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Meta-analysis of employee well-being and perception towards robot, artificial intelligence, and service automation

Kiky D. H. Saraswati, Fajrianthi Fajrianthi & Samian Samian

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Meta-analysis of employee well-being and perception towards robot, artificial intelligence, and service automation

Kiky D. H. Saraswati[a,b], Fajrianthi Fajrianthi[a] and Samian Samian[a]

[a]Faculty of Psychology, Airlangga University, Surabaya, Indonesia; [b]Faculty of Psychology, Universitas Tarumanagara, Jakarta, Indonesia

ABSTRACT

The implementation of smart technology has fundamentally restructured task processes and organisational optimisation. Simultaneously, its implementation presents multidimensional implications for employees, especially their well-being, while current empirical studies remain disjointed and lacks integration. A meta-analysis is considered fruitful since it provides a systematic synthesis to guide future research and delivers critical perspective for practical strategies, specifically HRM aimed at sustaining employee well-being. The objective of this meta-analysis was to investigate the correlation of employee perceptions towards robot, artificial intelligence, and service automation and their well-being, incorporating well-being conceptualisation and industry type as moderating variables. Peer-reviewed articles were retrieved from five databases, including Web of Science Scopus and EBSCOhost. Adhering the pre-determined inclusion criteria, 20 articles were statistically analyzed. The analysis conducted included effect size calculation, meta-analytic model, and heterogeneity assessment. Results revealed a significant correlation between employee perceptionsof RAISA and employee well-being. The effect size was low-to-moderate and the study heterogeneity was high. Additionally, meta-regression showed a non-significant moderating effect of industry type, yet a significant result for well-being conceptualization. This meta-analysis offers comperhensive direction for further studies, encompassing conceptual and methodological aspects, to encourage a more focused analysis on the relation between both variables.

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Introduction

Background

The contemporary industrial landscape is undergoing a profound transformation, fundamentally reshaped by the advancement of technology. At the forefront of this transformation is the widespread adoption of smart technology. In recent decade, the adoption of robot, artificial intelligence, and service automation (RAISA) have emerged as prominent technology, given their capability for pattern recognition, decision-making, and optimisation of task processes (Webb, 2019). In particular, robot is defined as a system which is able to influence its surroundings by grasping and repositioning objects around it (Nikolova et al., 2024). Artificial intelligence (AI) refers to systems that perform smart responses by analysing their environment and, with a certain level of autonomy, performing actions aimed at achieving defined goals (Sheikh et al., 2023), while automation is the replacement of human involvement in processes, procedures, or equipment with automatic operation (Gerovitch, 2003).

RAISA has been widely adopted in industrial settings, as evidenced by 2025 survey report indicating that 77% of 32,352 respondents stated that their organisations had adopted RAISA within work processes. Furthermore, 58% of participants indicated that they regularly used RAISA to support the completion of their task at work (Gillespie et al., 2025). This widespread adoption aligns with the initial

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objectives of RAISA, which include enhancing effectiveness and reducing operational costs (Lee et al., 2021). Consequently, the integration of RAISA potentially affects the tasks that must be completed, and in turn, transforms the job design that ultimately contributes to shaping work behaviour (Johanim et al., 2010). As an example, the deployment of robot, both in front-office and back-office functions, is reported as capable of handling difficult customers, undertaking repetitive tasks, and creating new career opportunities (Willems et al., 2023). On the contrary, system failures, data transfer errors, and poor technical support are examples of extra workloads that stress employees as it pushes them to work longer and faster (Hang et al., 2021; Turja et al., 2022). Such circumstances are likely to exert an influence on employee well-being.

Generally, well-being is described as a condition in which a person recognizes their own abilities, are able to manage daily life challenges, perform tasks efficiently and effectively at work, and provides a meaningful contribution to the community (World Health Organization, 2005). Studies shows that well-being contributes a significant impact on employee performance (Handayani et al., 2022; Lee et al., 2021). Given the significant impact of well-being on employee as well as on organisational performance, it is important to investigate the determinants that may affect employee well-being. A previously published scoping review had systematically mapped this area by discussing the determinants of employee well-being both in individual and organisational level (Saraswati et al., 2025). Prior empirical studies concluded that well-being is not automatically influenced merely by the technology implementation alone but also is profoundly affected by how employee perceives its existence (Stamate et al., 2021).

Perception is defined as the process or result of becoming aware of objects, relationships, and events by means of the senses, which includes such activities as recognizing, observing, and discriminating (VandenBos, 2015). Regarding the smart technology, an individual's perception towards RAISA is understood as a cognitive evaluation process that leads to emotional responses. The process encompasses four sequential questions: 1) whether the event is relevant to the individual's goals or well-being; 2) what consequences the event might produce; 3) whether the individual possesses adequate resources to cope with the consequences, and 4) whether the event aligns with the personal or societal norms (Somarathna et al., 2025). A cognitive evaluation that employee performs before adopting new technology helps them to make a comparison between what the technology can do and their needs to complete their job (Venkatesh & Bala, 2008). As RAISA increasingly shapes work design, employee's perception of its existence at their workplace are likely to play a critical role in shaping psychological outcomes, including well-being (Parker & Grote, 2022).

The broader literature has demonstrated through meta-analytic syntheses that technologies integrated in the workplace significantly influence employee well-being. For instance, in recent meta-analysis across 47 studies found that digital technology contributed to psychological effects, such as job satisfaction (Xu et al., 2025), psychological distress, anxiety, depression, stress, burnout, loneliness, social isolation, insomnia, and psychological well-being (Liţan, 2025). Despite this established evidence, a quantitative synthesis of the association between employee perception of RAISA and well-being evidence remains absent from the literature. Such finding is essential, as RAISA represents a more advanced form of workplace technology compared to those previously examined. Addressing this gap is essential not only for refining theoretical development, but also beneficial for managerial practice regarding the responsible and sustainable implementation of smart technology in organisational settings.

Evidently, empirical research has investigated employee well-being in relation to how employee perceive the integration of smart technology at work. For example, employee well-being was proven significantly affected by STARA awareness (Brougham & Haar, 2018; Jin et al., 2024), perception of AI opportunity (Farzana & Liu, 2024), and AI perceived usefulness (Stamate et al., 2021). Although prior research has examined the association of both variables and their findings have been rigorously discussed in a recent scoping review (Saraswati et al., 2025), there has yet to be a meta-analysis that synthesise all of them and estimate the effect size. Extending this foundation, the present study aims to advance the current literature by performing a meta-analysis to quantitatively synthesise the empirical evidence on the relationship of both variables. To the best of our knowledge, existing meta-analysis have not explicitly addressed perception towards RAISA as the central construct for examination. Instead, prior meta-analytic studies have focused on more general forms of technological and environmental context, such as digital technology (Liţan, 2025), internet use (Çikrıkci, 2016)

and the use of electronic communication media (Liu et al., 2019), which differ from the advanced smart technology integration in the workplace like RAISA. To address the gap, the current meta-analysis seeks to answer the following question: Does employee perception of RAISA correlate with their well-being?

Conceptualisation of well-being

Well-being is a broad, multi-dimensional concept whose various measures reflect related facets of the same psychological construct. While some research emphasises negative psychological states, such as burnout, job stress, or depression, others focus on positive aspects like life satisfaction or positive affect (Brougham & Haar, 2018; Chang et al., 2024; Jeong et al., 2024; Kim & Lee, 2024; Kong et al., 2023). Prior studies conceptualise the indicator of well-being as lying along a continuum, ranging from ill-being (e.g. stress, burnout) at one end to positive well-being at another (e.g. positive affect) at the other (Pandey et al., 2025). Within organisational settings, contemporary research often defines well-being as the combination of positive psychological states and the relative absence of negative experiences such as job strain or burnout (Kazlauskaitė et al., 2023). From this perspective, well-being and ill-being are best understood as opposite ends of the same latent continuum rather than as fully independent constructs. Additionally, incorporating both negative and positive indicators within a single analytical framework is theoretically justified, as they capture complementary variations in employee's psychological functioning. Hence, the current meta-analysis includes both type of indicators to provide a more comprehensive examination of how employees adapt psychologically to technological changes, specifically RAISA.

In the context of RAISA, the illustration of how the smart technology is assumed to be the affecting factor of well-being is best presented by Job Demands-Resources (JD-R) theory. This theory describes the mechanism through two processes, namely motivational and health impairment process (Bakker et al., 2023). Basically, well-being is shaped through the motivational process, which is activated when job resources fulfil employee's basic needs and promote work engagement. In this case, when employees view RAISA as a job resource, it creates an opportunity that helps them to promote career advancement and job security, participation in decision making, feedback provision, and role clarity in the work group (Bakker et al., 2023; Frey & Osborne, 2017). On the contrary, health impairment process is activated in situations when job demands require employees to exert greater effort, which in turn diminishes their job resources and ultimately leading to strain, psychological fatigue, and various health problems (Bakker et al., 2023). Previous studies stated that when employee experiences exceeding job demands that continuously depletes their physical and mental reserves, burnout occurs (Turja et al., 2022). In terms of RAISA integration, when it is viewed as a job demand, employee will feel threatened by the integration of the smart technology in their workplace (Frey & Osborne, 2017) as it increases work pressure, difficulty in communicating with customers, as well as repetitive and heavy tasks (Willems et al., 2023).

Despite the general definition, the conceptualisation of well-being was developed within two predominant approaches, namely hedonic and eudaimonic perspectives. The hedonic approach is represented by subjective well-being, referring to one's overall evaluation of life and emotional experiences, encompassing life satisfaction, positive affect, and minimal negative affect (Diener et al., 2015). Meanwhile, the eudaimonic approach was utilized to formulate psychological well-being, defining it as an individual's psychological health resulting from the fulfilment of criteria for positive psychological functioning (Ryff, 2023). Hence, eudaimonic perspective views well-being differently that it is beyond the mere experience of happiness and satisfaction. The distinction between these perspectives has important implications for understanding how RAISA affects well-being. In Job Demands-Resources Theory, RAISA integration may influence both hedonic and eudaimonic well-being. When perceived as a job resources, RAISA is likely to enhance hedonic well-being by reducing job stress and fostering positive affect through the automation of repetitive and routine tasks at work (Selenko et al., 2022). At the same time, RAISA promotes eudaimonic well-being by preserving personal growth through career sustainability (Nazareno & Schiff, 2021). Conversely, when perceived as job demands, RAISA impairs hedonic well-being by creating negative affect, such as learning anxiety, and negatively influence eudaimonic well-being by eliminating autonomy in job design.

Integration of RAISA in various industries

The nature of RAISA integration systematically differs between each type of industry. It is primarily shaped by the core operational goals which is unique to each sector. In the manufacturing industry, AI-powered robots primarily function as autonomous movers of materials and equipment within factories and warehouses (Webb, 2019). Their role is predominantly operational and efficiency-driven, focusing on automating heavy physical tasks with minimal human intervention. For instance, in logistic sectors, smart technology is used to automate material handling and optimise delivery routes (Jiang et al., 2021). The adoption of RAISA in this sector helps optimising distribution routes in work environments, reducing processing times, and operational costs (Wang et al., 2022).

On the contrary, the service industry emphasises human-AI interaction to enhance customer service experiences. In the hospitality sector, RAISA applications are deployed to improve convenience and personalisation for customer, such as assisting guests with travel planning or managing in-room services (Loureiro et al., 2023). Social robots are also functioned to enhance customer well-being by highlighting the importance of human-AI relationship (Rodrigues et al., 2023). In addition, service industry frequently implements chatbots or automated telephone routing systems to handle routine customer inquiries (Henkel et al., 2020). Consequently, RAISA integration in the service industry plays a significant role as supportive resource that alleviate repetitive workloads and stress due to routine customer handling.

Importantly, industry type has been identified as a significant intervening variable in prior meta-analysis examining job outcomes in technology-related context (Castaneda et al., 2026). This evidence underscores that the psychological impact of RAISA perception cannot be generalised across all types of industry without acknowledging contextual differences. Given the variation in RAISA deployment between industry sectors, industry type tends to influence how employees interpret the existence of RAISA, whether as a supportive tool that help task completion or as a substitute for human roles in the work environments, depending on the degrees of autonomy granted to the organisational system.

Hypotheses

As organisations are increasingly adopting smart technology to improve operational efficiency, positive outcomes for employees do not arise automatically. Instead, employee's perception towards RAISA can significantly influence their psychological conditions at work (Stamate et al., 2021). Employees who perceive RAISA as a threat to their existence at the organisation tend to experience negative psychological conditions, such as stress and anxiety. Conversely, a positive perception as supportive work tool may enhance positive psychological conditions, like job and life satisfaction. Referring to Job Demands-Resources Theory (Bakker et al., 2023), perception towards RAISA can act as a job demand as well as job resource. If RAISA is perceived as a demanding burden, employee well-being is likely to decline. However, if it is perceived as a resource that facilitates work, well-being may improve. Therefore, the first hypothesis is formulated as follows:

H1: Perception towards RAISA is significantly associated with employee well-being.

Although the direct relationship among perception towards RAISA and employee well-being is predicted to be significant, the strength and direction of the relationship are unlikely to be uniform. Hence, a moderator analysis should be carried out through meta-regression. Firstly, as illustrated in prior section, well-being is conceptualised into two predominant approaches: hedonic and eudaimonic. In Job Demands-Resources Theory framework (Bakker et al., 2023), RAISA perception influences well-being through different form of psychological condition. Hedonic well-being is affected through the occurrences of positive affect and minimal negative affect due to the integration of RAISA, whereas eudaimonic well-being is affected through deeper aspects of psychological functioning and fulfilment (Ryff et al., 2021). Prior empirical evidence demonstrated mixed findings regarding the impact of smart technology. On the one hand, such technology can enhance environmental mastery and personal growth through improved task efficiency, which are the central components of eudaimonic well-being (Soren & Ryff, 2023). On the other hand, smart technology is associated with reduced job satisfaction as well as increased anxiety and negative affect due to perceived threat caused by its existence (Kong et al., 2023;

Zhou et al., 2024), which are closely related to the hedonic well-being. Consequently, the present study hypothesised that the magnitude and direction of the relationship will differ depending on which well-being conceptualisation is measured.

H2a: Conceptualisation of well-being significantly moderates the association of perception towards RAISA and employee well-being.

Secondly, as described earlier, RAISA integration differs by industry type that it affects its functions (Rodrigues et al., 2023; Wang et al., 2022). Drawing upon Job Demands-Resources Theory (Bakker et al., 2023), the same workplace feature, in this case RAISA, can be perceived either as a demand of a resources depending on contextual factors. Prior literatures exhibited that various industry sectors resulted in varied psychological outcomes (Nagle et al., 2026). Due to the integration of RAISA, manufacturing industries adopt such technologies to reduce physical demands, such as heavy and hazardous tasks associated with fatigue and occupational safety (Nurski & Hoffmann, 2022). Meanwhile, service industries deploy RAISA to support cognitive workload like handling customer inquiries (Henkel et al., 2020). This function is likely to raise a concern in job security issues as RAISA potentially replaces human skill in this sector. Based on these functional differences, the present meta-analysis hypothesised that the magnitude of the effect size of RAISA perception on well-being will vary significantly across industry sectors.

H2b: Industry type significantly moderates the association of perception towards RAISA and employee well-being.

Methods

Meta-analysis design

This review used meta-analysis methods to answer meta-analysis questions. Meta-analysis refers to the statistical synthesis of quantitative results from two or more studies (Aromataris et al., 2024). To ensure this meta-analysis is carried out in a disciplined method, the authors employed the Joanna Briggs Institute (JBI) as guidance. In general, this guidance suggests several aspects to be reported in a meta-analysis, including: a) formulation of the meta-analysis question; b) development and registration of the protocol; c) systematic literature search; d) study selection; e) critical appraisal; f) data extraction; g) statistical synthesis; h) assessment of publication bias; and i) result reporting (Aromataris et al., 2024).

Meta-analysis question

Following the methodological guidance of the Joanna Briggs Institute (JBI), which advocates the use of Population, Concept, and Context (PCC) framework to formulate review questions (Peters et al., 2021), the scope of the current meta-analysis was defined. The population in current study comprises employees, concept is well-being, and context is the use of robot, artificial intelligence, and service automation (RAISA). Accordingly, this study sought to address the following questions: Does perception towards RAISA correlate with employee well-being in RAISA-integrated workplace?

Development and registration of the protocol

Methodological rigor and transparency were ensured through the prior development and publication of the review protocol. According to JBI, the protocol should be developed to explain key aspects, such as objective, model, effect size to be used, method, statistical testing procedures, indicator for heterogeneity, pre-planned sensitivity analysis, and pre-planned subgroup analysis (Aromataris et al., 2024). In accordance with the referenced methodological guidelines, this meta-analysis protocol was systematically developed and was prospectively pre-registered on May 14, 2024. The pre-registered protocol has been published and available to be accessed at https://doi.org/10.31219/osf.io/9xsnf.

Systematic literature search

The search strategy was formulated through the identification of keywords aligned with the PCC framework. PCC was used to ensure that the search process remained focus and conceptually coherent to retrieve relevant studies. The final set of keywords used in the search strategy was ('well-being' OR 'well-being' OR 'ill-being' OR 'illbeing') AND ('AI' OR 'artificial intelligence' OR 'automation' OR 'robot' OR 'RAISA' OR 'STARA' OR 'RAIA') AND 'employee*'. Two reviewers administered the literature search procedure on March 17th, 2025, and obtained 1,232 articles, as follows: a) Web of Science (337 articles); b) Scopus (364 articles); c) Taylor and Francis (440 articles); d) PubMed (65 articles); and e) EBSCOhost (26 articles).

Retrieved articles were initially imported into Zotero, a reference management tool. Deduplication procedure was performed within Zotero to remove duplicate records. This process resulted in a total of 989 articles. The deduplicated records were subsequently exported to Rayyan (https://rayyan.ai) to facilitate the study selection processes. Using Rayyan, reviewers independently screened the articles for potential inclusion in the meta-analysis. Inclusion and exclusion decisions were made based on the predetermined eligibility criteria. These criteria are presented in Table 1.

Study selection and critical appraisal

The study selection was performed by three reviewers. When disagreements regarding study inclusion arose, the first and second reviewer would take initiative to resolve through discussion. When consensus could not be reached, the third reviewer would provide the conclusive decision (Peters et al., 2020) Initial screening of the retrieved abstracts excluded articles that failed to fit with the inclusion criteria, narrowing the total of 85 articles. By applying the same criteria, a subsequent full-text review of these articles yielded 20 articles for final inclusion.

Critical appraisal was then evaluated according to AXIS, an assessment tool developed for evaluating cross-sectional study quality (Downes et al., 2016). AXIS measures 20 aspects which were classified into a) introduction; b) methods; c) results; d) discussion; dan e) others. Based on the quality assessment, only articles will low risk of bias were then included for meta-analysis.

Data extraction

Current meta-analysis employed a structured and standardised data extraction procedure. Prior to extraction, a predefined coding sheet was developed as a guideline for identifying and documenting all relevant variables (Higgins et al., 2003). The use of this sheet helps minimise subjectivity and enhance transparency in the data collection process. Two reviewers participated in the process and systematically recording relevant information from the included studies. Any disagreements were resolved through discussion, and the third reviewer was consulted to reach a consensus when necessary (Peters et al., 2020).

In this stage, the reviewers succeeded to extract relevant information for further analysis and report. The extracted data included descriptive information, such as author(s), publication year, sample size, study context (country), variables to measure perception of RAISA, and variables to measure well-being. Moreover, statistical information for data synthesis were also extracted, particularly the reported effect size (e.g. correlation or regression coefficient).

Table 1. Criteria of inclusion and exclusion.

Criteria	Inclusion criteria	Exclusion criteria
Concentration	Investigating the association between employee perception towards RAISA and well-being	Lacking a dedicated focus on this association and tested in other settings
Population	Employee	Other types of participants
Objective of research	Assessing the effect size of perception of RAISA on employee well-being.	Not assessing the association between the two variables.
Research design	Quantitative	Not implementing quantitative method
Reporting	Presenting result of correlation test between the two variables	Not presenting result of correlation test or not explicitly describing the observed variables
Article retrieval	Full text articles are available for access	Full text articles are not accessible
Language	Articles were published in English language	Publication in other languages, except English

A sequential procedure was implemented to address missing data in cases where primary studies did not provide the effect size for the correlation between observed variables. First, a conversion procedure was applied using a statistical effect size calculator, through which correlation coefficient was derived from alternative statistics such as t-value, F-value, or chi-square statistics. Second, when the statistical information available was insufficient for conversion, the corresponding author of the respective study was contacted by email. Third, if the required effect size remained unavailable following these two efforts, the study was then excluded from the analysis. The justification of the exclusion applied in this case was the study's failure to report correlation results.

Data synthesis and assessment of publication bias

The data synthesis aimed to answer meta-analysis questions and was analysed with Jamovi (2.4.7.0 version). Data was analyzed by measuring the effect size of perception towards RAISA on employee well-being in correlation coefficient (r). Effect size is defined as quantitative indicators of both direction and magnitude of the intervention's effect on outcomes (Aromataris et al., 2024). The result of the test was viewed through the confidence interval (CI), p-value and forest plot of the random-effects model.

The level of heterogeneity of the twenty studies was viewed through the value of *I2*. *I2* measures the proportion of total variation across study results that is attributable to real heterogeneity (Aromataris et al., 2024). In other words, it indicates what percentage of the observed dispersion is inconsistency between studies, as opposed to spurious sampling error. Higgins et al. (2003) suggests that a value of 0% indicates no heterogeneity among the studies. As this value increases, it reflects a greater degree of inconsistency in the observed results. To interpret the I2 value, a standard guideline has been proposed using three key values: 25%, 50%, and 75%. These values pertain to qualitative descriptions of low, moderate, and high heterogeneity, respectively (Higgins et al., , 2003).

In the event that substantial heterogeneity was detected, a moderator analysis, referred to as meta-regression analysis, would be conducted to explore potential sources of variability. Meta-regression aims to determine whether study characteristics are related to the magnitude and direction of effect sizes observed across studies included in a meta-analysis (Aromataris et al., 2024). In the current study, two moderator variables would be entered into the meta-regression to examine whether the relationship between RAISA perception and well-being is affected by other intervening factors. The first moderator distinguishes how employee well-being is conceptualised across studies. Furthermore, we would also incorporate the industry type as second moderator to capture the contextual variation in which RAISA is integrated. This moderator is expected to explain the differences in the extent of RAISA adoption and automation potential across sectors.

Moreover, publication bias analysis was also conducted to determine the presence of bias in the publication of studies on the two variables included in this study. Publication bias happens when published research on certain subject does not represent all of the studies that were actually completed (Aromataris et al., 2024). This distortion arises because studies resulting statistically significant or positive findings are far more likely to be published. Conversely, studies with non-significant or negative results frequently remain unpublished. This phenomenon leads to the incompletion and skewed studies presented by the published literatures. This bias can mislead readers and meta-analysis into overestimating the true effect of determinant variables. Therefore, an assessment of publication bias is now considered a necessary component to be reported in any rigorous meta-analysis. Publication bias test results are displayed through funnel plot, Begg and Mazumdar Rank Correlation, and Egger's Regression. In addition, publication bias could also be identified through potential missing data or non-publication of 'negative' results through fail-safe N.

Results and discussion

Data extraction

The article search for this meta-analysis was not restricted by publication year to ensure comprehensive coverage and to minimize temporal selection bias. Nevertheless, all articles that met inclusion criteria

were published between 2018 and 2025. This phenomenon reflects the growing scholarly interest in employee well-being investigation within RAISA context that parallels the advancement in organisational adoption of RAISA. The search of five databases yielded 1,232 articles. After removing 247 duplicates, 985 articles were screened. A total of 899 articles were excluded through an automated pre-screen (n = 193) and abstract screening (n = 706), leaving 85 articles for full-text retrieval. Five full text articles were inaccessible. Following a detailed review of the 80 retrieved studies, 20 articles fulfilled the inclusion criteria and were processed for the final review. The illustration of the study identification and selection is shown in Figure 1 below.

The geographical distribution of the included studies exhibits a concentration of empirical research conducted in Asia, with 14 studies originating from this region. In comparison, four studies were administered in America, while remaining studies were performed in Australia and Africa, indicating a more limited representation from these regions. The sample sizes varied among the included studies ranged from 120 to 820 participants. The study populations consisted of employees drawn from diverse industry sectors, such as logistic service and healthcare, that have integrated RAISA into their organisational processes. The overview of the articles obtained through the selection process is exhibited in Table 2 below.

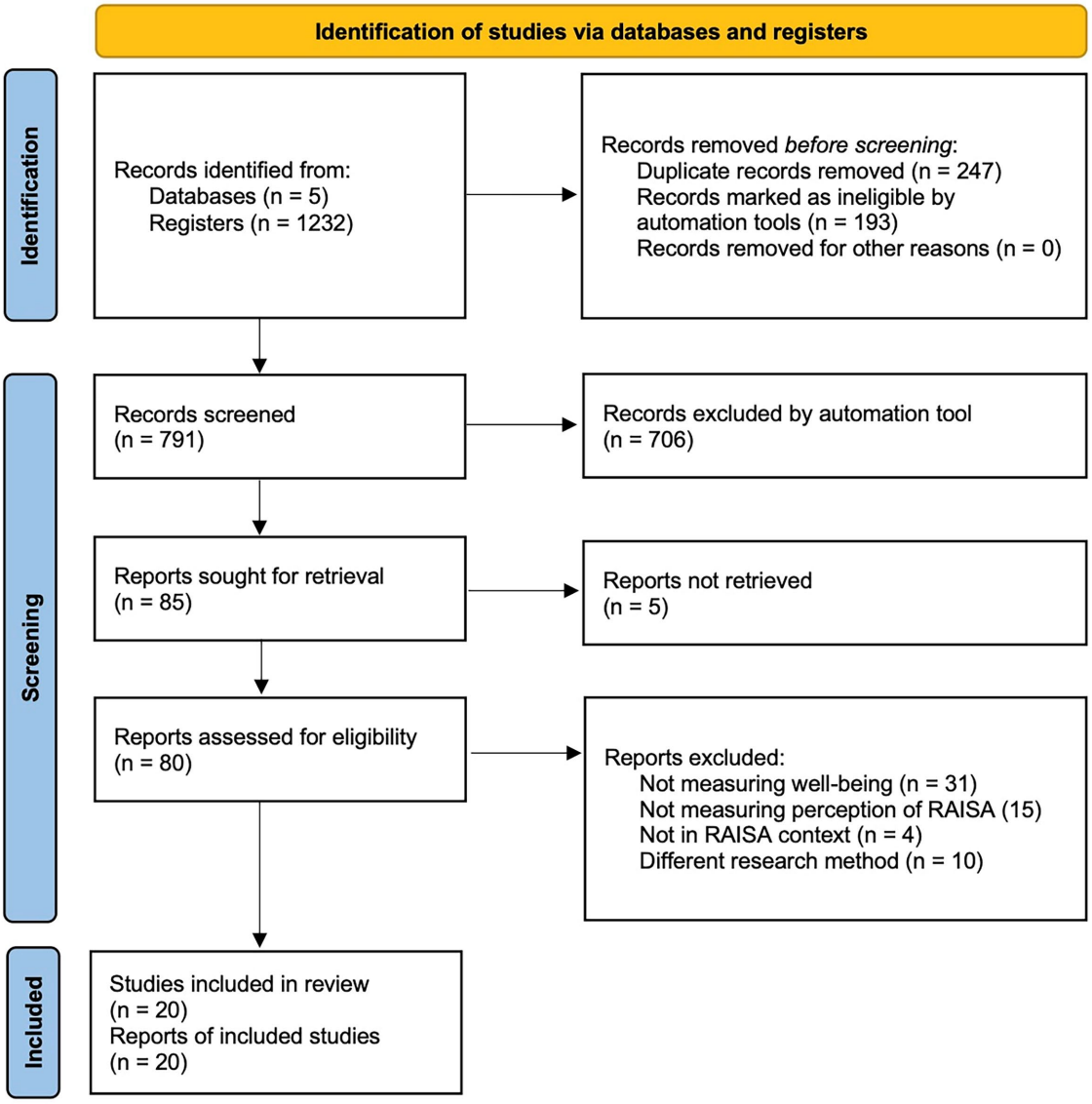

Figure 1. PRISMA flowchart of study identification and selection (Adapted from: https://www.prisma-statement.org/prisma-2020-flow-diagram).

Table 2. Summary of articles.

No.	Author(s) and year	Population	Country	Perception towards RAISA	Well-Being variables
1	Brougham and Haar (2018)	120	New Zealand	STARA awareness	Depression
2	Stamate et al. (2021)	546	Canada	AI perceived usefulness	Psychological well-being
3	Jiang et al. (2021)	516	China	Smart technology	Employee well-being
4	Kong et al. (2023)	447	China	AI trust	Life satisfaction
5	Konuk et al. (2023)	606	Turkey	AI anxiety	Psychological well-being
6	Xu et al. (2023)	268	China	AI opportunity perception	Employee workplace well-being
7	Aulia and Lin (2025)	286	Indonesia	Human-AI teaming	Well-being
8	Chang et al. (2024)	301	China	AI anxiety	Positive affect
9	Chen et al. (2024)	479	China	Technological anxiety	Well-being
10	Farzana and Liu (2024)	215	USA	AI opportunity perception	Employee workplace well-being
11	Jeong et al. (2024)	375	South Korea	AI adoption	Job stress
12	Jin et al. (2024)	349	China	STARA awareness	Work affective well-being
13	Kim and Lee (2024)	416	South Korea	AI adoption	Burnout
14	Meduri et al. (2024)	320	India	Intensity of AI integration	Employee burnout
15	Soomro et al. (2026)	324	Pakistan	AI anxiety; AI adoption	Employee well-being
16	Wu et al. (2024)	350	China	Tech-learning anxiety	Well-being
17	Zhou et al. (2024)	820	China	AI awareness	Negative emotion
18	Arboh et al. (2025)	420	Ghana	AI awareness	Workplace well-being
19	He et al. (2025)	173	USA	Self-esteem threat; perceived intelligence of robots	Burnout
20	Sharif et al. (2025)	277	China	Use of AI	Employee well-being

Statistical synthesis

The forest plot synthesised evidence from 20 studies investigating the correlation between 22 types of perception towards RAISA and employee well-being in workplace implementing RAISA. The primary goal of this meta-analysis was to derive a reliable estimate of this correlation by statistically combining the results of all included studies. The main finding is the correlation coefficient of 0.273 (95% CI [0.20, 0.35]), calculated using a random effect model. This result explains that both observed variables are correlated significantly with low-to-moderate association according to Cohen's criteria (Cohen, 2013). The confidence interval of 95% lies entirely above zero allows us to conclude that the observed overall effect is genuine and not due to random chance.

However, the feature of the plot also exhibits a substantial heterogeneity among the individual research results. The effect sizes are varied and display a wide range from very weak ($r=0.08$) to very strong ($r=0.68$). For instance, Xu et al., Chang et al., and Wu et al. reported strong correlation results in their studies. Meanwhile, Chen et al. and Konuk et al. reported the opposite. Such differences suggest that the correlation between the variables may vary depending on the contextual factors employed in each study.

In the forest plot, the precision of each individual study and the combined meta-analysis result is visually and statistically conveyed. The width of each study's confidence interval is inversely related to its precision. Narrower intervals indicate greater precision, which is typically stemming from a larger sample size or lower variance. For instance, studies like Chen et al. and He et al., depicted with wider confidence intervals, demonstrate less statistical accuracy in their individual point estimates of the effect of perception of RAISA on well-being. However, the true power of meta-analysis is revealed in the combined result. The diamond symbol at the bottom of the plot aggregates data from all included studies. Despite the imprecision of some individual studies, this overall diamond is notably narrow, indicating a highly precise summary estimate. This finding occurs because synthesising multiple studies increases the overall effective sample size and reduces random error. Consequently, the meta-analysis yields a more reliable and accurate population estimate than any single study could achieve alone.

The assessment of heterogeneity was conducted by referring to the criteria established by Higgins et al. (2003). Analysis via Jamovi indicated a high degree of variance, as the heterogeneity among the included studies was substantial. This finding was confirmed by a Cochran's Q test, which yielded a highly significant result ($Q=241.562$, $p<0.001$). This statistical significance led to a conclusion that all studies do not share a common effect size. The description of the forest plot is presented in Figure 2.

Furthermore, the *I2* statistic was calculated at 91.85%, indicating that there was an estimated 91.85% variability in the results between studies due to differences. Higgins et al. (2003) confirmed that value

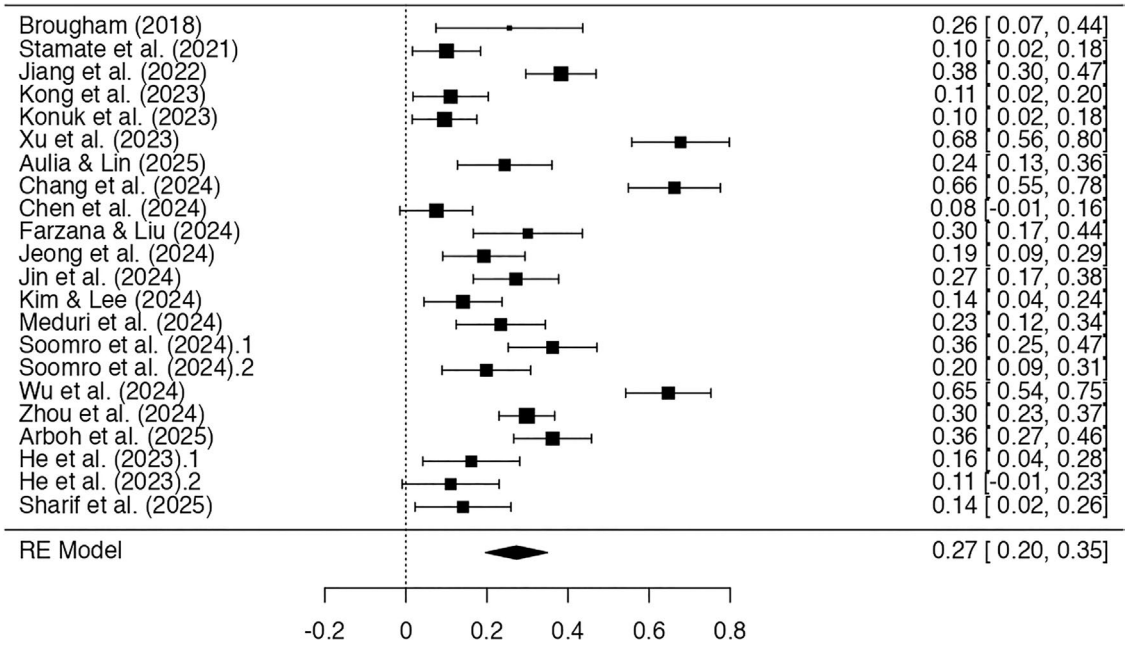

Figure 2. Forest plot.

exceeding 75% is classified as high heterogeneity. Consequently, this finding confirms inconsistency in the effect estimates, that the studies are not estimating a single population effect.

Moderator analysis

To explore underlying sources of the heterogeneity, a meta-regression was performed with conceptualisation of well-being and industry type as moderating variables. Well-being conceptualisation was classified into hedonic, which was coded of 0, and eudaimonic, which was coded of 1. Moreover, each study was also classified according to its primary industry sector. Mixed-industry sample was assigned a code of 0, manufacturing industries a code of 1, and service industry a code of 2. The results showed that well-being conceptualisation played a significant role in moderating the association of RAISA perception and employee well-being (p = .0008). Conversely, industry type did not significantly moderate the correlation between observed variables (p = .584). Even though well-being conceptualisation was evidently a significant moderator, the heterogeneity remained substantial ($I2$ = 89.39%; Q = 176.685; p < .001). Therefore, this finding indicated that the moderator explained only a limited proportion of the variance and unexplained heterogeneity may be caused by other factors not included in the current model.

Assessment of publication bias

The funnel plot in Figure 3 provides a visual assessment of the distribution of effect size and potential publication bias within current meta-analysis. Upon initial inspection, the funnel plot presents as asymmetrical distribution of studies. The individual study points are scattered broadly across the middle area of the funnel rather than forming a symmetric and converging pattern close to the mean effect size. Additionally, a concentration of points appears on the left side of the plot. This pattern could suggest the possibility of heterogeneity among the studies or indicate that smaller studies with opposing results (potentially located on the right side) may be absent from the published literature for various reasons. This phenomenon is known as publication bias.

On the contrary, further statistical analysis for funnel plot asymmetry concluded that the result s of Begg and Mazumdar's rank correlation test yielded a non-significant *p-value* of .225. Similarly, Egger's regression test showed insignificant result (p= .455). These insignificant outcomes indicated evidence of failure to present asymmetry in the funnel plot. Comparing both visual impression of the funnel plot and statistical evidence, the authors decided to interpret the presence of publication bias based on the result

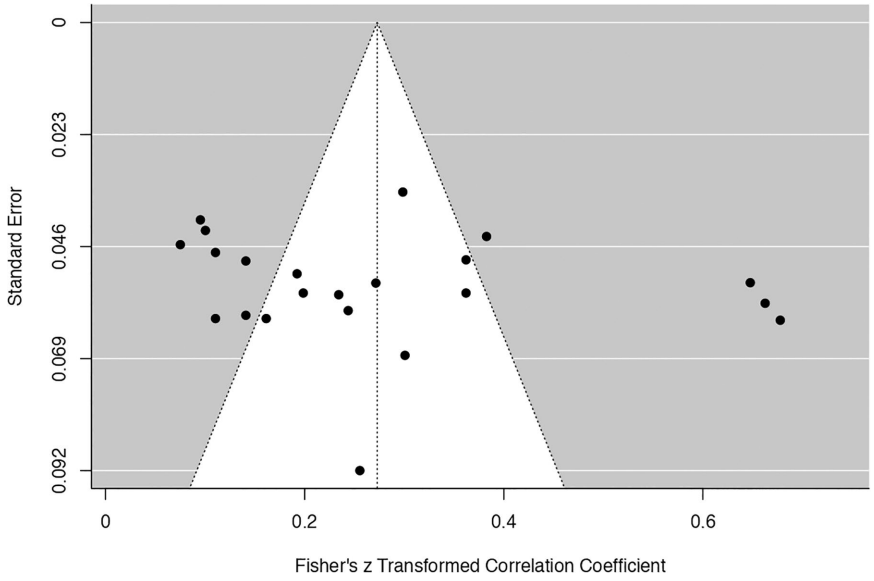

Figure 3. Funnel plot.

of statistical analysis. The observed scattering of study points is possibly attributed the expected heterogeneity between studies or to random sampling variation rather than to systematic bias stemming from unpublished research findings. Accordingly, no indication of publication bias was detected in the current meta-analysis.

In addition to the results of the two tests above, publication bias can be identified by estimating the fail-safe N, which is the number of articles with 'negative' results. Usually, these articles are not published because the study results show a very small effect size. In this meta-analysis, the calculated fail-safe N was 4,584. This means that 4,584 research articles are required to make the effect size statistically insignificant.

Discussion

The findings of current meta-analysis revealed a statistically significant correlation between perception towards RAISA and employee well-being, indicating that positive perception of RAISA leads to better well-being. According to the Job Demands-Resources Theory, when employees perceive RAISA positively, they view it as a valuable resource that enhance well-being through motivational process (Bakker et al., 2023). Additionally, job resources are also beneficial in buffering the negative impact of job demands. In this case, when RAISA functions as job resources, such as automating repetitive tasks and reducing workloads (Brougham & Haar, 2018), it fosters positive emotions that promote well-being at work (Demerouti et al., 2001). Despite the size effect, this overall effect masks a high-level heterogeneity. According to these findings, the discussion regarding the findings of this study is necessarily carried out in three-fold, including: 1) variance in effect size; 2) heterogeneity; and 3) theoretical implications and comparison with existing literature.

Firstly, although the magnitude of the correlation was classified as low to moderate, the result still contributes a valuable insight due to the complex nature of both constructs as well as its potential theoretical and practical implications. In a dynamic phenomenon of psychological and organisational context, such effect size is acceptable and should be interpreted in the cumulative impact towards individual as well as organisational level. As argued in previous literature, well-being is rarely determined by any single antecedent but emerges from a complex interaction between individual dispositions, job characteristics, and organisational conditions (Bakker et al., 2023). In the context of RAISA integration, it had been mapped that employee well-being is a consequence of the interaction between individual and organisational determinants (Saraswati et al., 2025). Hence, our findings suggest that the association between both variables depends on contextual circumstances and individual differences that were not measured in the study. Further analysis also found that although the overall effect was positive and

statistically significant, the true effect might be negative in some context. As shown in the predictive interval, future studies conducted in similar conditions may yield a negative correlation between RAISA perception and employee well-being. It indicates that RAISA perception does not guarantee enhanced well-being. Under certain circumstances, the association may lead to reverse direction. For instance, when RAISA is perceived as a threat to their job security and job autonomy, employee is likely to build a negative emotion that leads to reduced well-being.

Secondly, the heterogeneity documented in this meta-analysis should be interpreted as evidence of boundary conditions that shape the relationship of the observed variables. At the contextual level, the included studies span a diverse range of occupational sectors, organisational settings, and cultural backgrounds. Each of these contextual features has its own potential to influence employee perception and response towards the integration of such technology. For instance, Konuk et al. (2023) conducted a study among similar occupation, namely call centre officers, while Xu et al. (2023) did not set the occupational restrictions in their samples. This variation in sampling scope potentially contributes to the observed heterogeneity. At the job feature level, prior research has established that differences in job characteristics, including job resources, job challenges and job hindrance, vary across roles and organisations. These differences do not only affect respondent's reported well-being (Stamate et al., 2021), but also influence the research findings. Furthermore, the variability of sample might also impact the result of this meta-analysis. Demographic aspects, such as age and employment status, might cause an effect on the observed variables. Previous study concluded that perception towards technology use in the workplace is influenced by age. Millennials are known as a generation that is always connected to the latest communication technologies, such as smartphones, the internet, and social media. They can work efficiently by utilizing this technology (Lie et al., 2023). Unlike the older generations, Gen Y and Gen Z are familiar with the use of advanced technology because they were born in an era where the technology has developed and is widely used in various aspects of life. Therefore, their perception towards RAISA integration in the workplace will be different when compared to older generations. In terms of employment status, in their study, Baek et al. (2022) concluded that permanent employees experience higher levels of anxiety toward automation than non-permanent ones. An explanation for this finding was proposed by De Cuyper et al. (2019), who argued that permanent employees tend to have stronger psychological contracts with their organisation compared to non-permanent ones. As a result, they exhibit greater loyalty and expect the organisation to reciprocate their loyalty by providing job security. Taken together, the contextual and sample variability lead to an important insight, that employee well-being is affected by multiple sources of influence. Rather than viewing as a limitation, heterogeneity should be recognised as evidence that the association of RAISA perception and well-being is not universal. Instead, it is contingent upon a complex interaction among contextual, occupational, and individual factors.

Regarding the high heterogeneity, meta-regression analysis was performed by incorporating conceptualisation of well-being and industry type as moderator variables. Conceptualisation of well-being was statistically proven to moderate the relationship between perception towards RAISA and well-being. Well-being is often treated as a general construct rather than a theoretically phenomenon. For instance, scholars used depression, job stress, and burnout to measure well-being in their studies. This lack of conceptual clarity highlights a challenge in well-being research in RAISA-integrated work environment. As established in the literature, distinct conceptual models of well-being influence the conclusion on how well-being associated with its determinants and impacts. As an illustration, hedonic well-being is focused on pleasure and life satisfaction, while eudaimonic approach is focused on fulfilling potential and meaning of life (Disabato et al., 2016). Considering the situation, the included studies were systematically classified into both well-being approaches and resulted a significant result of partially explaining the heterogeneity of current meta-analysis. This finding indicates that well-being operates through different mechanisms. On the one hand, hedonic well-being may be influenced immediately by the reduction of job demands. Under this circumstances, employees view that RAISA can reduce workload, decrease prospective stress and anxiety, then consequently build positive affect towards the work situation (Loureiro et al., 2023). On the other hand, eudaimonic well-being may depend on more complex process. The existence of RAISA may be perceived over longer time, as the employees need to observe whether their job roles evolve before they decide that it causes changes in how they work and how much it affects their job autonomy and responsibilities. While automation facilitates work completion, it also

erodes job attractiveness, challenge, and meaning (Kinowska & Sienkiewicz, 2023). The potential threat of this smart technology will possibly demote employee's sense of meaning and purpose which is central in eudaimonic well-being. Hence, the different conceptualisation may produce various effect on employee well-being, especially in terms of the time lag needed for employees to develop their perception towards RAISA integration.

Conversely, industry type was concluded as insignificant intervening variable that may influence the correlation coefficient of the observed variables. Unlike prior studies (Castaneda et al., 2026), the assumption that different industry had their own levels of technology adoption and exposure to automation is not statistically proven. Conclusively, industry type is not a relevant boundary condition in the research of interaction between perception towards RAISA and well-being. However, this non-significant result should not be interpreted as evidence that context is irrelevant. Rather, it implied that industry classifications might be too broad to capture the mechanism of how RAISA perception affects well-being. Instead of concentration on technical issues of the smart technology deployment in specific industry, scholars would benefit from shifting their focus on how RAISA in implemented, experienced, and interpreted within daily tasks and organisational processes. This strategy would be beneficial as it refers to the central finding of this meta-analysis, that perception of RAISA is significantly correlated with employee well-being.

Thirdly, our findings deliver several theoretical implications for understanding the association of RAISA perception and well-being. According to Job Demands-Resources Theory, job characteristics are conventionally classified as either job demands or job resources. Job demands consume energy and create strain, while job resources fuel motivation and protect well-being (Bakker et al., 2023). Building upon this foundation, our findings indicate that RAISA can be further conceptualised as a workplace stimulus embedded within a dual-pathway model, in which it may serve as either a job demand or a job resource, depending on how employees interpret its existence and purpose through cognitive processes (Stamate et al., 2021; Willems et al., 2023). When viewed as an opportunity to help employee completing their tasks at work, RAISA plays a role as a job resource and activates the motivational process that promotes well-being. On the contrary, when employees perceive RAISA as a threat to their career sustainability, it functions as a job demand and activates the health impairment process that reduces well-being. This dual-pathway model allows the simultaneous assessment of the effects of exogenous variables on endogenous variables through two distinct mechanisms (Bai et al., 2025), thereby offering a more comprehensive explanation of employee well-being in RAISA-integrated workplace. Furthermore, our findings also extend Job Demands-Resources Theory by introducing a cognitive mechanism through which RAISA integration shapes employee well-being. Current meta-analysis demonstrates that job characteristics in the context of RAISA integration cannot be merely viewed as objective features. Instead, it is relative to how employees subjectively interpret RAISA and its role in their work environment. This cognitive mechanism complements the Job Demands-Resources framework by explaining why similar technological adoption may affect various well-being outcomes in different individuals or organisational contexts.

Taken together, this meta-analysis provides a synthesised overview of the existing literature. The findings imply that the association between perception of RAISA and employee well-being appears to follow a dual-pathway and contextual structure. This means that whether employees perceive RAISA as beneficial or detrimental to their well-being depends on how they interpret the technology within their specific environment. The observed correlation is not uniform across all contexts but varies depending on job characteristics, organisational settings, and individual differences. Shortly, understanding how RAISA affects well-being likely requires attention to multiple interacting factors rather than a single and straightforward explanation.

Limitation and implications

This section discusses the limitations of the present meta-analysis and suggests directions for future research. To begin with, a concern is addressed to the database selection. Only five databases were utilised in this meta-analysis: Web of Science, Scopus, Taylor and Francis, EBSCOhost, and PubMed. Future analysis could be extended by using databases specialised in certain field, such as APA PsycNet for psychology literature. Moreover, this analysis did not include grey literature, such as conference

proceedings, institutional repositories, preprints and Google Scholar articles. The inclusion of these resources would broaden the scope of evidence and promote the comprehensiveness of future analysis.

Secondly, the conceptualisation of well-being was proven significant to moderate the correlation between the observed variables. Meanwhile, current meta-analysis did not limit the conceptualisation with the established frameworks of well-being. Several studies operationalised well-being using terms like life satisfaction, depression, and burnout as the indicators. While these indicators capture certain aspect of psychological functioning, they do not comprehensively reflect well-being as defined in dominant theoretical perspectives, such as hedonic and eudaimonic approaches. This conceptual variation may limit the comparability of the meta-analysis finding. A more focused meta-analysis on well-being would benefit from the explicit adoption of a theoretical framework, thereby assuring that only studies aligned with a specific well-being conceptualisation are included. Additionally, measuring employee well-being using a conceptualisation specifically developed for the workplace context is likely to yield more representative research findings than incorporating instruments that assess well-being in more general contexts.

Thirdly, the high level of heterogeneity observed in the present meta-analysis indicates that the association between RAISA perception and employee well-being is likely influenced by additional factors not examined in this study. Given that industry type did not emerge as significant moderator, it is predicted that other moderators serve as a more decisive contributor on how employees perceive and respond to RAISA integration. Individual factors, such as age and employment status, may influence whether RAISA is viewed as a threat or a challenge. At the organisational level, aspects like culture and communication management may become significant factors in shaping employee's interpretation and emotional responses. Future research is expected to systematically investigate these alternative explanations to comprehend the boundary conditions of the association of both observed variables, thereby the heterogeneity could be explained and enhance the accuracy of the overall findings.

Ultimately, this meta-analysis is expected to yield beneficial theoretical contributions and practical implications for stakeholders. Future study is suggested to examine other determinants of employee well-being in RAISA-integrated work environments. While the Job Demands-Resources Theory identifies job demands and job resources as key determinants of well-being, our finding revealed that the classification of RAISA as either a demand or a resource is contingent upon employee's cognitive interpretation. Therefore, employee's subjective perception towards RAISA should also be simultaneously measured in dual-pathway model to gather a more integrative picture of the relationship among RAISA perception and employee well-being. Additionally, to mitigate the high level of heterogeneity, future study should examine potential moderators across contextual level. Variables in individual and organisational level are expectedly contributing on explaining the heterogeneity when employed as moderators in the meta-regression analysis.

From practical perspective, this meta-analysis confirms that employee's perception of RAISA significantly influences their well-being. Negative perceptions of smart technology adoption are associated with lower well-being, whereas positive perceptions contribute to enhanced employee well-being. Given this finding, management should pay greater attention to how employee perceives the integration of RAISA within the organisational process. To mitigate the potential negative effect, organisational interventions should focus on communication and job design. One practical communication strategy is the use of regular town hall meetings, which provide a forum for transparent, two-way dialogue between management and employees. Through these meetings, management can clearly demonstrate how RAISA facilitates task completion, openly respond to employee concerns, and reduce uncertainty and anxiety, which in turn promotes employee well-being. Additionally, job design serves as a protective factor for well-being in RAISA-integrated work environments, particularly when job preserves employee autonomy which allows them to be in control over how tasks should be executed despite automation. However, such job design changes must be formally documented in updated Standard Operating Procedures (SOPs) and properly socialised to employee through training, briefing, or dedicated communication channels. When employees are fully aware of how their roles have been redesigned to preserve job autonomy and meaningful work, they tend to develop positive perception towards RAISA and experience enhanced well-being.

Conclusion

This meta-analysis examined the association between perception towards RAISA and employee well-being, specifically in RAISA-integrated workplace. Based on 20 included studies, it is evident that both variables are significantly correlated, implying the importance of developing a positive perspective of the existence of smart technology as it may lead to affecting well-being. This result underscores the importance of fostering positive perception of RAISA as part of organisational processes, in a sense that such perception may influence employee's psychological experience at work, including their overall well-being. Rather than the technology itself, employee's positive interpretation and evaluation play a more significant role in promoting well-being in RAISA-integrated work setting.

Author contributions

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CRediT authorship contributions

Kiky D.H. Saraswati: Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation. Methodology, Project administration, Resources, Software, Validation, Visualisation, Writing-original draft, Writing-review and editing. Fajrianthi: Conceptualisation, Funding acquisition, Project administration, Supervision, Validation, Writing-review and editing. Samian: Conceptualisation, Supervision, Validation, Writing-review and editing.

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Data availability statement

The supporting data of this study will be provided from first author upon request, subject to ethical and confidentiality considerations.

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