

The Effect of Empowering Leadership, Perceived Organizational Support, and Job Demands on Work Engagement through Work Fatigue as a Mediating Variable

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Keywords:	Abstract
empowering leadership; perceived organizational support; job demands; work fatigue; work engagement	Maintaining employee engagement is particularly important in project-based construction, where productivity and organizational continuity depend on employees who can remain attentive and committed despite heavy workloads, strict deadlines, safety obligations, and operational complexity. This study investigates how empowering leadership, perceived organizational support, and job demands are related to work engagement, with work fatigue examined as a mediating mechanism. The respondents were employees of PT Hutama Karya (Persero) Infrastructure Division I assigned to MRT CP 203, NPEA Section 1, the Jakarta Sewerage Development Project (JSDP), and Huntara Senen in the Greater Jakarta area. The research applied a quantitative explanatory design with cross-sectional data from 182 purposively selected employees. Responses to 57 questionnaire items were analyzed in SmartPLS 4 using Partial Least Squares Structural Equation Modeling (PLS-SEM), a reflective-reflective hierarchical component model, and the disjoint two-stage procedure. The estimates indicate that empowering leadership and perceived organizational support are positively associated with work engagement and negatively associated with work fatigue. Job demands show the opposite pattern, with a negative relationship to work engagement and a positive relationship to work fatigue. Work fatigue is also negatively related to engagement and carries complementary partial mediation for each of the three exogenous constructs. The results highlight the need for project organizations to develop empowering supervisors, provide credible organizational support, regulate excessive demands, and establish sufficient opportunities for employee recovery.

INTRODUCTION

Schaufeli and Bakker (2004) describe work engagement as a favorable psychological condition reflected in vigor, dedication, and absorption. For construction-project employees, sustaining these qualities requires more than physical attendance. They must preserve stamina, mental endurance, enthusiasm, pride, focus, and involvement while responding to compressed schedules, technical uncertainty, cross-functional dependencies, safety standards, and frequently changing site conditions. Initial evidence from PT Hutama Karya (Persero) Infrastructure Division I suggested that employees generally retained the technical

competence needed to perform their duties, yet some experienced reduced energy, dedication, and concentration. Prolonged workload, deadline pressure, and insufficient recovery can gradually weaken engagement while increasing fatigue in physical, cognitive, and emotional forms. Engagement in this setting is therefore a practical resource for maintaining careful execution, reliable coordination, and consistent attention to project objectives.

The decline in engagement and the emergence of work fatigue at the operational level should therefore be viewed as interconnected rather than isolated experiences. Both conditions develop through cumulative and simultaneous processes, and neither can be adequately understood by examining only one dimension at a time.

To represent this multidimensional structure, Empowering Leadership, Perceived Organizational Support, Job Demands, Work Fatigue, and Work Engagement were modeled as reflective-reflective higher-order constructs. Each higher-order variable was represented by several lower-order dimensions. This hierarchical arrangement retains the distinctive components of leadership, organizational support, work demands, fatigue, and engagement while allowing the structural analysis to operate at the broader construct level instead of depending on a single aspect such as workload, physical fatigue, support, or enthusiasm.

The comparative preliminary results supported the choice of work engagement as the principal dependent construct. The issue identified within PT Hutama Karya (Persero) Infrastructure Division I was not primarily a lack of technical capability, but a weakening of the energy, dedication, and absorption that employees brought to their work. Such disengagement may limit enthusiasm, impair concentration during execution, and reduce employees' willingness to remain actively involved when project operations become complex or rapidly change.

The preliminary inquiry was subsequently broadened to identify organizational and psychological conditions that might explain this engagement problem. Work fatigue was introduced as the mediator, while job demands and organizational job resources were examined as antecedent variables.

Under Job Demands-Resources (JD-R) Theory, these circumstances are consistent with the health impairment process, whereby persistent demands consume physical, cognitive, and emotional resources (Demerouti et al., 2001; Bakker & Demerouti, 2017). The preliminary survey also indicated that respondents did not always perceive leadership empowerment and organizational support as sufficient. In particular, 73.3% reported that the company had not been sufficiently responsive in supporting employee welfare and recovery.

A further 66.7% considered the empowerment provided by supervisors inadequate for resolving technical issues in the field. Conservation of Resources (COR) Theory suggests that employees become more vulnerable to resource depletion when intense demands are met with limited supporting resources (Hobfoll, 1989; Hobfoll et al., 2018). From this perspective, work fatigue may explain part of the process through which job demands, empowering leadership, and perceived organizational support are linked to engagement.

Taken together, the project evidence provides a coherent basis for the variables included in the model. Attendance and overtime records were treated as contextual signals of demanding working conditions rather than as direct measures of engagement. The preliminary engagement survey pointed to declining energy, dedication, and absorption even when employees remained capable of completing formal tasks. At the same time, high fatigue

and job demands, alongside weaker perceptions of organizational support and empowering leadership, suggested that fatigue could transmit part of the influence of demands and resources to work engagement. Empowering leadership, perceived organizational support, job demands, work fatigue, and work engagement were therefore selected because each construct corresponds directly to conditions observed among employees of Infrastructure Division I working on Jabodetabek projects. This sequence connects the initial organizational evidence with the theoretical model and avoids treating the variables as choices based only on prior literature.

Job demands do not necessarily produce the same outcome in every situation. Their consequences depend partly on whether employees interpret them as opportunities for achievement or as obstacles, and partly on whether sufficient resources are available. Evidence from diary-study meta-analysis indicates that continuing challenge and hindrance stressors can both generate strain, while hindrance demands may undermine engagement through self-regulatory fatigue (Pindek et al., 2024; Zhou et al., 2025). This pattern implies that fatigue may account for a portion of the association between job demands and work engagement rather than the relationship operating only through a direct path (Mazzetti et al., 2023).

Another unresolved issue concerns the pathways through which job resources operate. Research on empowering leadership has largely concentrated on motivational explanations, including psychological empowerment and improved job characteristics (Hashemi et al., 2025; Wen et al., 2023; Helland et al., 2020). Studies of perceived organizational support have more often examined meaningful work, psychological security, and proactive behavior (Canboy et al., 2023; Jankelová et al., 2021; Park & Kim, 2024). Fewer studies have integrated both resources in one model while treating work fatigue as an energy-loss mechanism that connects them to engagement. Bringing these streams together allows the model to evaluate motivational resources and health-related depletion within the same empirical structure.

Recent evidence also supports further examination of work fatigue as a mediator. Pan et al. (2023), through the study *Chronotype and Work Engagement: The Influence of Work Fatigue and Time Management Planning*, found that fatigue was negatively related to work engagement. Their model, however, centered on personal characteristics, particularly chronotype and individual time-management planning. Much less is known about whether resources supplied by the work environment, including empowering field leadership and systematic organizational support, help employees preserve physical, mental, and emotional energy. JD-R Theory provides a basis for treating these external resources as protective conditions when personal capacity is increasingly strained by work pressure.

The research context also remains underexplored. Much of the earlier work on fatigue, chronotype, and engagement has been carried out in settings with relatively predictable work patterns, including public services, education, banking, and healthcare. The environment of PT Hutama Karya (Persero) Infrastructure Division I differs because employees work within temporary project structures, fixed completion targets, substantial safety exposure, and fluctuating overtime requirements (Dlouhy et al., 2024; Helland et al., 2020; Nong et al., 2022; Zhou et al., 2025). Meeting National Strategic Project targets under these conditions can restrict recovery, accelerate physical and psychological depletion, and

make sustained engagement more difficult. The temporary nature of projects also means that staffing, schedules, and operational priorities can change before employees have fully recovered from earlier work cycles.

Accordingly, three gaps remain relevant: prior findings are not fully consistent, existing models rarely integrate the selected demands and resources with fatigue, and evidence from project-based construction is limited. This study addresses those gaps by examining job demands, empowering leadership, and perceived organizational support as predictors of work engagement, both directly and through work fatigue. Focusing on Infrastructure Division I employees assigned to strategic projects in the Greater Jakarta area provides a context-specific account of the psychological processes that accompany demanding project work.

Within this framework, lower engagement is not attributed solely to physical tiredness. It is understood as a possible outcome of the combined influence of work demands, organizational treatment, field-level leadership, and fatigue experienced across physical, mental, and emotional domains. Such an approach encourages construction human resource management to consider employee psychological capacity alongside schedule, cost, quality, and safety targets. In practice, employees may continue meeting formal responsibilities even while the psychological resources that sustain enthusiasm and deep involvement are declining.

The principal contribution of the study is the integration of work fatigue as a mediator between empowering leadership, perceived organizational support, job demands, and work engagement in a project-based construction setting. Rather than treating engagement only as an immediate response to resources and demands, the model examines whether fatigue in physical, mental, and emotional domains forms an intervening psychological process (Frone & Tidwell, 2015). This application extends the empirical use of Job Demands-Resources Theory and Conservation of Resources Theory to a complex construction environment.

The study is academically and managerially relevant because project delivery depends on employees who can remain engaged over demanding work cycles. When fatigue is not recognized and controlled, reduced engagement may be accompanied by weaker productivity, delays, and avoidable costs arising from inefficient execution. Continued depletion may also threaten psychological well-being and the organization's ability to retain competent project personnel. On the basis of the observed conditions and the identified research gaps, the study was entitled "The Effect of Empowering Leadership, Perceived Organizational Support, and Job Demands on Work Engagement through Work Fatigue as a Mediating Variable." Understanding these relationships can help management distinguish between short-term task completion and the longer-term capacity of employees to remain psychologically involved.

The study was designed around ten questions derived from the organizational problem, prior evidence, and the proposed theoretical relationships. These questions concern the direct associations of empowering leadership, perceived organizational support, and job demands with work engagement and work fatigue; the relationship between work fatigue and work engagement; and the indirect roles of fatigue in the three predictor-engagement relationships. Thus, the research objectives were to estimate seven direct paths and to determine whether work fatigue mediates the effects of empowering leadership, perceived

organizational support, and job demands on engagement among Infrastructure Division I employees assigned to Jabodetabek projects.

The expected contribution is both theoretical and practical. Theoretically, the study evaluates work fatigue as a resource-depletion process connecting job resources and job demands with engagement, thereby adding contextual evidence to Job Demands-Resources Theory and Conservation of Resources Theory. It also examines empowering leadership and perceived organizational support simultaneously as organizational resources that may sustain engagement and limit fatigue in construction projects. Practically, the findings can guide PT Hutama Karya (Persero) in developing supervisors, strengthening organizational support, regulating job demands, and creating realistic recovery opportunities. The results may also inform other construction organizations seeking to protect psychological well-being and engagement under intensive operational conditions.

METHOD

Research Design

A quantitative explanatory approach was adopted, and all variables were measured at one point in time. This cross-sectional design enabled estimation of the proposed direct and mediated relationships among empowering leadership, perceived organizational support, job demands, work fatigue, and work engagement. The empirical model contained seven direct paths and three indirect paths through work fatigue among operational employees engaged in intensive construction-project activities. The design estimates theoretically directed associations but does not by itself establish temporal causality among the constructs.

Research Setting

The study was undertaken in PT Hutama Karya (Persero) Infrastructure Division I among personnel assigned to strategic projects in Greater Jakarta. Respondents were drawn from MRT CP 203, NPEA Section 1, the Jakarta Sewerage Development Project (JSDP), and Huntara Senen. These projects operate under the same divisional coordination but differ in scope, duration, technical difficulty, coordination arrangements, and completion schedules, providing varied project conditions within one organizational setting.

Project location was recorded according to the respondent's assignment when the survey was administered. Time spent on the current project was not treated as the employee's total organizational or project experience. The one-year eligibility requirement therefore referred to cumulative employment or assignment experience in PT Hutama Karya (Persero) or Infrastructure Division I, whether acquired on the present project or on an earlier one. This treatment accommodates the routine reassignment of project personnel in response to organizational needs. Respondents were therefore not excluded merely because their present assignment had begun less than one year before data collection.

Infrastructure Division I was selected because its work is temporary, operationally dynamic, and continuously adjusted to field developments. Employees are expected to meet deadlines, quality and safety standards, coordination requirements, and efficiency objectives at the same time. Although the intensity and composition of demands differ across the four projects, each location offers an appropriate setting for evaluating leadership empowerment, organizational support, work demands, fatigue, and engagement.

Population and Sample

Population

In methodological terms, the population comprises all units that possess the characteristics specified by the study. Sekaran and Bougie (2016) emphasize that a population is defined not only by its size but also by its relevance to the phenomenon, objectives, and analytical boundaries. A clear population definition therefore determines the group to which the empirical findings may reasonably be applied. In this study, the defining attributes concerned employment status, divisional assignment, project involvement, and exposure to operational construction work.

The target population included active employees of PT Hutama Karya (Persero) Infrastructure Division I who were assigned to strategic projects in Greater Jakarta during 2026. It covered personnel involved directly in project operations, including engineering, field execution, Quality, Health, Safety, Security, and Environment (QHSSE), project risk management, project administration, and related technical functions associated with National Strategic Projects. Their work was performed in project structures marked by technical complexity, changing operational conditions, and pressure to meet completion targets.

This population routinely encounters demands that require physical effort, sustained concentration, and emotional control. Employees must address technical problems, protect quality and safety, coordinate across functions, and continue delivering under operational pressure. In JD-R terms, repeated exposure to such demands may consume energy, increase fatigue, and limit engagement. The population was therefore suitable for testing the proposed relationships among empowering leadership, perceived organizational support, job demands, work fatigue, and work engagement. This fit between the population and the research constructs was necessary because respondents had to evaluate both operational demands and the resources available to manage them.

Internal staffing and attendance records for 2026 identified 264 active employees assigned to the relevant strategic projects. These employees constituted the defined population and the operational sampling frame used to establish the minimum sample and recruit respondents for the PLS-SEM analysis.

Sample

The sample consisted of eligible members of the defined population who supplied the data used in the analysis. Careful selection was required so that the responses represented the intended unit of analysis and the findings remained interpretable within the stated project context. Representativeness in this context refers to alignment with the specified eligibility criteria rather than equal random selection from every employee category.

As an operational reference for sample adequacy, the minimum number of responses was first estimated from the known population of 264 employees using the Slovin equation at a 5% error level. The calculation was performed as follows:

$$n = N / (1 + Ne^2)$$

Description:

n = Minimum target sample size

N = Population size (264 employees)

e = Margin of error (5% or 0.05)

Substituting the population size and error level into the equation gives:

$$n = 264 / (1 + 264 \times 0.05^2)$$

$$n = 264 / (1 + 264 \times 0.0025)$$

$$n = 264 / (1 + 0.660)$$

$$n = 264 / 1.660$$

$$n = 159.04$$

The Slovin computation yielded 159.04 and was rounded upward to a minimum target of 160 respondents. A separate a priori power analysis, specified with four predictors, alpha of 0.05, statistical power of 0.80, and a medium effect size of $f^2 = 0.15$, indicated that at least 85 observations were required. The final dataset contained 182 eligible and complete responses, exceeding both reference values. Using both references showed that the achieved sample was adequate for the planned structural estimates while remaining within the defined population.

Sampling Techniques

Respondents were recruited through non-probability purposive sampling because the study required employees with direct and sustained exposure to construction-project operations. Selection was therefore based on characteristics relevant to the model rather than random inclusion. This procedure ensured that participants had sufficient experience to evaluate supervisory empowerment, organizational support, job demands, fatigue, and engagement in the project environment.

The unit of analysis was controlled through the following eligibility requirements:

- **Employment Status:** The respondent was an active employee of PT Hutama Karya (Persero) Infrastructure Division I assigned to a strategic project in the Greater Jakarta area.
- **Operational Involvement:** The respondent participated directly in daily project activities in engineering, field operations, Quality, Health, Safety, Security, and Environment (QHSSE), project risk management, project administration, or another related technical function. Senior managers and head-office personnel without direct exposure to operational project demands were not included.
- **Actual Working Period:** The respondent had accumulated at least one year of employment or project-assignment experience within PT Hutama Karya (Persero) or Infrastructure Division I. Experience could come from the current assignment, earlier projects, or a combination of both, ensuring adequate familiarity with organizational conditions, supervisors, support practices, and project demands.
- **Voluntary Participation:** The respondent confirmed voluntary participation through the informed-consent statement provided with the questionnaire.

RESULTS AND DISCUSSION

Statistical Data Analysis

The empirical analysis used Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 4. This method was applied to estimate the direct and mediated paths linking Empowering Leadership, Perceived Organizational Support, Job Demands, Work Fatigue, and Work Engagement within the hierarchical model. Analysis was conducted on the valid responses after respondent eligibility and data completeness had been confirmed.

Because the five principal variables were specified as reflective-reflective higher-order constructs, estimation followed the disjoint two-stage procedure. Stage one linked 57 observed items to 19 lower-order dimensions. The resulting latent variable scores were then entered in stage two as reflective measures of the five higher-order constructs used in the structural analysis.

All responses used a five-point Likert scale across 57 statements. Empowering Leadership was measured with 15 items adapted from the Empowering Leadership Questionnaire (Arnold et al., 2000). Perceived Organizational Support used nine items derived from Eisenberger et al. (1986) and Rhoades and Eisenberger (2002). Job Demands comprised 15 items based on the Job Demands-Resources framework (Demerouti et al., 2001). Work Fatigue was represented by nine items adapted from the Three-Dimensional Work Fatigue Inventory (Frone & Tidwell, 2015), and Work Engagement by nine UWES-9 items (Schaufeli & Bakker, 2004). The instrument structure preserved the multidimensional content of each construct while maintaining a manageable number of indicators in the stage-two analysis.

The higher-order model was estimated only after the item-level and lower-order assessments in stage one satisfied the specified validity and reliability standards. Every one of the 57 indicators was retained. The stage-two scores were subsequently used to evaluate the higher-order measurement model, assess the structural relationships, and test the ten hypotheses.

Measurement Model Evaluation (Outer Model)

Evaluation of the measurement component examined whether the indicators and dimensions represented their assigned constructs with adequate reliability and validity. The criteria included outer loadings, Average Variance Extracted (AVE), Cronbach's Alpha, rho_A, Composite Reliability, and discriminant validity assessed with the Heterotrait-Monotrait Ratio (HTMT). The assessment was conducted sequentially so that structural interpretations were made only after the quality of the measurement relationships had been established.

Convergent Validity

Convergent validity concerns the extent to which measures intended for the same construct share sufficient variance. For reflective specifications, outer loading indicates how strongly each observed measure is related to its latent construct. Hair et al. (2021) recommend a loading of at least 0.708, considered together with acceptable construct reliability and AVE.

At the first stage, all 57 item loadings satisfied the adopted criteria and were statistically significant for their 19 lower-order constructs. No item belonging to Empowering Leadership, Perceived Organizational Support, Job Demands, Work Fatigue, or Work Engagement required deletion. The full set of indicators was therefore carried forward to the reliability, convergent-validity, discriminant-validity, and second-stage assessments. Statistical significance was evaluated together with the magnitude of the loadings rather than used as the sole basis for retention.

The loading pattern further indicated that each item adequately represented its designated lower-order dimension. Scores for the 19 dimensions could consequently be used

to operationalize the five reflective higher-order constructs. The complete measurement structure was retained when estimating the final structural model.

Construct Reliability and Validity

Internal consistency and convergent validity were examined through Cronbach's Alpha, rho_A, Composite Reliability (rho_C), and AVE. Reliability was regarded as satisfactory at values above 0.70, while an AVE greater than 0.50 indicated that a construct explained more than half of the variance in its measures. These criteria provide complementary information on consistency and the amount of indicator variance captured by the construct.

Cronbach's Alpha, rho_A, and Composite Reliability exceeded 0.70 for every construct, and each AVE was above 0.50. The results therefore supported both internal consistency and convergent validity across the item and dimensional measures.

Discriminant Validity

Discriminant validity was checked to determine whether the constructs captured empirically different concepts. The analysis relied on HTMT, using 0.85 as the conservative upper boundary for acceptable separation. This step was necessary because high reliability alone does not demonstrate that conceptually different variables are empirically distinguishable.

Every HTMT coefficient remained below 0.85. The largest coefficient, 0.693, occurred between Work Fatigue and Work Engagement. The measurement model therefore demonstrated adequate empirical distinction among all constructs.

Structural Model Evaluation

The structural assessment examined the explanatory relationships among the latent variables. It included R-Square, f-Square, inner Variance Inflation Factor (VIF), Standardized Root Mean Square Residual (SRMR), a full-collinearity check for common method variance, and bootstrapped hypothesis testing. Q-Square and PLSpredict were not interpreted because the relevant predictive output was unavailable. The reported diagnostics address explanatory capacity, relative effect size, collinearity, approximate fit, and statistical significance. The combination of these statistics provides a broader evaluation than relying only on the significance of the path coefficients.

Collinearity Statistics (VIF)

Inner VIF values were inspected to determine whether overlapping information among predictor constructs could distort the estimated path coefficients. Values below 3 were used as the criterion for the absence of problematic structural collinearity.

The observed inner VIF statistics ranged from 1.008 to 1.819. Because all coefficients were well below 3, the predictor constructs did not display problematic multicollinearity, allowing the structural paths to be interpreted without substantial inflation arising from predictor overlap.

R-Square

R-Square was used to quantify the proportion of variance explained in the two endogenous constructs, Work Fatigue and Work Engagement.

For Work Engagement, R-Square was 0.455, meaning that Empowering Leadership, Perceived Organizational Support, Job Demands, and Work Fatigue jointly accounted for 45.5% of the observed variance. Work Fatigue had an R-Square of 0.450, so 45.0% of its

variance was explained by Empowering Leadership, Perceived Organizational Support, and Job Demands. Variation not captured by these percentages reflects determinants outside the specified model. These values indicate meaningful explanatory capacity while also leaving room for personal, team, project-stage, and other organizational factors not included in the study.

f-Square

The f-Square statistic was examined to determine how much each predictor contributed to an endogenous construct relative to the remaining predictors. The resulting values were categorized as small, medium, or large.

The largest relative contribution was observed for the path from Job Demands to Work Fatigue, with $f\text{-Square} = 0.369$, which falls in the large-effect category. Empowering Leadership to Work Fatigue, Perceived Organizational Support to Work Engagement, and Perceived Organizational Support to Work Fatigue produced medium effects. The other paths were small. Thus, job demands were the most influential predictor of fatigue in a setting characterized by workload, deadline pressure, and multiple forms of work demand.

Common Method Variance

Because the constructs were reported by the same respondents through one questionnaire, the possibility of common method variance was examined using full-collinearity VIF. Values below 3.3 were treated as evidence that the common measurement source was unlikely to account for a serious proportion of the estimated relationships. This diagnostic was interpreted as a complement to, rather than a replacement for, the structural collinearity assessment. The test does not prove that method effects are absent, but it provides a diagnostic indication that they were not severe enough to dominate the model.

The full-collinearity VIF results were 1.306 for Empowering Leadership, 1.380 for Perceived Organizational Support, 1.467 for Job Demands, 1.836 for Work Engagement, and 1.929 for Work Fatigue. Since each value was below 3.3, the data did not indicate serious common-method bias under this diagnostic.

Model Fit

Approximate model fit was reviewed through the Standardized Root Mean Square Residual (SRMR). A value below 0.08 was adopted as an indication that the discrepancy between the observed and model-implied correlations was not excessive.

The estimated SRMR was 0.062, which satisfied the 0.08 criterion and provided supportive evidence of adequate correspondence between the specified model and the data. This statistic was used as a supplementary diagnostic. Q-Square and PLSpredict were excluded from the conclusions because their required SmartPLS outputs were not available.

Hypothesis Testing

The direct and indirect paths were evaluated with SmartPLS 4 bootstrapping based on 5,000 subsamples. Statistical support was determined using a two-tailed t-value above 1.96 and a p-value below 0.05, while the coefficients were inspected for their direction and magnitude. The use of 5,000 resamples provided empirical standard errors for relationships whose sampling distributions cannot be assumed to be normal.

Path Coefficient

All estimated path directions agreed with the hypotheses. Empowering Leadership and Perceived Organizational Support were positively related to Work Engagement, while

Job Demands were negatively related to it. Empowering Leadership and Perceived Organizational Support were negatively associated with Work Fatigue; Job Demands were positively associated with fatigue; and Work Fatigue was negatively associated with engagement.

T-Statistics

Each direct path produced a t-statistic greater than 1.96 and a p-value under 0.05. Consequently, H1 through H7 received empirical support.

Mediation Effect Testing

Mediation was assessed through the bootstrapped specific indirect effects. The analysis examined whether Work Fatigue carried part of the influence of Empowering Leadership, Perceived Organizational Support, and Job Demands to Work Engagement. An indirect effect was treated as significant at $p < 0.05$, and its mediation form was determined by comparing the significance and signs of the indirect and corresponding direct paths.

Indirect Effect

The three specific indirect effects were statistically significant at the 5% level. These results supported H8, H9, and H10 and indicated that Work Fatigue transmits part of the relationships of each exogenous construct with Work Engagement.

Mediation Classification

The indirect coefficients were 0.076 for Empowering Leadership, 0.078 for Perceived Organizational Support, and -0.111 for Job Demands. Their corresponding direct paths were also significant and pointed in compatible directions. Each mediation pattern was therefore classified as complementary partial mediation, indicating that fatigue is one important pathway to engagement but does not account for the entire relationship. In other words, fatigue explains a meaningful share of each association while direct motivational or demand-related mechanisms remain present.

The following discussion interprets these estimates through Job Demands-Resources Theory, Conservation of Resources Theory, relevant empirical research, and the operational circumstances of Infrastructure Division I. For each hypothesis, the statistical result is considered together with its theoretical meaning and its application to construction-project work.

The Effect of Empowering Leadership on Work Engagement

The Empowering Leadership to Work Engagement path was positive and statistically significant (coefficient = 0.251; $t = 4.300$; $p < 0.001$). This result indicates that employees reporting stronger empowering behavior from supervisors also tended to report higher engagement. H1 was therefore supported.

This association is meaningful in project work, where field conditions shift quickly and employees must coordinate decisions, resolve technical obstacles, and respond to completion pressure. Supervisors who communicate clearly, demonstrate trust, involve employees in relevant decisions, and provide coaching can increase employees' control and ownership of the work. Those conditions make it easier for employees to invest energy, commitment, and focused attention in project activities. Empowerment is therefore relevant not only as a leadership preference but also as a way of reducing delays and uncertainty in day-to-day problem solving.

The result is consistent with the motivational process proposed by Job Demands-Resources Theory and with the behavioral view of empowering leadership, which includes leading by example, participation, coaching, information sharing, and concern for team members (Arnold et al., 2000). It also aligns with studies linking empowering leadership to engagement through autonomy, psychological empowerment, and meaningful participation (Helland et al., 2020; Wen et al., 2023; Hashemi et al., 2025).

The Effect of Perceived Organizational Support on Work Engagement

Perceived Organizational Support showed a positive, significant path to Work Engagement (coefficient = 0.319; $t = 5.967$; $p < 0.001$). Employees who perceived greater organizational support were more likely to report stronger engagement, providing support for H2.

Organizational support is especially relevant in construction projects because employees must maintain physical stamina, cognitive readiness, and emotional stability over intensive work periods. Adequate facilities, visible attention to safety, access to development, recognition of contribution, and fair treatment signal that the organization values its employees. Within Infrastructure Division I, these resources can help employees remain enthusiastic, dedicated, and focused despite schedule pressure and extensive coordination responsibilities.

This interpretation follows Organizational Support Theory, which proposes that employees form broad judgments about whether the organization values their contribution and protects their well-being (Eisenberger et al., 1986; Rhoades & Eisenberger, 2002). The result is also compatible with evidence connecting perceived organizational support to engagement through recognition, meaningfulness, psychological security, and access to organizational resources (Canboy et al., 2023; Jankelová et al., 2021; Park & Kim, 2024).

The Effect of Job Demands on Work Engagement

The path from Job Demands to Work Engagement was negative and significant (coefficient = -0.218; $t = 3.485$; $p < 0.001$). Higher perceived demands were therefore associated with lower engagement, and H3 was supported.

Employees in Infrastructure Division I encounter demands in the form of workload, limited time, physical effort, complex information, and emotionally demanding interactions. They are expected to reach production targets while protecting quality and safety, coordinating across parties, and responding rapidly to field changes. When these pressures continue without sufficient recovery or resources, employees have less energy available for enthusiasm, persistence, and full concentration, which helps explain the negative relationship with engagement. The negative coefficient does not imply that every demanding task is harmful, but it indicates that the combined demands reported in this sample were associated with reduced engagement.

The finding accords with Job Demands-Resources Theory and prior evidence that excessive or obstructive demands consume energy and weaken engagement when employees lack sufficient resources and recovery opportunities (Mazzetti et al., 2023; Pindek et al., 2024; Zhou et al., 2025).

The Effect of Empowering Leadership on Work Fatigue

Empowering Leadership was negatively associated with Work Fatigue (coefficient = -0.309; $t = 5.014$; $p < 0.001$). Employees who perceived more empowering supervisory behavior tended to report less fatigue, supporting H4.

The result suggests that empowering leadership contributes not only to motivation but also to resource preservation. Autonomy, coaching, access to information, participation, and supervisor support reduce uncertainty and help employees solve problems more efficiently, limiting unnecessary expenditure of physical, cognitive, and emotional energy. This interpretation is consistent with evidence that empowering leadership supports well-being and is associated with lower emotional exhaustion and strain (Cougot et al., 2022; Nong et al., 2022).

The Effect of Perceived Organizational Support on Work Fatigue

Perceived Organizational Support had a negative and statistically significant relationship with Work Fatigue (coefficient = -0.318; $t = 6.503$; $p < 0.001$). Greater perceived support was associated with lower fatigue, so H5 was supported.

In practical terms, support in construction projects may be expressed through reliable facilities, clear safety arrangements, health assistance, recognition, opportunities to develop competence, and policies that consider employee welfare. Personnel in Infrastructure Division I operate under time constraints and dense coordination requirements. When they experience the organization as responsive and dependable, fewer personal resources are consumed by uncertainty and perceived neglect, which may help limit fatigue. Support is thus relevant both as a material condition of work and as a psychological signal that employee effort and well-being are taken seriously.

The finding is consistent with Organizational Support Theory and with studies showing that perceived support provides instrumental and psychological resources that reduce strain under demanding working conditions (Rhoades & Eisenberger, 2002; Canboy et al., 2023).

The Effect of Job Demands on Work Fatigue

Job Demands displayed the strongest positive relationship with Work Fatigue (coefficient = 0.452; $t = 7.524$; $p < 0.001$), supporting H6. Employees facing higher demands were more likely to report greater fatigue.

This path also produced the largest f-Square value in the structural model. Construction personnel must often manage high task volume, compressed schedules, physical exposure, cognitive complexity, emotional pressure, safety obligations, changing site conditions, and decisions that cannot be delayed. Continued investment of energy across these demands can accumulate as physical, mental, and emotional fatigue.

The result supports the health impairment process in Job Demands-Resources Theory, which proposes that demands sustained over time consume physical and psychological resources and contribute to fatigue (Demerouti et al., 2001; Bakker & Demerouti, 2017; Pindek et al., 2024).

The Effect of Work Fatigue on Work Engagement

Work Fatigue was negatively and significantly related to Work Engagement (coefficient = -0.246; $t = 3.665$; $p < 0.001$), supporting H7. As fatigue increased, reported engagement tended to decline.

Construction tasks require employees to remain alert, physically capable, emotionally regulated, and attentive to quality and safety. Fatigue reduces the resources available for these requirements. Employees who are physically depleted, mentally tired, or emotionally drained are less able to sustain vigor, dedication, and absorption, which explains the negative relationship observed in Infrastructure Division I. Fatigue may therefore be present even when employees continue to complete assigned tasks, because engagement concerns the quality of psychological involvement rather than performance alone.

This result corresponds with the multidimensional interpretation of work fatigue and with prior findings that fatigue limits employees' ability to remain energetic, committed, and fully absorbed in their work (Frone & Tidwell, 2015; Pan et al., 2023).

Work Fatigue Mediates the Influence of Empowering Leadership on Work Engagement

The specific indirect path from Empowering Leadership to Work Engagement through Work Fatigue was significant (indirect coefficient = 0.076; $t = 3.033$; $p = 0.002$). Because the direct path also remained significant and both paths supported a positive overall relationship, the mediation was complementary and partial. H8 was supported.

In project settings, empowering supervisors may reduce fatigue by clarifying expectations, allowing appropriate participation in technical decisions, building problem-solving competence through coaching, and sharing responsibility for field difficulties. These practices increase perceived control and reduce avoidable psychological pressure. The energy preserved through lower fatigue can then be directed toward dedication, concentration, and active involvement in project work.

The mediation result indicates that empowering leadership relates to engagement through two compatible routes: a direct motivational route and an indirect route involving lower fatigue. This extends earlier evidence by showing that empowerment may operate alongside a resource-preservation mechanism (Wen et al., 2023; Cougot et al., 2022; Pan et al., 2023).

Work Fatigue Mediates the Effect of Perceived Organizational Support on Work Engagement

The indirect relationship between Perceived Organizational Support and Work Engagement through Work Fatigue was also significant (indirect coefficient = 0.078; $t = 3.498$; $p < 0.001$). The significant direct path had the same overall direction, producing complementary partial mediation and supporting H9.

Organizational support helps preserve employee energy when it is experienced through adequate work resources, dependable safety and health systems, recognition, fair procedures, and development opportunities. Such support makes project pressure easier to manage without excessive depletion. Employees who experience less fatigue are consequently better positioned to remain enthusiastic, dedicated, and attentive to their work. The indirect pathway shows why support policies can influence engagement even when they do not directly change the technical content of a task.

Accordingly, perceived organizational support is linked to engagement both directly, through recognition and reciprocal commitment, and indirectly, through lower resource depletion and fatigue. This dual pattern is consistent with prior organizational-support and engagement research (Rhoades & Eisenberger, 2002; Canboy et al., 2023; Jankelová et al., 2021; Pan et al., 2023).

Work Fatigue Mediates the Influence of Job Demands on Work Engagement

Work Fatigue significantly mediated the relationship between Job Demands and Work Engagement (indirect coefficient = -0.111; $t = 2.991$; $p = 0.003$). The direct effect remained significant and pointed in the same negative direction, indicating complementary partial mediation. H10 was therefore supported.

The demands faced in Infrastructure Division I are not limited to the quantity of tasks. They also include time restrictions, coordination complexity, safety exposure, changing field conditions, and the need to make rapid technical decisions. As these pressures accumulate, employees become increasingly susceptible to physical, mental, and emotional fatigue. That depletion reduces the capacity needed to sustain energy, dedication, and deep concentration in project work.

The result indicates that job demands weaken engagement through both a direct route and an indirect route that operates through greater fatigue. This pattern is consistent with the JD-R health impairment process, in which sustained demands generate strain and resource loss before engagement deteriorates (Pindek et al., 2024; Zhou et al., 2025; Pan et al., 2023).

In summary, engagement among Infrastructure Division I employees reflects the balance between available job resources and the demands imposed by project work. Empowering Leadership and Perceived Organizational Support are associated with stronger engagement and lower fatigue, whereas Job Demands are associated with higher fatigue and weaker engagement. Project human resource practices should therefore reinforce useful resources, prevent demands from becoming excessive, and provide credible recovery opportunities. The findings consequently support an integrated response rather than treating leadership development, support policy, workload control, and recovery as unrelated interventions.

CONCLUSION

The analysis of 182 employees assigned to four Greater Jakarta projects indicates that empowering leadership and perceived organizational support are positively related to work engagement and negatively related to work fatigue. Job demands show a negative relationship with engagement and a positive relationship with fatigue. Work fatigue is negatively associated with engagement and carries complementary partial mediation for all three exogenous constructs. For PT Hutama Karya (Persero), these results support supervisor-development initiatives that strengthen empowerment, organizational policies that improve facilities and employee welfare, workload arrangements that control excessive demands, and structured opportunities for recovery. Future studies may incorporate personal resources, psychological empowerment, recovery experience, meaningful work, safety climate, work-life balance, and psychological capital. Broader project samples and longitudinal, mixed-method, or multigroup designs would also help evaluate whether these relationships remain stable across locations and over time.

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