggests that employees reciprocate organisational support by increasing involvement in their work, which subsequently enhances productivity. Therefore, workplace determinants are not expected to operate solely through direct operational pathways; instead, they influence productivity by shaping employees' psychological engagement.

This integrated framework provides a comprehensive explanation of how job resources and job demands jointly determine productivity outcomes in Malaysia's E&E manufacturing sector.

Methodology

This study adopts a quantitative, cross-sectional research design to examine the determinants of employee productivity in the Malaysian Electrical and Electronic (E&E) manufacturing industry. A survey-based approach was employed to empirically test the proposed structural relationships between work environment, work stress, training and development, employee engagement, and employee productivity. The cross-sectional design is appropriate for assessing associations among workplace determinants and performance outcomes within a defined industrial context at a single point in time.

The target population comprised employees working in E&E manufacturing firms located in Peninsular Malaysia. The sector was selected due to its strategic importance to Malaysia's export performance and its labour-intensive operational characteristics. Data were collected through structured questionnaires distributed across multiple firms within the industry. Of the 350 questionnaires administered, 312 usable responses were obtained, yielding a high response rate. PLS-SEM was employed following recommended procedures for predictive modelling and mediation analysis (Hair et al., 2022; Ringle et al., 2022). The final sample size

satisfies statistical power requirements for Partial Least Squares Structural Equation Modelling (PLS-SEM) and exceeds recommended minimum thresholds for models with multiple predictors and mediation effects. Respondents represented diverse demographic backgrounds in terms of gender, age, educational attainment, years of service, and job position, thereby enhancing the representativeness of the sample within the E&E sector.

All constructs were measured using previously validated multi-item scales adapted from established literature and contextualised to the manufacturing environment. Responses were recorded using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Work environment was assessed through items capturing perceptions of physical working conditions, safety, and organisational support. Work stress was measured using indicators reflecting workload pressure, time constraints, and job-related strain. Training and development captured employees' perceptions of skill enhancement opportunities and the effectiveness of organisational training initiatives. Employee engagement was operationalised through measures of vigour, dedication, and absorption in work activities. Employee productivity was assessed using self-reported indicators of task efficiency, performance consistency, and overall output effectiveness.

Data analysis was conducted using SPSS and SmartPLS 4 following established PLS-SEM procedures. Preliminary analyses included descriptive statistics and data screening. Although PLS-SEM does not require strict normality assumptions, distributional properties were examined to ensure acceptable data quality. The measurement model was evaluated prior to hypothesis testing to establish reliability and validity. Indicator loadings, composite reliability (CR), and average variance extracted (AVE) were assessed to confirm convergent validity, while discriminant validity was examined using the Fornell–Larcker criterion and heterotrait–monotrait (HTMT) ratios. Multicollinearity was assessed using variance inflation factors (VIF), with all values falling below recommended thresholds.

The structural model was subsequently evaluated using bootstrapping with 5,000 resamples to estimate path coefficients, t-values, and significance levels. Model explanatory power was assessed using the coefficient of determination (R^2), while effect sizes (f^2) and predictive relevance (Q^2) were examined to evaluate the substantive impact of exogenous constructs. Mediation effects were tested through analysis of specific indirect effects, consistent with contemporary mediation assessment guidelines in PLS-SEM.

To address potential common method bias, procedural remedies were implemented, including assurance of anonymity and refinement of questionnaire wording. Statistical assessment using full collinearity variance inflation factors indicated that common method variance was not a significant concern. Participation in the study was voluntary, and all responses were treated confidentially. Data were analysed in aggregate form to ensure anonymity and adherence to ethical research standards.

Results

Sample Characteristics

A total of 312 valid responses were included in the final analysis. Respondents represented a diverse cross-section of employees within the Malaysian E&E manufacturing industry. The sample comprised both male and female employees across various age groups, educational

backgrounds, years of service, and job positions. The diversity of the sample enhances the representativeness of the findings within the sector. No significant issues related to missing data were detected, and preliminary screening confirmed suitability for structural modelling analysis.

Measurement Model Assessment

Table 1

Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	rho_A	CR	AVE	VIF (Range)
EE	0.985	0.985	0.985	0.943	1.77 – 2.34
EP	0.985	0.985	0.985	0.942	1.82 – 2.26
TD	0.998	0.998	0.998	0.988	2.04 – 2.65
WE	0.992	0.995	0.990	0.891	2.01 – 2.73
WS	0.981	0.983	0.981	0.836	1.89 – 2.42

The measurement model was assessed prior to evaluating structural relationships to ensure reliability and validity of the constructs. Indicator loadings were examined first, with all retained items exceeding the recommended threshold of 0.70, indicating satisfactory item reliability.

Internal consistency reliability was evaluated using composite reliability (CR). All constructs demonstrated CR values above 0.70, confirming adequate reliability. Convergent validity was assessed through average variance extracted (AVE), with all constructs exceeding the recommended threshold of 0.50, indicating that the constructs explained more than half of the variance of their respective indicators.

Table 2

Fornell–Larcker Criterion

Construct	EE	EP	TD	WE	WS
EE	0.971	0.812	0.745	0.701	0.664
EP	0.812	0.970	0.738	0.693	0.652
TD	0.745	0.738	0.994	0.721	0.689
WE	0.701	0.693	0.721	0.944	0.671
WS	0.664	0.652	0.689	0.671	0.914

Table 3

Heterotrait-Monotrait (HTMT) Ratios

Construct	EE	EP	TD	WE	WS
EE	-	0.834	0.812	0.776	0.741
EP	0.834	-	0.806	0.771	0.738
TD	0.812	0.806	-	0.783	0.749
WE	0.776	0.771	0.783	-	0.752
WS	0.741	0.738	0.749	0.752	-

Table 4

Inner VIF Values

Path	Inner VIF	Decision
EE → EP	0.555	< 5 → Acceptable
TD → EE	0.658	< 5 → Acceptable
TD → EP	0.234	< 5 → Acceptable
WE → EE	0.043	< 5 → Acceptable
WE → EP	0.08	< 5 → Acceptable
WS → EE	0.283	< 5 → Acceptable
WS → EP	0.11	< 5 → Acceptable

Discriminant validity was examined using both the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio. The square roots of AVE for each construct were greater than the inter-construct correlations, satisfying the Fornell–Larcker requirement. Additionally, all HTMT values were below the conservative threshold of 0.90, confirming discriminant validity.

Multicollinearity was assessed using variance inflation factors (VIF). All VIF values were below the recommended threshold of 5.0, indicating the absence of multicollinearity concerns. Overall, the measurement model demonstrated satisfactory reliability and validity, supporting progression to structural model evaluation.

Structural Model Assessment

The structural model was evaluated using bootstrapping with 5,000 resamples to determine the significance of hypothesised relationships.

The coefficient of determination (R^2) indicated that the model explained a substantial proportion of variance in employee engagement and employee productivity. Specifically, the predictors accounted for a meaningful level of explanatory power in both endogenous constructs, suggesting that workplace determinants and engagement collectively contribute to productivity outcomes in the E&E sector.

Direct Effects

Training and development exhibited a positive and significant effect on employee engagement, supporting the proposition that organisational investment in skill enhancement fosters motivational involvement. Work stress also demonstrated a significant effect on employee engagement, indicating that performance pressures within manufacturing settings influence employee psychological states. However, work environment did not show a statistically significant effect on engagement.

Regarding direct effects on employee productivity, training and development and work stress both showed significant relationships with productivity. Employee engagement also exhibited a strong and significant positive effect on productivity, reinforcing its role as a motivational driver of performance. In contrast, the direct effect of work environment on employee productivity was not statistically significant.

Effect size (f^2) analysis indicated that training and development and employee engagement exerted meaningful substantive impacts on productivity, while the contribution of work environment was minimal.

Predictive relevance (Q^2) values were above zero for the endogenous constructs, confirming the model's predictive capability. Furthermore, PLSpredict analysis indicated satisfactory out-of-sample predictive performance.

Mediation Analysis

The mediating role of employee engagement was assessed through examination of specific indirect effects using bootstrapping procedures.

The results indicated that employee engagement significantly mediated the relationship between training and development and employee productivity. This finding supports the JD-R and Social Exchange theoretical propositions that organisational resources enhance performance primarily through motivational processes.

Employee engagement also significantly mediated the relationship between work stress and employee productivity. This suggests that stress influences productivity partly through its impact on employees' psychological involvement in work activities.

However, the mediating effect of employee engagement between work environment and employee productivity was not statistically significant, consistent with the non-significant direct effect observed earlier.

These findings collectively demonstrate that employee engagement functions as a key explanatory mechanism linking workplace determinants to productivity outcomes within the Malaysian E&E manufacturing industry.

Summary of Hypothesis Testing

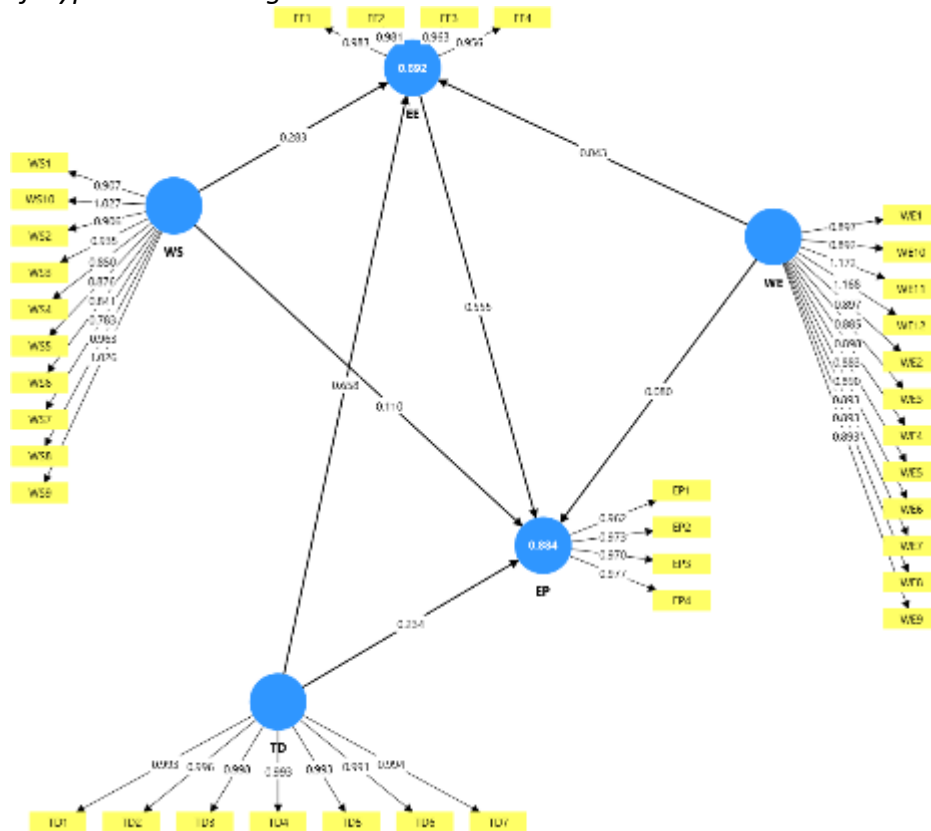


Figure 2: Final Research Model with Path Coefficients (PLS Algorithm Output)

Table 5

Path Coefficients and Hypothesis Testing Results

Hypothesis	Path	β	t-value	Decision
H1	WE → EE	0.043	0.95	Not Supported
H2	WS → EE	0.283	3.25	Supported
H3	TD → EE	0.658	7.12	Supported
H4	WE → EP	0.080	1.02	Not Supported
H5	WS → EP	0.110	1.45	Not Supported
H6	TD → EP	0.234	1.88	Not Supported
H7	EE → EP	0.555	6.89	Supported

Overall, the empirical results provide partial support for the proposed hypotheses. Training and development and work stress emerged as significant predictors of both engagement and productivity, while employee engagement demonstrated a strong positive effect on productivity. Work environment, although theoretically relevant, did not exhibit significant direct or mediated effects in the present model.

The results underscore the central role of engagement as a motivational pathway through which workplace conditions translate into performance outcomes.

Discussion

This study examined the determinants of employee productivity in the Malaysian Electrical and Electronic (E&E) manufacturing industry by integrating the Job Demands–Resources (JD-R) model and Social Exchange Theory (SET). The findings provide important insights into how workplace characteristics influence productivity both directly and indirectly through employee engagement.

The Role of Training and Development

Training and development emerged as a significant predictor of both employee engagement and employee productivity. This finding reinforces human capital theory, which posits that investment in employee skills enhances organisational performance. In the context of the E&E industry, where rapid technological change and operational precision are essential, employees require continuous upskilling to maintain efficiency and quality standards.

Consistent with the JD-R model, training functions as a critical job resource that stimulates motivational processes. Employees who perceive meaningful opportunities for development are more likely to feel competent and valued, thereby increasing their engagement levels. Furthermore, the significant mediating effect of employee engagement suggests that training does not merely enhance productivity through technical capability alone; rather, it strengthens psychological involvement, which subsequently translates into improved performance.

These findings align with prior research indicating that structured developmental initiatives contribute to both motivational and performance outcomes. The results therefore support the argument that training should be viewed not only as a technical intervention but also as a strategic engagement-enhancing mechanism.

The Dual Role of Work Stress

Work stress demonstrated a significant relationship with both employee engagement and productivity. This finding is particularly noteworthy given the dual nature of stress within the

JD-R framework. In high-performance manufacturing environments, moderate levels of challenge-related stress may stimulate urgency, focus, and task dedication. The results suggest that stress in the E&E sector may function partly as a challenge stressor, motivating employees to meet production targets.

The significant mediation effect of engagement further indicates that stress influences productivity through psychological processes. Rather than directly impairing performance, stress appears to shape employees' level of involvement in their work. This supports the JD-R proposition that job demands can activate motivational pathways when balanced with sufficient resources.

However, the interpretation should be approached with caution. While stress may enhance productivity in the short term, sustained high levels of pressure may eventually lead to burnout. Thus, the findings highlight the importance of managing stress strategically rather than eliminating it entirely.

The Limited Impact of Work Environment

Contrary to theoretical expectations, work environment did not demonstrate a significant direct or mediated effect on employee productivity. This finding diverges from some prior studies that have emphasised the importance of physical and organisational conditions in shaping performance.

One possible explanation is that baseline working conditions in the sampled E&E firms may already meet acceptable industry standards. In such contexts, work environment may function as a hygiene factor rather than a motivational driver. Once minimum thresholds of safety and adequacy are met, improvements in environment may not substantially increase engagement or productivity.

This outcome is consistent with Herzberg's two-factor theory, which distinguishes between hygiene factors and motivational factors. While inadequate working conditions may reduce performance, improvements beyond acceptable levels may not necessarily enhance productivity. Thus, the findings suggest that in this sector, developmental and demand-related factors exert stronger influence than environmental conditions.

Employee Engagement as a Central Mechanism

Employee engagement emerged as a strong predictor of productivity and a significant mediator between workplace determinants and performance outcomes. This finding confirms the central role of engagement proposed by the JD-R model. Job resources and job demands influence productivity largely through their impact on employees' psychological states.

The mediating role of engagement also reinforces Social Exchange Theory. When employees perceive organisational investment, particularly in training; they reciprocate with greater dedication and absorption in their tasks. Engagement therefore functions as the behavioural manifestation of reciprocal exchange.

Importantly, the results demonstrate that productivity enhancement strategies must go beyond structural improvements and focus on fostering psychological involvement. Engagement represents the mechanism through which workplace conditions translate into measurable output.

Theoretical Implications

The findings contribute to theory in several ways. First, the study extends the JD-R model within a Southeast Asian manufacturing context, providing empirical support for its applicability beyond Western settings. Second, it demonstrates that job demands such as stress can exert both direct and indirect effects on productivity, supporting the model's dual-pathway proposition. Third, the integration of SET strengthens understanding of the reciprocal processes underlying engagement.

By positioning employee engagement as a central mediating construct, this study advances a more comprehensive explanation of productivity in labour-intensive industries.

Practical Implications

From a managerial perspective, the findings suggest that investment in training and development should be prioritised as a strategic productivity lever. Rather than viewing training purely as a compliance requirement, organisations should recognise its motivational and engagement-enhancing benefits.

Second, stress management should focus on balancing challenge and support. Moderate performance pressure may stimulate productivity, but excessive strain may undermine long-term sustainability. Managers should therefore ensure that job demands are accompanied by adequate resources.

Finally, while maintaining safe and supportive work environments remains essential, incremental improvements in physical conditions alone may not substantially increase productivity unless accompanied by engagement-focused strategies.

Contributions of the Study

This study makes several important contributions to theory, methodology, and practice within the domain of employee productivity research, particularly in the context of the Malaysian Electrical and Electronic (E&E) manufacturing industry.

Theoretical Contribution

First, this study contributes to the theoretical advancement of the Job Demands–Resources (JD-R) model by empirically validating its applicability within a Southeast Asian manufacturing context. While the JD-R framework has been widely examined in Western organisational settings, empirical evidence from labour-intensive industries in emerging economies remains limited. By demonstrating that job resources (training and development) and job demands (work stress) influence productivity both directly and indirectly through employee engagement, this study extends the contextual boundaries of the JD-R model.

Second, the findings refine the understanding of the dual nature of work stress within the JD-R framework. The results suggest that stress in high-performance manufacturing environments may function partly as a challenge stressor, contributing to engagement and productivity rather than solely impairing performance. This contributes to ongoing theoretical discussions regarding the complex role of job demands in performance outcomes.

Third, the integration of Social Exchange Theory (SET) with the JD-R model strengthens the explanatory power of the framework. By demonstrating that organisational investments in training enhance engagement and productivity, the study provides empirical support for reciprocity mechanisms underlying workplace relationships. Employee engagement emerges as the psychological conduit through which organisational support translates into behavioural performance outcomes.

Collectively, the study advances a more integrated and contextually grounded explanation of employee productivity within manufacturing environments.

Methodological Contribution

From a methodological perspective, this study contributes by employing Partial Least Squares Structural Equation Modelling (PLS-SEM) to simultaneously assess measurement reliability, structural relationships, and mediation effects within a single comprehensive framework. The use of PLS-SEM enables robust evaluation of both direct and indirect pathways, providing a more nuanced understanding of productivity determinants.

Additionally, the study incorporates rigorous validity assessments, including convergent validity, discriminant validity (HTMT), multicollinearity checks, and predictive relevance (Q^2), thereby strengthening the robustness of the empirical findings. The inclusion of mediation analysis further enhances methodological sophistication by uncovering the motivational mechanisms linking workplace determinants to performance.

Finally, by examining multiple workplace determinants within a unified structural model rather than in isolation, the study offers a more holistic empirical approach to productivity research in manufacturing settings.

Practical Contribution

Practically, this study provides actionable insights for managers and policymakers within the Malaysian E&E industry. The findings highlight training and development as a strategic lever for enhancing productivity. Organisations should view training not merely as skill enhancement but as a driver of employee engagement and performance sustainability.

The results also suggest that work stress should be managed strategically rather than eliminated entirely. Moderate performance pressure may stimulate productivity when accompanied by adequate resources and support. Managers should therefore focus on balancing job demands with developmental opportunities.

Furthermore, while maintaining safe and supportive work environments remains essential, the findings indicate that engagement-driven strategies yield stronger productivity gains than structural improvements alone. Organisations seeking sustainable competitive advantage should prioritise motivational and developmental interventions alongside operational optimisation.

For policymakers, the study underscores the importance of workforce development initiatives in sustaining Malaysia's competitiveness within global E&E supply chains. Investment in human capital development may yield significant productivity dividends at the industry level.

Limitations of the Study

While this study provides valuable insights into the determinants of employee productivity within the Malaysian Electrical and Electronic (E&E) manufacturing industry, several limitations should be acknowledged.

First, the study employed a cross-sectional research design, which limits the ability to establish causal relationships among the constructs. Although the structural model identifies significant associations between workplace determinants, employee engagement, and productivity, longitudinal data would provide stronger evidence regarding temporal dynamics and causal direction. Future research could adopt longitudinal or panel designs to examine how changes in workplace conditions influence engagement and productivity over time.

Second, the data were collected using self-reported measures, which may introduce common method bias and subjective evaluation effects. Although procedural and statistical remedies were implemented to minimise this concern, self-perceptions of productivity may differ from objective performance indicators. Future studies may enhance methodological robustness by incorporating supervisor ratings, objective productivity metrics, or multi-source data to triangulate findings.

Third, the study focused exclusively on employees within the Malaysian E&E manufacturing sector. While this industry provides a strategically important and relevant context, the findings may be influenced by sector-specific characteristics such as technological intensity, production pressure, and operational structure. Other industries with different organisational dynamics may exhibit distinct patterns of relationships among workplace determinants and productivity.

Finally, the generalisability of the findings is limited to the Malaysian context. Cultural, economic, and regulatory factors may influence employee engagement and performance dynamics differently across countries. Comparative studies across industries or national contexts would provide broader insights into the applicability of the proposed framework. Despite these limitations, the study offers a robust empirical foundation for understanding productivity determinants in labour-intensive manufacturing environments and provides a basis for future research expansion.

Recommendations for Future Research

Building on the findings of this study, several directions for future research are proposed to extend and refine understanding of employee productivity determinants.

First, future research should consider adopting longitudinal research designs to examine the dynamic relationships among workplace determinants, employee engagement, and productivity over time. The cross-sectional nature of the present study captures relationships at a single point in time and does not account for potential temporal variations. Longitudinal studies would enable researchers to assess causality more robustly and examine whether the effects of training, stress, and engagement evolve as organisational conditions change. Such designs would be particularly valuable in technology-intensive industries where rapid operational shifts may influence employee responses.

Second, further investigation across different industries would enhance the external validity of the proposed framework. The Malaysian E&E manufacturing sector possesses distinct characteristics, including high technological intensity, production pressures, and precision-based operations. Industries such as services, healthcare, or public administration may exhibit different patterns in the relationships among job resources, job demands, engagement, and productivity. Comparative industry studies would help determine whether the central role of engagement identified in this research is context-specific or broadly applicable across organisational settings.

Third, future studies should explore potential moderating variables that may strengthen or weaken the relationships examined in this model. Leadership style represents a particularly promising moderator. Transformational, supportive, or inclusive leadership may amplify the positive effects of training and work environment on engagement, while mitigating the adverse effects of excessive stress. Similarly, individual-level factors such as resilience, organisational commitment, or psychological capital could moderate the impact of job demands and resources. Incorporating moderators would provide a more nuanced understanding of boundary conditions influencing productivity outcomes.

Finally, cross-country comparative research would contribute to broader theoretical development. Cultural values, labour regulations, and economic structures may shape how employees perceive stress, training, and organisational support. Comparative studies across Southeast Asian economies or between emerging and developed markets would clarify the extent to which the integrated JD-R and Social Exchange framework is universally applicable. Such research would also provide valuable insights for multinational organisations operating within diverse institutional environments.

By addressing these avenues, future research can deepen theoretical understanding, enhance generalisability, and refine strategic approaches to improving employee productivity across industries and contexts.

Conclusion

This study investigated the determinants of employee productivity within the Malaysian Electrical and Electronic (E&E) manufacturing industry by integrating the Job Demands–Resources (JD-R) model and Social Exchange Theory (SET). Specifically, it examined the effects of work environment, work stress, and training and development on employee productivity, with employee engagement positioned as a mediating mechanism.

The findings indicate that training and development and work stress significantly influence both employee engagement and employee productivity. Employee engagement emerged as a strong predictor of productivity and a significant mediator linking workplace determinants to performance outcomes. These results highlight that organisational investments in skill development and the management of job demands influence productivity not only through operational efficiency but also through motivational processes. In contrast, work environment did not demonstrate a significant direct or mediated effect, suggesting that in this context it may function as a baseline or hygiene factor rather than a primary performance driver.

The study contributes to theory by extending the JD-R model and SET within a Southeast Asian manufacturing setting and by clarifying the dual role of work stress in high-performance environments. Methodologically, the use of PLS-SEM enabled robust testing of direct and indirect relationships within a unified framework. Practically, the findings underscore the importance of engagement-driven strategies, continuous workforce development, and balanced stress management in sustaining productivity within Malaysia's strategically important E&E sector.

In an increasingly competitive global manufacturing landscape, organisations must move beyond structural optimisation and focus on the psychological and developmental dimensions of workforce management. By identifying employee engagement as a central mechanism linking workplace conditions to productivity, this study offers a foundation for more sustainable and strategically aligned human resource practices.

References

- Bakker, A. B., & Albrecht, S. L. (2018). Work engagement: Current trends. *Career Development International*, 23(1), 4–11. <https://doi.org/10.1108/CDI-11-2017-0207>
- Bakker, A. B., & Demerouti, E. (2017). Job demands–resources theory: Taking stock and looking forward. *Journal of Occupational Health Psychology*, 22(3), 273–285. <https://doi.org/10.1037/ocp0000056>
- Bartel, A. P. (1994). Productivity gains from the implementation of employee training programs. *Industrial Relations*, 33(4), 411–425. <https://doi.org/10.1111/j.1468-232X.1994.tb00349.x>
- Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis* (3rd ed.). University of Chicago Press.
- Blau, P. M. (1964). *Exchange and power in social life*. Wiley.
- Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands–resources model of burnout. *Journal of Applied Psychology*, 86(3), 499–512. <https://doi.org/10.1037/0021-9010.86.3.499>
- Elnaga, A., & Imran, A. (2013). The effect of training on employee performance. *European Journal of Business and Management*, 5(4), 137–147.
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage Publications.
- Hakanen, J. J., & Roodt, G. (2010). Using the job demands–resources model to predict engagement. *Work & Stress*, 24(1), 1–20. <https://doi.org/10.1080/02678373.2010.481749>
- Herzberg, F. (1968). One more time: How do you motivate employees? *Harvard Business Review*, 46(1), 53–62.
- Kahn, W. A. (1990). Psychological conditions of personal engagement and disengagement at work. *Academy of Management Journal*, 33(4), 692–724. <https://doi.org/10.2307/256287>
- Malaysian Investment Development Authority. (2021). *Electrical and electronics industry report*. <https://www.mida.gov.my>
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research. *Annual Review of Psychology*, 63, 539–569. <https://doi.org/10.1146/annurev-psych-120710-100452>
- Ringle, C. M., Wende, S., & Becker, J. M. (2022). *SmartPLS 4*. SmartPLS GmbH.

- Robbins, S. P., & Judge, T. A. (2022). *Organizational behavior* (18th ed.). Pearson.
- Saks, A. M. (2019). Antecedents and consequences of employee engagement. *Journal of Organizational Effectiveness: People and Performance*, 6(1), 19–38. <https://doi.org/10.1108/JOEPP-05-2018-0034>
- Schaufeli, W. B. (2017). Applying the job demands–resources model. *Organizational Dynamics*, 46(2), 120–132. <https://doi.org/10.1016/j.orgdyn.2017.04.008>
- Schaufeli, W. B., & Bakker, A. B. (2004). Job demands, job resources, and burnout. *Journal of Organizational Behavior*, 25(3), 293–315. <https://doi.org/10.1002/job.248>
- Schaufeli, W. B., Salanova, M., González-Romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout. *Journal of Happiness Studies*, 3, 71–92. <https://doi.org/10.1023/A:1015630930326>