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S.P. Udhayakumar, M. Sivasubramanian

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## Evaluating the functions of client involvement, team dynamics, and communication in software requirements engineering

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S.P. Udhayakumar and M. Sivasubramanian\*

Department of Management,  
Sathyabama Institute of Science and Technology,  
Chennai, 600119, India  
Email: 23udhayakumar@gmail.com  
Email: ms2008.sb@gmail.com  
\*Corresponding author

**Abstract:** The software development life cycle requires requirements engineering (RE) to gather, evaluate, and validate software requirements. Communication is crucial throughout the requirements phase to comprehend and express the issue. Understanding customer behaviour affects market dynamics in many businesses. Client retention requires technology-driven marketing efforts like digital, internet, electronic, and viral marketing. Organisation-to-public and organisation-to-customer communication has changed thanks to social media marketing. This study analyses how the voice of consumers and Quality function deployment affect software requirement elicitation, including communication techniques, team personality dynamics, and client involvement. The study collected data quantitatively. According to the study, client engagement grows dramatically as effective communication improves. Developers should choose the right requirements elicitation method, be culturally sensitive, create a respectful and open communication environment, excel in communication skills, and master technical language to solve communication issues. Future studies will analyse how many factors affect software requirement elicitation, and industry partnerships will enable case studies to explore actual issues and solutions.

**Keywords:** communication and requirement elicitation; software development; team dynamic; business information systems; client engagement; software quality.

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**Biographical notes:** S.P. Udhayakumar is a seasoned Software Consultant with a strong educational background, holding both a Master's degree in Computer Application and in Business Administration. He is widely recognised as a software quality and agile reengineering consultant for his insightful papers in Software Engineering, contributing valuable insights to the industry. His passion lies in consulting, teaching, and coaching, where he leverages his expertise to help organisations and individuals succeed. Beyond his professional pursuits, he finds balance through his love for travel, believing in the importance of harmonising work and leisure to lead a fulfilling life.

M. Sivasubramanian has more than three decades of industrial and academic experience. Presently, he is a state-quality mentor and project consultant for state-funded urban infrastructure projects of the Government of Tamil Nadu and Visiting Faculty for reputed universities. He has completed his mathematics and postgraduate studies at PSG College of Arts and Science and PSG College of Technology. He has a doctoral degree in Banking (microfinance) with a special reference to women's entrepreneurship. Published more than 25 papers on various management subjects in reputed indexed journals.

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## **1 Introduction**

Requirements engineering (RE) determines and specifies what needs to be built, and it is one of the trickiest parts of the software development life cycle. One of the software engineering subfields resulting from the challenge of gathering, evaluating, and validating software requirements is requirements engineering (RE) (Adekola and Aribisala, 2023). Elicitation, analysis, specification, validation and verification, and management are commonly used to characterise the RE process (Anand et al., 2024). When stakeholders are involved in meeting quality standards, the requirements engineer's time is taken up by various issues (Broome et al., 2007; Iqbal and Suaib, 2014; Pennington et al., 2018). Additional tasks like identifying stakeholders, negotiating, and choosing techniques are also needed to understand stakeholders' diverse needs and preferences (Bastareche, 2024). Different methods are available for gathering software requirements, but having the expertise to choose the most appropriate ones for a specific project is crucial (Estolonio et al., 2023). Therefore, improving the methods requirements engineers use to understand stakeholder demands is essential for obtaining high-quality requirements, which in turn enhances software quality (Ghozali, 2024). Understanding users, their needs, and their operational contexts is crucial for enhancing project success significantly (Ecija et al., 2024). This shift has replaced previous views focusing solely on functional and technological aspects, highlighting the importance of accurately capturing requirements in real-world scenarios (Gomathy and Venkatasbramanian, 2023). Deep comprehension of the problem domain, including users, work environments, and the broader organisational context, is essential for achieving higher levels of usefulness and usability in systems (Jaji et al., 2023). The foundation of these needs lies in the problem domain, and while perfect understanding is challenging, a thorough grasp ensures system usability (Jasper et al., 2023). The effectiveness of understanding needs depends on how they are presented; user-involved approaches foster more productive communication for requirements gathering (Kler et al., 2024).

During a project's requirements phase, there's extensive communication among diverse individuals with varying backgrounds, skills, positions, and knowledge levels (Kolachina et al., 2023). The goal is to understand and convey the problem effectively, which is challenging due to the unpredictable and intricate nature of the requirements (Lavanya et al., 2023). Gathering requirements often encounter hurdles in effective communication because human and organisational elements deeply influence system design and development (Lishmah Dominic et al., 2023). Despite the emergence of socio-technical approaches to address human aspects in design and communication challenges, a study by Curtis et al. underscores the importance of effective communication in system

design (Moyo and Nithyanantham, 2024). Although the study is over a decade old, its findings remain relevant, highlighting the ongoing need for improved communication strategies in system design (Ocoró et al., 2023). Understanding consumer behaviour is paramount in several industries, as it influences market dynamics significantly. Analysing and comprehending the behaviours of different groups and individuals is essential amidst growing market competition. Organisations must employ direct marketing strategies to retain their customers effectively (Olubunmi, 2024). Hence, a deep understanding of the factors shaping consumer behaviour becomes imperative (Padmavathy et al., 2024). Marketing studies highlight consumer loyalty as a pivotal aspect of consumer behaviour, representing a key goal for organisations (Peñaflorida and Basañes, 2024). Achieving customer loyalty is challenging yet crucial, contributing significantly to a company's marketing efforts (Pulivarthy, 2024). Customer loyalty, influenced by customer satisfaction and engagement, is pivotal in gaining a competitive advantage (Rafiq and Subbulakshmi, 2024).

In recent years, global academia has shown increasing interest in studying customer engagement practices, recognising their pivotal role in nurturing customer loyalty and driving referrals (Ramos et al., 2023). Technology-driven marketing initiatives, including digital, internet, electronic, and viral marketing, are crucial for attracting and retaining clients (Reethu et al., 2024). This underscores the importance of prioritising social media, mobile, and email marketing strategies for long-term customer retention (Dwivedi et al., 2021). Social media marketing emerged as a novel approach in 2000 and has since evolved into a vital tool for user interaction, shaping organisation-to-public and organisation-to-customer communication (Saboor et al., 2024). Digital technology is utilised by businesses to engage with individuals and the general public, subject to consumers' consent, given the ubiquitous presence of mobile phones in our daily lives and their significant growth in recent years (Ozuem and Mulloo, 2018). Given the widespread use of platforms like Facebook globally, leveraging social media applications has become a key driver for business success (Saxena et al., 2023). In real-time, many service providers, such as banking, retailers, insurance, and Fintech, enhance their marketing practices based on customer preferences and decision-making patterns (Saleh et al., 2024). Revolves around understanding their behaviour, which directly affects the software requirement elicitation (Shilesh et al., 2024). Understanding their pattern marketing research technique, behavioural finance insights, and continuous feedback from customers would help to enhance the establishment of client engagement in software requirement elicitation (Sabti et al., 2023; Mompel and Lombrio, 2024).

In reality, poor communication, a struggle to articulate the customer needs, a lack of communication, and a lack of teamwork could cause a lack of engagement among clients (Singh et al., 2023). Hence, the need to examine the intricate issue of requirement communication in system design, especially from the user-designer viewpoint, is emphasised (Sudha et al., 2024). To address this, the paper is organised into seven additional sections. Section 2 delves into a socially-oriented approach to design, highlighting the critical role of communication and team dynamics. Based on these goals, the research question has been framed.

- Does effective communication influence client engagement?
- Does team dynamics affect client engagement in the IT sector?

Despite recognising the benefits of being attuned to communication challenges, Section 3 outlines existing problems. Given these communication challenges, Section 4 introduces a four-dimensional framework to analyse various socio-technical methodologies and their requirements gathering stages based on the issues identified earlier (Silvia Priscila et al., 2023). The paper concludes in Section 6 with recommendations from the analysis to enhance communication activities during requirements gathering. Lastly, the final section outlines potential directions for future research that could yield significant insights. This study aims to explore the influence of the voice of consumers and quality function deployment on the effectiveness of software requirement elicitation and examine the interplay between communication strategies, team personality dynamics, and client engagement in this context. The objectives are framed based on the following research questions and how effective communication and team dynamics affect client engagement in requirement elicitation processes.

## **2 Literature review**

In the context of requirement elicitation, many methods for understanding and assessing communication effectiveness often fail to focus on studying or measuring actual communication interactions. One prevalent approach revolves around individuals perceived as successful communicators in eliciting requirements. Researchers who follow this approach often examine effective requirement elicitors' characteristics and personal growth (Lai and Ali, 2013). Zhang (2007) presents a widely accepted view, defining a 'mediating man' as someone who embodies beliefs in the common unity of humanity, cultural relativity of values, cognitive adaptability, participation in international social networks, and reference to supranational groups. As a result, the psychosocial approach typically portrays an idealised individual whose personal and social qualities are believed to enhance successful communication in eliciting requirements across various contexts and cultures (Tripathi and Al-Zubaidi, 2023).

Despite efforts to develop theories about these 'multicultural individuals' (Connor et al., 2009), few studies have linked these identified characteristics with measurable traits in requirement elicitation. Some research exploring the connection between specific predispositions and effective communication in eliciting requirements includes Detweiler's investigation into the impact of category width on inference-making skills among Peace Corps volunteers, Harker et al. (1993) study of cognitive complexity and perceptions of requirement elicitation effectiveness, and studies examining how an internal or external locus of control influences communication in requirements elicitation (Wiegiers and Beatty, 2013). Efforts to correlate personality traits with performance in requirement elicitation settings have generally lacked empirical support (Tan, 1993). Additionally, this approach primarily focuses on conditions preceding interactions among stakeholders rather than directly addressing the communication behaviours themselves during requirement elicitation.

### **3 Theoretical background**

The voice of the customer (VOC) is a business process that captures and structures customers' requirements, creating a hierarchy of their desires and needs. This method offers a thorough grasp of customer needs, establishes a common language for teams, provides essential inputs for design specifications, and catalyses product innovation. VOC studies encompass qualitative and quantitative market research steps and are typically undertaken at the outset of new product, process, or service design endeavours (Suresh and Gopinath, 2018). The VOC plays a pivotal role in defining new products, deploying quality functions (QFD), and establishing detailed design specifications. Active involvement of the product development core team is crucial for fully internalising the VOC and making informed product design decisions. Customer needs are articulated as benefits to be delivered by the product or service rather than as specific solutions or metrics. As an integrated function, marketing aims to shape product and marketing strategies to influence customer perceptions (Upadhyay et al., 2024).

The VOC process categorises customer needs into primary, secondary, and tertiary levels. Primary needs, typically between 2 and 10, guide strategic marketing directions. In contrast, secondary needs offer detailed insights for engineering, R&D, and advertising agencies to develop precise product features or content that align with the primary and secondary needs (Abramov, 2015). Additionally, the Visual Organisational Framework (VOC) serves as a tool to comprehend customer preferences and needs, aiding in decisions that balance the cost of meeting a customer's need with the desirability of doing so (Freeman and Radziwill, 2018). Emerging techniques now empower agents to prioritise customer needs effectively, while perceptions of performance stem from quantitative market research. Intel, the world's foremost microprocessor manufacturer, devised its own VOC strategy to delve into customer requirements for specialised microprocessors across diverse applications. Similarly, PPG Industries, a prominent producer of industrial coatings and materials, trained its product development teams in VOC methodologies and executed successful studies globally (Subramaniam et al., 2009).

The VOC is a vital element of new product development's 'fuzzy front end', which furnishes a robust foundation for design and marketing choices from conceptualisation to product launch. Quality function deployment (QFD) is a product development approach that integrates the VOC throughout the development lifecycle. Typically led by a cross-functional team, QFD involves creating matrices like the house of quality (HOQ) to link customer desires and needs with product features. Metrics are then established to gauge how well these features meet customer needs, aiding in identifying and prioritising design specifications (Chan and Wu, 2002). Initially developed in the 1970s at a Japanese shipbuilding firm, QFD offers a systematic framework for navigating the complexities and trade-offs inherent in design decisions (Venkateswaran et al., 2023). Evolving through input from Japanese academics, it later permeated the Japanese and USA auto industries by the mid-1980s and is now prevalent across diverse industries and applications. A comprehensive QFD approach utilises multiple matrices, sequentially linking customer Needs to Performance Measures, Performance Measures to Features or Solutions, Features or Solutions to Parts Specifications, and Parts Specifications to Manufacturing Processes (Herrmann et al., 2006). Theoretical frameworks emphasise the importance of two key components to enhance the VOC and improve Quality Function Deployment, thereby enhancing client engagement (Venkatasubramanian et al., 2023).

QFD is a structured methodology that transits customers' needs into specific engineering and business requirements. In real-time, many service-providing apps like banking, food delivery, and shopping want to enhance user experience based on customer preferences (Venkateswaran et al., 2024). Through the VOC, these services could receive their customer feedback about security, transition speed, and ease of usage. These companies could even build customer requirements such as secure login, intuitive UI through biometric authentication, optimised server response, and simplified menu design. By applying effective QFD, the software development team ensures clarity, prioritisation, and alignment between customer expectations and product design. Based on the VOC perspective, the study takes effective communication. From the QFD perspective, team dynamics are an important factor affecting client engagement in software requirement processes.

### *3.1 Effective communication*

Communication involves key elements like sender-receiver, encoder-decoder, feedback, message, noise, context, and impact. Rooted in the Latin terms 'communis' and 'communicate', communication is viewed as a means of comprehending and interpreting exchanged messages, leading to the creation of knowledge or symbols (Yaseen et al., 2015). Scholars articulate this concept in various ways (Holtzblatt and Beyer, 1995). However, a common thread among these descriptions is the focus on understanding others and expressing oneself, which involves transferring and connecting ideas. Skill is "the ability to accomplish and expediently complete a task based on one's predisposition and learning" (Coughlan and Macredie, 2002). Consequently, communication skills involve searching for and integrating descriptions and possible perspectives of the events one encounters. A person who has developed these skills can interpret warnings, criticisms, or complaints directed at them from multiple perspectives rather than a single one (Yaseen et al., 2015). Furthermore, communication skills underpin many other abilities and can be summarised as sensitivity to verbal and non-verbal messages, active listening, and active responding (Putri et al., 2024).

Rizwan Beg et al. (2013) and Yaseen et al. (2015) describe the communication process as having information sources, a message, a transmitter, a signal, a receiver, a destination, and noise. Tan addressed that it involves two or more participants who act and react to one another, with the successful exchange of a message requiring both parties to perceive it in the same way. Feedback from the receiver is crucial for effective communication, and the context and channel chosen for transmission also influence this process (Pa and Zin, 2011). The meaning of a message is not entirely determined by the message itself but is constituted by the receiver's background. Differences in background can significantly differ from the intended meaning of the sender.

Communication extends beyond mere expression; participants must share attributes like language, experiences, cultural values, and knowledge. It occurs within specific contexts, encompassing four dimensions: physical, social, psychological, and temporal (Rizwan Beg et al., 2013). The physical dimension pertains to the environment, while the social dimension encompasses relationships, societal norms, and cultures. Psychological context includes factors like friendliness and formality. Berlo's model underscores communication as an interactive, non-linear process comprising four key elements: source, message, channel, and receiver. Ali et al. (2019) argue that a message is encoded based on the sender's personality, environmental perceptions, context, message content,

receiver, and self-perceptions. Barnlund's model interprets cues as signals processed from the environment. Pandey et al. (2010) describe the communication process using an infinity symbol, illustrating its continuous and ongoing nature.

### *3.2 Team dynamics*

Carron et al. (1989) defined team dynamics as an active process characterised by the group's tendency to remain united in pursuing instrumental objectives or satisfying member affective needs. Brawley et al. (1993) discovered that 83% of cohesion studies reported a positive link between cohesion and group performance. Thus, comprehending the cohesion-performance relationship and the factors that foster or hinder cohesion would greatly benefit sports managers and coaches striving for peak performance. The relationship between team performance and cohesion is cyclical, with higher cohesion levels resulting in better performance. Martens and Peterson's 1971 study demonstrated this cyclical relationship, showing a strong connection between team cohesiveness and performance. Numerous studies across various sports have supported this connection. However, Delice et al. (2019) suggested that understanding the cohesion-performance relationship requires examining mediating variables. Proenca (2007) highlighted the need to investigate potential mediators and moderators to understand the relationship better.

Collective efficacy often acts as a significant link between cohesion and performance. In highly cohesive teams, players may hold stronger shared beliefs in their team's capabilities, resulting in increased success (Walker et al., 2020). Successful group performance can further boost players' perceptions of collective efficacy, fostering cohesion development (Sunarto et al., 2024). Nevertheless, certain studies indicate that this triadic relationship can be more intricate and challenging than the straightforward connection described by these scholars. Abelein et al. conducted semi-structured interviews with twelve IT business coordination experts, revealing limited communication with developers and a lack of a standardised method for user-developer communication in large-scale IT projects. Their findings align with our research, offering valuable insights and results that complement our work. O'Neill et al. (2020) introduced a development approach called 'Cloud Teams', which suggests that the physical presence of end users during the development process is not necessary for effective requirements elicitation. This methodology can help address deficiencies in requirements elicitation and circumvent certain challenges (Venkatasubramanian et al., 2023).

Eubanks et al. (2016) discussed traditional requirements-gathering processes that overlook communication issues, emphasising the significance of language and time zone differences in communication breakdowns. The data collection method employed in their research was a survey. Romero et al. delved into the causes of failures during the requirements-gathering process and proposed solutions to rectify and enhance them. They suggested a simulation tool for students to practice requirement-gathering skills before entering the workforce, considering cultural, cognitive, geographical, and time zone disparities. These studies are valuable due to their scientific relevance and proximity to our research, laying the groundwork for further advancements and a promising start.

### *3.3 Client engagement*

Effective communication and team dynamics are potent strategies for engaging and motivating people toward achieving organisational goals (Imanzadeh et al., 2021). They foster emotional involvement and problem-solving, making complex tasks more appealing. The primary challenge for organisations lies in effectively engaging employees and customers to fulfil basic business objectives. These factors introduce engagement mechanics into intricate tasks through incentives, rendering them more enticing (Kang et al., 2023). Previous literature has explored the production of effects by heterogeneous actor-networks comprising human and non-human ‘actants’ and various linking devices across time and space. It aims to shift agency from individual actors to the network as a whole, where ‘actants’ contribute significantly. The core principle of client engagement is symmetry, which advocates treating all actants equally. This principle stems from the commitment to analyse all scientific claims uniformly, irrespective of their current status as ‘true’ or ‘false’ in the scientific community. In research projects such as commercial endeavours, this principle examines outcomes, the transformation of diverse requirements, and client engagement throughout the process.

Within client engagement, these factors allow examining client presence (and absence) in ongoing negotiations regarding emerging issues. This approach elucidates how engagement in a construction process can reshape the client and their objectives. Team dynamics portrays client objectives as an outcome of their participation in a dynamic, heterogeneous network. In construction research, prior studies often take a ‘light touch’ approach, focusing on one or more key concepts. For instance, Bashir et al. (2018) explored material objects to delve into the evolving project goals.

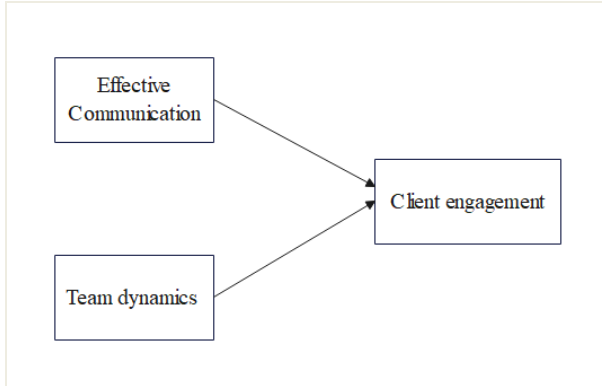
Meanwhile, Lingard et al. used multiple interactions and heterogeneous networks to study the evolution of specific design decisions. By treating the fixing of a particular design feature as a network effect involving various actors, this analysis provides a fresh perspective on client engagement and its modalities (Holdsworth et al., 2014). The Architect Use Case Diagram (AUCD) specifies functional and quality attribute requirements in a single diagram. It utilises connectors like sub-flow for optional functionalities, alternative flow for exceptional and alternative flows, security flow for security requirements, response time indicators for performance requirements, and scalability indicators for specifying maximum data transfer or user access within a specific timeframe (Landrum et al., 2012). Requirement visualisation through AUCD encourages active participation in requirement elicitation, particularly when using gamification methods. Gamification effectively motivates participation and improves communication between stakeholders and the development team.

AUCD can mitigate challenges such as lack of motivation and active user participation (Gillespie et al., 2004). For example, an AUCD for the place order use case in an online sales portal project visualises, deletes, updates, and confirms orders as sub-flows while considering alternative factors like out-of-stock, less quantity, and no cash on delivery as alternative flows. The graphical representation of most ASRs enhances customer involvement, leading to the identification of more ASRs (Roeg et al., 2015). The following hypotheses and research models are based on the abovementioned literature (Figure 1).

*H1: Effective communication impacts Client engagement during the requirement elicitation process.*

*H2: Team Dynamics impact Client engagement during the requirement elicitation process.*

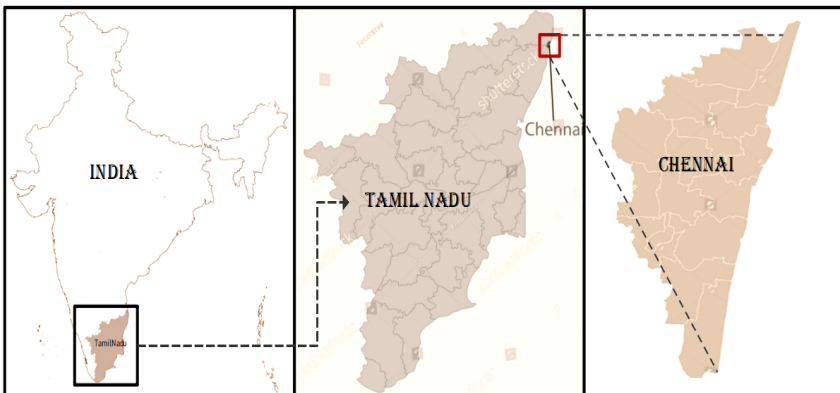
**Figure 1** Proposed conceptual model



#### 4 Research methodology

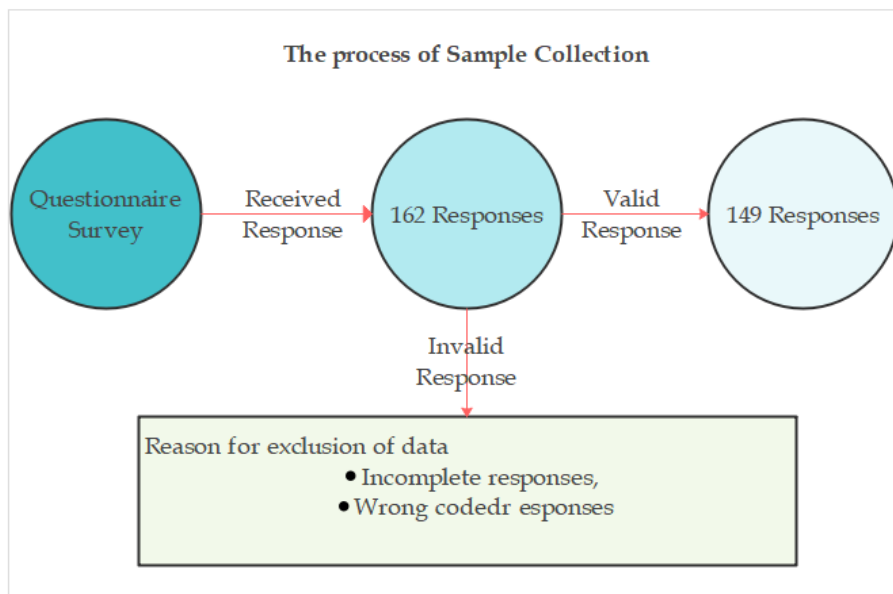
The study utilised a descriptive and exploratory research design employing a quantitative research approach and the survey method. This study tries to quantify and explore the behaviour and opinion toward client engagement among the specific population of IT sector employees. The target population comprised all employees working in the software development department in the IT sector in private companies in Chennai (Figure 2). Chennai was selected as the research location due to its significant concentration of private IT employees, status as a software company's hub, advanced infrastructure, cultural diversity, strong industry connections, accessibility, and vibrant IT community. Consequently, 200 private IT employees in the software development department who met the study's criteria were invited to participate in the research.

**Figure 2** Study area map: Tamil Nadu, Chennai (see online version for colours)



The snowball sampling method was used to obtain individuals working in software development companies. This method is an easy way to obtain the sample and is more affordable for obtaining a larger sample size. The study was conducted through a questionnaire survey, which included inquiries about managing effective communication, team dynamics, and client engagement scales. As per Linares-Fontela, the initial step involves determining whether a survey suits the situation. In addressing our research question, the survey is one of the most suitable tools. The survey comprises demographic information and measurement scale items for each scale. The measurement scales were adapted based on prior literature. The scale was adopted by Kline et al. (2018) for client engagement. For Team dynamics, Song et al. (2015) adopted the scale. The scale was adopted from Buluş et al. (2017) for effective communication. The survey questionnaire needed to specify the type of information sought to determine the appropriate survey type for each scenario. In our case, we determined that a detailed survey would most effectively gather accurate data through an online questionnaire survey and enable interpretation and analysis through graphics and statistical calculations. We distributed a questionnaire to participants to gather primary data, resulting in over 160 responses. After screening for invalid and missing responses, 149 valid sample sizes were used for the data analysis (see Figure 3) for hypothesis testing structural equation modelling analysis employed using SPSS software.

**Figure 3** The process of sample data collection (see online version for colours)



## 5 Results

This section deals with data analysis results and their interpretation. It includes demographic characteristics, construct validity, and reliability. For hypothesis testing, the path coefficient has been analysed (Table 1).

**Table 1** Demographic characteristics

| <i>Particulars</i> | <i>Items</i>                | <i>F</i> | <i>Percentage (%)</i> |
|--------------------|-----------------------------|----------|-----------------------|
| Gender             | Female                      | 23       | 15.4                  |
|                    | Male                        | 126      | 84.6                  |
| Age                | 26–30                       | 17       | 11.4                  |
|                    | 31–35                       | 42       | 28.2                  |
|                    | 36–40                       | 63       | 42.3                  |
|                    | Above 40                    | 27       | 18.1                  |
|                    |                             |          |                       |
| Designation        | Project manager             | 5        | 3.3                   |
|                    | Team Leader                 | 32       | 21.4                  |
|                    | Team member                 | 38       | 25.5                  |
|                    | Software Developer          | 18       | 12.2                  |
|                    | Client relationship Manager | 56       | 37.6                  |

The study reveals a gender distribution of 84.6% males and 15.4% females, with the largest age group being 36–40 years old, comprising 42.3% of the sample. Most respondents hold the designation of Client Relationship Manager, accounting for 37.6% of the sample. The age distribution is relatively balanced across different age brackets. Most respondents are team members, with 25.5% and 21.4% respectively. Most respondents are project managers, with 12.2% holding the designation. The data provides insights into the demographic and professional profile of the respondents, including gender distribution, age groups, and job designations from the software development companies.

Reliability refers to the consistency and dependability of the data collection process, which is to have a steady hand that yields the same result each time it performs a task (George and Mallery, 2018). Validity refers to the accuracy and meaningfulness of your data, ensuring the puzzle pieces the research assembles create the intended picture. When the method and measurement technique are valid, they consistently produce results that reflect reality accurately (Rourke and Anderson, 2004). Table 2 displays the results of the model validity and reliability tests. Cronbach's-Alpha (CA) and composite reliability (CR) are measures of the internal consistency or reliability of scales or items in a questionnaire. They help assess how well the items in a construct measure the same underlying concept. Effective communication (EC) has a high level of internal consistency with a CA value of 0.802 and a CR value of 0.787. Team dynamics (TD) has a moderate level of internal consistency with a CA value of 0.721 and a CR value of 0.815. Client engagement (CE) has high internal consistency with a CA of .861 and a CR value of 0.751.

**Table 2** Constructs validity and reliability

| <i>Constructs</i>       | <i>Cronbach's Alpha (CA)</i> | <i>Composite reliability (CR)</i> |
|-------------------------|------------------------------|-----------------------------------|
| Effective Communication | 0.802                        | 0.787                             |
| Team dynamics           | 0.721                        | 0.815                             |
| Client management       | 0.861                        | 0.751                             |

Convergent validity indicates how closely the new scale correlates with other variables and measures of the same construct (Kim et al., 2013). Each item loading must be at least 0.5, relevant, and have a correlated p-value less than or equal to 0.05 to demonstrate convergent validity. Each inactive creates AVE ought to be at least 0.5. Table 3 displays the factor AVE values, with values greater than 0.5 deemed more effective. Although effective communication, team dynamics, and client engagement have not yet achieved the AVE value of 0.5, these figures are considered reliable indicators of findings (Table 4).

**Table 3** Convergent validity

| <i>Constructs</i>       | <i>Average-variance-extracted (AVE)</i> |
|-------------------------|-----------------------------------------|
| Effective communication | 0.465                                   |
| Team dynamics           | 0.398                                   |
| Client management       | 0.431                                   |

**Table 4** Discriminant validity

| <i>Constructs</i>       | <i>EC</i> | <i>TD</i> | <i>CM</i> |
|-------------------------|-----------|-----------|-----------|
| Effective communication | 0.669     |           |           |
| Team dynamics           | 0.602     | 0.493     |           |
| Client engagement       | 0.117     | 0.206     | 0.242     |

Discriminant validity is demonstrated when measures of constructs that theoretically should not be closely related are, in fact, not highly correlated. In practice, discriminant validity coefficients should be significantly smaller than convergent ones (Farrell and Rudd, 2009). Table 4 shows the correlation values among the constructs used in this study. Effective communication is extremely correlated with team dynamics (0.602). Client engagement has a weaker correlation with effective communication (0.117). Client engagement has moderated corrections with team dynamics (0.206), and this construct has a high level of discriminant validity. Additionally, all the constructs' correlation values are below 0.85 and 0.90. The constructs used in this research are highly discriminant from each other.

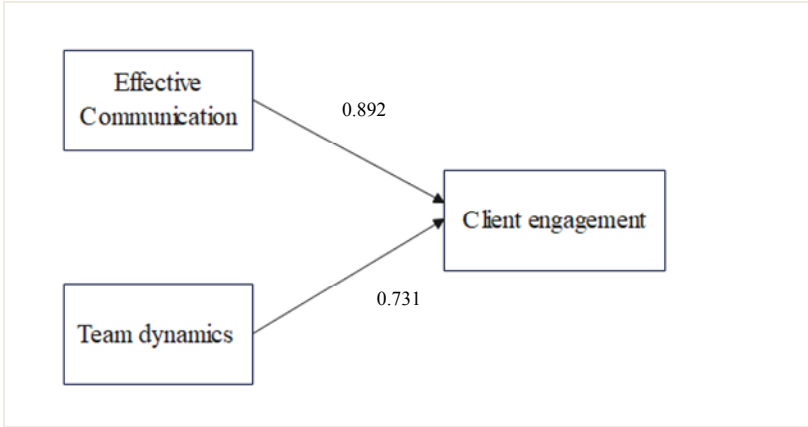
The path coefficient of 0.892 ( $p = 0.000$ ) indicates a strong positive relationship between effective communication and client engagement (Table 5). This suggests that as effective communication increases, client engagement also increases significantly. Clear, timely, and productive communication within the team and with clients increases client engagement and satisfaction with the project or service. The path coefficient 0.731 ( $p = 0.000$ ) indicates a strong positive relationship between team dynamics and client engagement. Positive team dynamics, including collaboration, cohesion, and effective teamwork, contribute positively to client engagement. Both factors play crucial roles in enhancing client engagement, with effective communication having a slightly stronger impact. Hence, H1 and H2 are accepted. Both factors are essential for ensuring high levels of client engagement in software development projects or service delivery (Figure 4).

**Table 5**      Path coefficient

| <i>Constructs relationship</i>              | <i>Path coefficients</i> | <i>t-value</i> | <i>p-value</i> |
|---------------------------------------------|--------------------------|----------------|----------------|
| Effective communication → Client engagement | 0.892                    | 17.84          | 0.000**        |
| Team Dynamics → Client engagement           | 0.731                    | 14.62          | 0.000**        |

\*\*Highly significant.

**Figure 4**      Structural model



## 6 Discussion

In this section, we delve into the primary discoveries of the study. A significant 100% of respondents affirmed that requirements gathering in software development stands out as one of the project's most critical phases. Given this unanimous agreement, all professionals surveyed have engaged in this process and have encountered challenges that either led to project failure or client dissatisfaction with the system developed. Thus, ensuring the correct execution of this process is paramount before proceeding with system development. Enhancing skills in requirements elicitation among software engineers and students is suggested through the utilisation of simulation techniques and artificial agents. However, regardless of the technique employed, effective communication with the customer remains crucial, necessitating reinforcement in this area for requirements engineers. A commonly used technique for requirements gathering is focus groups, which aligns well with agile methodologies, where the entire team collaborates closely with the client during the requirements gathering process.

A survey was conducted to assess the effectiveness of our current requirements-gathering processes. The results indicate that most developers believe gathering requirements is suboptimal, while fewer consider it effective. This suggests that most respondents need change or innovation in certain aspects of the requirements-gathering process. In response to how to identify communication issues between clients and developers, our study found that most developers reported experiencing communication problems when clients frequently change system requirements. Meanwhile, some mentioned encountering challenges due to the client's limited interest in the development

process. None of the respondents noted that clients expressed discomfort. From this, we can infer that communication issues arise when clients continuously change requirements, and although they do not express discomfort, there are evident communication challenges in the process.

A technique that fewer professionals are familiar with compared to focus groups. This could be due to project manager instructions or the technique's inapplicability to the project. Surveys are also less commonly used, possibly because they are not part of the professionals' work environment or are perceived as time-consuming and costly. Similarly, experiments are the least known technique, likely because of the significant time investment required or the high costs associated with conducting them. This shift may stem from the constant technological advancement developers face, leading to increased complexity in client-required functionalities, necessitating a more thorough and modern approach to requirements gathering and improved client communication. Many professionals in the survey prefer the 'Focus Group' technique due to its agility. However, Barrón et al. note the importance of employing multiple techniques sometimes. The choice of requirement-gathering techniques often depends on client needs and system complexity. Customers exhibit signs of problems in the requirements-gathering process, either directly through dissatisfaction or indirectly through frequent changes in system requirements. These changes may result from a lack of trust between the client and the developer. Regularly revisiting the requirements-gathering process can help verify implemented functionalities, identify communication and trust issues, and save development and error correction time.

Developers face the challenge of keeping the client at the forefront of system development, as only the client knows their desired product and functionalities. Effective communication should foster trust and create a seamless flow of information, ensuring the developer implements requirements optimally. Our research findings align with those of Abelein et al., who also observed a lack of long-term communication between clients and developers in IT project development. Although our data collection method differed (general survey vs. personal interviews), the consistent conclusion strengthens our findings. Hassan et al. offer a different perspective, highlighting communication challenges between mobile application users and developers, leading to inadequate feedback for app improvements. This reinforces our research's conclusion about the communication gap between clients and developers. The study discovered that no technique is immune to failures, with surveys being the most problematic. This is often due to a lack of effective communication between the requirements engineer and the client, as surveys may rely on closed questions that limit clients' input or may not include opportunities for clients to express their opinions on requirements. Although relatively new in software engineering, experiments are also prone to errors and are less reliable for clients and professionals. Following this, focus groups can encounter challenges such as shyness or limited participation, hindering effective requirements gathering. In contrast, direct observation experiences fewer failures as the requirements engineer directly witnesses what is needed for the project, making it a more reliable technique.

To address shortcomings in our processes, it's vital to acknowledge the global context of today's society and tailor software project teams' approaches to their specific geographical settings. Globalisation urges us to stay current with the world, adopting newer and more efficient methods rather than rigidly sticking to traditional ones. However, the efficacy of these methods can vary depending on the location, necessitating a blend of traditional and contemporary approaches as needed. Our survey garnered

various insights on improving communication gaps with clients. Many respondents stressed that simply following traditional processes correctly is not enough. Instead, they advocated for a more thorough analysis and careful collection of client information to ensure effectiveness and relevance. The effectiveness of this solution may vary depending on several factors, particularly identifying the root cause of the problem and applying the appropriate remedy.

Additionally, a proposed solution involves implementing an offshore distribution strategy and dividing roles, essentially outsourcing certain aspects of the project. While this solution may not be universally ideal, it can significantly mitigate the communication problem. By hiring external staff who are impartial to the requirements of the engineer and the client, valuable insights can be gained into the root cause of the problem and potential solutions. Although this may entail additional costs for the company, it can remedy miscommunication between clients and developers.

Early on in a software project, it's critical to understand the myriad of elements that affect whether or not clients and engineers communicate effectively. These elements include project management know-how, cultural sensitivity, effective communication techniques, strategic considerations, and possible technical difficulties. Several crucial tactics are necessary to improve communication. First and foremost, choosing the right requirements elicitation technique is essential. Avoiding misunderstandings with clients is facilitated by maintaining cultural sensitivity. Creating and maintaining an open, courteous communication with clients is critical. The requirements engineer must also have excellent communication skills and a thorough understanding of project management concepts like cost and time. Lastly, the engineer must communicate well in technical terms so that the client and developer can understand project details. The engineer should adeptly translate technical concepts into layperson's terms for client understanding if needed.

### *6.1 Practical and theoretical implications*

Several strategies exist to improve team collaboration, communication efficiency, and client relationships in software development. Clear communication channels, defined roles and responsibilities, knowledge sharing, adoption of agile practices, regular feedback sessions, fostering a continuous improvement culture, providing training and skill development opportunities, empowering team members through autonomy, decision-making authority, and ownership over tasks, and acknowledging and rewarding team achievements are all essential components of these strategies. Project management tools like Slack and Microsoft Teams allow for real-time information sharing, reducing miscommunication and ensuring everyone is on the same page about project progress and objectives. Defined roles and responsibilities ensure team members understand their tasks, areas of expertise, and accountability, leading to improved efficiency and productivity. Knowledge sharing fosters a culture of learning, collaboration, and continuous improvement, avoiding repeated mistakes and leveraging expertise. Agile methodologies like Scrum or Kanban promote iterative development, frequent feedback, and adaptive planning, resulting in faster delivery of high-quality software products. Involving clients in regular feedback sessions helps gather input, validate requirements, and address concerns early in development. Establishing an effective communication process among employees could strengthen strong client engagement. Companies could use the following communication practices for effective communication: conducting

regular meetings with stakeholders, using wireframes and interactive prototypes, and encouraging developers to use layperson's terms.

Fostering a continuous improvement culture encourages team members to seek opportunities for learning, innovation, and process refinement, identifying areas for improvement and optimising performance. Training and skill development opportunities equip team members with technical expertise, communication skills, and collaboration techniques, boosting morale and contributing to overall project success. Recognising and rewarding team achievements boosts morale, motivation, and cohesion, creating a positive work environment. Providing regular client updates through status reports, progress dashboards, and milestone presentations keeps clients informed and engaged in the project, aligning with client expectations and strengthening client relationships. To gather project requirements effectively, it's essential to understand all stakeholders' needs, goals, and expectations. This can be achieved through interviews, workshops, and surveys. Clear objectives and multiple elicitation techniques, such as SMART goals, can avoid ambiguity and ensure alignment. Prioritising requirements based on importance, feasibility, and impact on project success can be achieved using techniques like MoSCoW or impact-effort matrix. Collaboration and communication among stakeholders are crucial, and requirements should be documented clearly and concisely. Validating requirements with stakeholders is essential to ensure they accurately reflect their needs. An iterative approach is recommended, with domain experts, subject matter experts, and experienced team members providing valuable insights. Improvement in requirement elicitation processes can lead to better-defined requirements, improved project outcomes, and increased client satisfaction.

## **7 Conclusion**

This research underscores the critical importance of requirements elicitation in software projects, nearly equivalent to programming tasks. Survey responses pinpoint communication and idea exchange as central challenges, leading to project delays and timeline deviations. Effective communication, characterised by clear and dependable language between the requirements elicitor and project lead, is vital. The requirements elicitor can offer valuable insights from previous successful endeavours. Knowledge and experience are pivotal in strengthening the conceptualisation of the product idea. This study reveals a gap in the requirements-gathering process, highlighting potential specific or similar problems that may arise. These issues warrant further exploration from diverse perspectives, as demonstrated in this research. The analysis demonstrated that good team dynamics and communication favourably impact client engagement. These close working relationships create active involvement in the software development process through team dynamics and communication. In the elicitation process, these two elements may lessen the likelihood that a software project will fail. Poor system design, scope creep, a lack of stakeholder participation, and a lack of awareness of stakeholder needs are some issues that efficient communication methods could resolve. Furthermore, it promotes the highest level of stakeholder participation throughout the RE process and uses prototyping to obtain preliminary user input, which helps stakeholders develop a common understanding of requirements.

Future studies will focus on analysing the influence of various factors, such as cultural aspects, client engagement strategies, team elements, and measurement

frameworks on software requirement elicitation. Additionally, it will conduct longitudinal research to monitor changes in communication patterns, team dynamics, and client engagement across multiple software projects. This study only focuses on employees in the IT sector. Future studies could be in Fintech, banking, and insurance. Collaboration with industry partners will enable case studies, exploring practical challenges and solutions in communication, team dynamics, and client engagement during software requirement elicitation. The study will also explore user experience (UX) considerations to enhance communication clarity, team collaboration, and client satisfaction. Ultimately, the goal is to deepen the understanding of these roles and contribute to developing more efficient practices and strategies in this domain.

## Conflicts of interest

All authors declare that they have no conflicts of interest.

## References

- Abramov, O.Y. (2015) 'Voice of the product to supplement 'Voice of the customer'', *Proceedings of TRIZFest-2015 Conference*, Seoul, South Korea, pp.309–317.
- Adekola, R.A. and Aribisala, O.O. (2023) 'Impact of entrepreneurial skill on attaining sustainable development in business education', *FMDB Transactions on Sustainable Social Sciences Letters*, Vol. 1, No. 3, pp.180–188.
- Ali, Z., Yaseen, M. and Ahmed, S. (2019) 'Effective communication as critical success factor during requirement elicitation in global software development', *International Journal of Computer Science Engineering (IJCSE)*, Vol. 8, No. 3, pp.108–115.
- Anand, R., Jestadi, R., Govinda, K. and Sharma, D. (2024) 'Data-driven insights: analyzing and visualizing trends in the chocolate market for strategic decision-making', *AVE Trends in Intelligent Technoprise Letters*, Vol. 1, No. 2, pp.60–70.
- Bastareche, R.D. (2024) 'Global educational collaboration: its platform, premises, and promises', *FMDB Transactions on Sustainable Techno Learning*, Vol. 2, No. 2, pp.88–101.
- Brawley, L.R., Carron, A.V. and Widmeyer, W.N. (1993) 'The influence of the group and its cohesiveness on perceptions of group goal-related variables', *Journal of Sport and Exercise Psychology*, Vol. 15, No. 3, pp.245–260.
- Broome, K.M., Flynn, P.M., Knight, D.K. and Simpson, D.D. (2007) 'Program structure, staff perceptions, and client engagement in treatment', *Journal of Substance Abuse Treatment*, Vol. 33, No. 2, pp.149–158.
- Buluş, M., Atan, A. and Sankaya, H.E. (2017) 'Effective communication skills: a new conceptual framework and scale development study', *International Online Journal of Educational Sciences*, Vol. 9, No. 2, pp.575–590.
- Carron, A.V., Widmeyer, W.N. and Brawley, L.R. (1989) 'The measurement of cohesion in sports teams: the Group Environment Questionnaire', *Journal Canadien Des Sciences Du Sport [Canadian Journal of Sport Sciences]*, Vol. 14, No. 1, pp.55–59.
- Chan, L.K. and Wu, M.L. (2002) 'Quality function deployment: a literature review', *European Journal of Operational Research*, Vol. 143, No. 3, pp.463–497.
- Connor, A.M., Buchan, J. and Petrova, K. (2009) 'Bridging the research-practice gap in requirements engineering through effective teaching and peer learning', *2009 Sixth International Conference on Information Technology: New Generations*, April, IEEE, Las Vegas, NV, USA, pp.678–683.

- Coughlan, J. and Macredie, R.D. (2002) 'Effective communication in requirements elicitation: a comparison of methodologies', *Requirements Engineering*, Vol. 7, No. 2, pp.47–60.
- Delice, F., Rousseau, M. and Feitosa, J. (2019) 'Advancing teams research: what, when, and how to measure team dynamics over time', *Frontiers in Psychology*, Vol. 10, No. 6, pp.1–20.
- Dwivedi, Y.K., Ismagilova, E., Hughes, D.L., Carlson, J., Filieri, R., Jacobson, J. and Wang, Y. (2021) 'Setting the future of digital and social media marketing research: perspectives and research propositions', *International Journal of Information Management*, Vol. 59, No. 8, p.102168.
- Eciija, J.D., Abris, M.G. and Sabejon, M.B. (2024) 'Preparedness on disaster risk reduction management measures, competence, and challenges faced by schools', *FMDb Transactions on Sustainable Humanities and Society*, Vol. 1, No. 3, pp.100–112.
- Estolonio, H.M., Nicol, J.A., Santos, P.C.C. and Ramos, J.I. (2023) 'Impact of remote work on employee engagement and productivity in operations management', *FMDb Transactions on Sustainable Management Letters*, Vol. 1, No. 4, pp.155–167.
- Eubanks, D.L., Palanski, M., Olabisi, J., Joinson, A. and Dove, J. (2016) 'Team dynamics in virtual, partially distributed teams: optimal role fulfillment', *Computers in Human Behavior*, Vol. 61, No. 8, pp.556–568.
- Farrell, A.M. and Rudd, J.M. (2009) 'Factor analysis and discriminant validity: a brief review of some practical issues', *Australia and New Zealand Marketing Academy Conference 2009 (ANZMAC)*, Melbourne, Australia, pp.1–9.
- Freeman, G. and Radziwill, N. (2018) 'Voice of the customer (VoC): a review of techniques to reveal and prioritize requirements for quality', *Joaqat-Journal of Quality Management Systems, Applied Engineering, and Technology Management*, Vol. 2018, No. 3, pp.1–29.
- George, D. and Mallery, P. (2018) *Reliability Analysis*, IBM SPSS statistics 25 step by step', Routledge, Oxfordshire, UK, pp.249–260.
- Ghozali, M.T. (2024) 'Assessment of knowledge, perception, and readiness for telepharmacy-assisted pharmaceutical services among young pharmacists in rural Indonesia', *Exploratory Research in Clinical and Social Pharmacy*, Vol. 16, No. 12, p.100513, <https://doi.org/10.1016/j.rcsop.2024.100513>
- Gillespie, M., Smith, J., Meaden, A., Jones, C. and Wane, J. (2004) 'Clients' Engagement with Assertive Outreach Services: a Comparison of Client and Staff Perceptions of Engagement and Its Impact on Later Engagement. *Journal of Mental Health*, Vol. 13, No. 5, pp.439–452.
- Gomathy, V. and Venkatasbramanian, S. (2023) 'Impact of teacher expectations on student academic achievement', *FMDb Transactions on Sustainable Techno Learning*, Vol. 1, No. 2, pp.78–91.
- Harker, S.D., Eason, K.D. and Dobson, J.E. (1993) 'The change and evolution of requirements as a challenge to the practice of software engineering', *Proceedings of the IEEE International Symposium on Requirements Engineering*, January, IEEE, San Diego, CA, USA, pp.266–272.
- Herrmann, A., Huber, F., Algesheime, R. and Tomczak, T. (2006) 'An empirical study of quality function deployment on company performance', *International Journal of Quality and Reliability Management*, Vol. 23, No. 4, pp.345–366.
- Holdsworth, E., Bowen, E., Brown, S. and Howat, D. (2014) 'Client engagement in psychotherapeutic treatment and associations with client characteristics, therapist characteristics, and treatment factors', *Clinical Psychology Review*, Vol. 34, No. 5, pp.428–450.
- Holtzblatt, K. and Beyer, H.R. (1995) 'Requirements gathering: the human factor', *Communications of the ACM*, Vol. 38, No. 5, pp.31–32.
- Imanzadeh, S., Alivandi Vafa, M., Hashemi, T. and Azemoudeh, M. (2021) 'Examining the role of the therapeutic alliance in treatment efficacy by mediating client engagement', *Journal of Applied Psychological Research*, Vol. 12, No. 3, pp.171–190.
- Iqbal, T. and Suaib, M. (2014) 'Requirement elicitation technique:-a. review paper', *Int. J. Comput. Math. Sci.*, Vol. 3, No. 9, pp.1–6.

- Jaji, K.D., Cui, P., Talisic, H. and Macaspac, J.L. (2023) 'Adversities on employee tenure workforce: an investigation of aging workforce job performance on organization', *FMDB Transactions on Sustainable Technoprise Letters*, Vol. 1, No. 3, pp.135–144.
- Jasper, K., Neha, R. and Hong, W.C. (2023) 'Unveiling the rise of video game addiction among students and implementing educational strategies for prevention and intervention', *FMDB Transactions on Sustainable Social Sciences Letters*, Vol. 1, No. 3, pp.158–171.
- Kang, E., Chen, J. and Foster, E.R. (2023) 'Feasibility, client engagement, and person-centeredness of telehealth goal setting and goal management intervention', *OTJR: Occupational Therapy Journal of Research*, Vol. 43, No. 3, pp.408–416.
- Kim, Y., Park, I. and Kang, M. (2013) 'Convergent validity of the international physical activity questionnaire (IPAQ): meta-analysis', *Public Health Nutrition*, Vol. 16, No. 3, pp.440–452.
- Kler, R., Jamoliddinov, J., Nematjonov, J., Kadirov, I. and Muzaffarov, M. (2024) 'Locating contribution of health and education in regional growth in Uzbekistan', *AVE Trends in Intelligent Techno Learning*, Vol. 1, No. 1, pp.11–22.
- Kline, E.R., DeTore, N.R., Keefe, K., Seidman, L.J., Srihari, V.H., Keshavan, M.S. and Guyer, M. (2018) 'Development and validation of the client engagement and service use scale: a pilot study', *Schizophrenia Research*, Vol. 201, No. 11, pp.343–346.
- Kolachina, S., Sumanth, S., Godavarthi, V.R.C., Rayapudi, P.K., Rajest, S.S. and Jalil, N.A. (2023) 'The role of talent management to accomplish its principal purpose in human resource management', *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp.274–292.
- Lai, R. and Ali, N. (2013) 'A requirements management method for global software development', *AIS: Advances in Information Sciences*, Vol. 1, No. 1, pp.38–58.
- Landrum, B., Knight, D.K. and Flynn, P.M. (2012) 'The impact of organizational stress and burnout on client engagement', *Journal of Substance Abuse Treatment*, Vol. 42, No. 2, pp.222–230.
- Lavanya, D., Rangineni, S., Reddi, L.T., Regin, R., Rajest, S.S. and Paramasivan, P. (2023) 'Synergizing efficiency and customer delight on empowering business with enterprise applications', *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp.149–163.
- Lishmah Dominic, M., Venkateswaran, P.S., Reddi, L.T., Rangineni, S., Regin, R. and Rajest, S.S. (2023) 'The synergy of management information systems and predictive analytics for marketing', *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp.49–63.
- Mompel, J.T. and Lombrio, C. (2024) 'Impact of physical education as a form of recreational activities: academic performance of the students', *FMDB Transactions on Sustainable Humanities and Society*, Vol. 1, No. 3, pp.113–123.
- Moyo, S.B. and Nithyanantham, V. (2024) 'Evaluating the influence of parental involvement in early childhood education programs', *AVE Trends in Intelligent Techno Learning*, Vol. 1, No. 1, pp.47–60.
- O'Neill, T.A., Pezer, L., Solis, L., Larson, N., Maynard, N., Dolphin, G.R. and Li, S. (2020) 'Team dynamics feedback for post-secondary student learning teams: introducing the "Bare CARE" assessment and report', *Assessment and Evaluation in Higher Education*, Vol. 45, No. 8, pp.1121–1135.
- Ocoró, M.P., Polo, O.C.C. and Khandare, S. (2023) 'Importance of business financial risk analysis in SMEs according to COVID-19', *FMDB Transactions on Sustainable Management Letters*, Vol. 1, No. 1, pp.12–21.
- Olubunmi, O.I. (2024) 'Impact of learning resources management strategies on academic performance of junior secondary school business studies', *AVE Trends In Intelligent Techno Learning*, Vol. 1, No. 1, pp.1–10.
- Ozuem, W. and Mulloo, B.N. (2018) 'Basics of mobile marketing strategy', *Mobile Commerce: Concepts, Methodologies, Tools, and Applications*, IGI Global, Hershey, PA, USA, pp.1–18.

- Pa, N.C. and Zin, A.M. (2011) 'Requirement elicitation: identifying the communication challenges between developer and customer', *International Journal of New Computer Architectures and Their Applications (IJNCAA)*, Vol. 1, No. 2, pp.371–383.
- Padmavathy, V., Venkateswaran, P.S., Begum, S. and Sheela, K. (2024) 'A review of the faculty engagement and performance in higher educational institutions', *AVE Trends in Intelligent Techno Learning*, Vol. 1, No. 2, pp.76–87.
- Pandey, D., Suman, U. and Ramani, A.K. (2010) 'An effective requirement engineering process model for software development and requirements management', *2010 International Conference on Advances in Recent Technologies in Communication and Computing*, October. IEEE, Kottayam, India, pp.287–291.
- Peñaflorida, M.C.A. and Basañes, R.A. (2024) 'Academic support of graduates of professional teacher certification program senior high school teachers', *FMDB Transactions on Sustainable Techno Learning*, Vol. 2, No. 1, pp.32–40.
- Pennington, K.M., Dong, Y., Coville, H.H., Wang, B., Gajic, O. and Kelm, D.J. (2018) 'Evaluation of TEAM dynamics before and after remote simulation training utilizing CERTAIN platform', *Medical Education Online*, Vol. 23, No. 1, p.1485431.
- Proenca, E.J. (2007) 'Team dynamics and team empowerment in health care organizations', *Health Care Management Review*, Vol. 32, No. 4, pp.370–378.
- Pulivarthy, P. (2024) 'Research on oracle database performance optimization in IT-based university educational management system', *FMDB Transactions on Sustainable Computing Systems*, Vol. 2, No. 2, pp.84–95.
- Putri, M.F.J.L., Sunarso, S. and Samsuri, S. (2024) 'Citizenship education as an effort to prevent radicalism and extremism', *FMDB Transactions on Sustainable Humanities and Society*, Vol. 1, No. 2, pp.82–90.
- Rafiq, M. and Subbulakshmi, S. (2024) 'Cause-related marketing and its impact on consumer behaviour: an investigation with FMCG brands', *FMDB Transactions on Sustainable Humanities and Society*, Vol. 1, No. 1, pp.21–29.
- Ramos, J.I., Lacerona, R. and Nunag, J.M. (2023) 'A study on operational excellence, work environment factors and the impact to employee performance', *FMDB Transactions on Sustainable Social Sciences Letters*, Vol. 1, No. 1, pp.12–25.
- Reethu, M.R.M., Mudunuri, L.N.R. and Banala, S. (2024) 'Exploring the big five personality traits of employees in corporates', *FMDB Transactions on Sustainable Management Letters*, Vol. 2, No. 1, pp.1–13.
- Rizwan Beg, M., Muqem, M. and Faizan Farooqui, M. (2013) 'Extending the application of non-verbal communication to effective requirement elicitation', *Advances in Computing and Information Technology: Proceedings of the Second International Conference on Advances in Computing and Information Technology (ACITY)*, 13–15 July, 2012, Chennai, India, Vol. 2, Springer, Berlin, Heidelberg, Germany, pp.623–630.
- Roeg, D., van de Goor, I. and Garretsen, H. (2015) 'Predicting initial client engagement with community mental health services by routinely measured data', *Community Mental Health Journal*, Vol. 51, No. 7, pp.71–78.
- Rourke, L. and Anderson, T. (2004) 'Validity in quantitative content analysis', *Educational Technology Research and Development*, Vol. 52, No. 1, pp.5–18.
- Saboor, A., Butt, H. and Touseef, M. (2024) 'Impact of interpersonal skills of textile sector employees on the performance of organizations', *FMDB Transactions on Sustainable Technoprise Letters*, Vol. 2, No. 1, pp.10–22.
- Sabti, Y.M., Alqatrani, R.I.N., Zaid, M.I., Taengkliang, B. and Kareem, J.M. (2023) 'Impact of business environment on the performance of employees in the public-listed companies', *FMDB Transactions on Sustainable Management Letters*, Vol. 1, No. 2, pp.56–65.
- Saleh, M., Mustapha, Z.B. and Ndirmbitah, B.K. (2024) 'Empirical analysis of digital marketing on the purchasing habit of conservative digital users of common social media', *FMDB Transactions on Sustainable Technoprise Letters*, Vol. 2, No. 1, pp.31–41.

- Saxena, D., Khandare, S. and Chaudhary, S. (2023) 'An overview of chatGPT: impact on academic learning', *FMDB Transactions on Sustainable Techno Learning*, Vol. 1, No. 1, pp.11–20.
- Shilesh, D.M., Linson, L., Babu, J. and Ashifa, K.M. (2024) 'Exploring the impact of social media on adolescent food habits and dietary choices', *AVE Trends In Intelligent Social Letters*, Vol. 1, No. 3, pp.148–156.
- Silvia Priscila, S., Soji, E.S., Hossó, N., Paramasivan, P. and Suman Rajest, S. (2023) 'Digital realms and mental health: examining the influence of online learning systems on students', *FMDB Transactions on Sustainable Techno Learning*, Vol. 1, No. 3, pp.156–164.
- Singh, S., Rajest, S.S., Hadoussa, S., Obaid, A.J. and Regin, R. (Eds.) (2023) 'Data-driven decision making for long-term business success', *Advances in Business Information Systems and Analytics*, IGI Global, USA, DOI: 10.4018/979-8-3693-2193-5.
- Song, H., Chien, A.T., Fisher, J., Martin, J., Peters, A.S., Hacker, K. and Singer, S.J. (2015) 'Development and validation of the primary care team dynamics survey', *Health Services Research*, Vol. 50, No. 3, pp.897–921.
- Subramaniam, L.V., Faruquie, T.A., Ikbali, S., Godbole, S. and Mohania, M.K. (2009) 'Business intelligence from voice of customer', *2009 IEEE 25th International Conference on Data Engineering*, March, IEEE, Shanghai, China, pp.1391–1402.
- Sudha, P., Prabhakaran, S., Hajduk, S., Kunicina, N., Dumitru, C. and Omrane, A. (2024) 'Evaluating the impact of employee welfare measures on workplace wellbeing', *AVE Trends in Intelligent Technoprise Letters*, Vol. 1, No. 2, pp.100–111.
- Sunarto, A., Nurlaili, L. and Anwar, S. (2024) 'Analysis of the village head's leadership in the development of Pamijahan village', *AVE Trends In Intelligent Social Letters*, Vol. 1, No. 3, pp.135–147.
- Suresh, S.T.S.G.R. and Gopinath, V. (2018) 'VoC-DL: revisiting voice of customer using deep learning', *Proceedings of the AAAI Conference on Artificial Intelligence*, April, New Orleans, Louisiana, USA, Vol. 32, No. 1, pp.1–6.
- Tripathi, S. and Al-Zubaidi, A. (2023) 'A study within Salalah's Higher Education Institutions on online learning motivation and engagement challenges during Covid-19', *FMDB Transactions on Sustainable Techno Learning*, Vol. 1, No. 1, pp.1–10.
- Upadhyay, S., Pathania, M., Rawat, D., Panwar, N. and Sergeevna, K.A. (2024) 'A study comparing placental weight with birth weight in anemic and non-anemic pregnant women', *AVE Trends in Intelligent Health Letters*, Vol. 1, No. 2, pp.92–109.
- Venkatasubramanian, S., Gomathy, V. and Saleem, M. (2023) 'Investigating the relationship between student motivation and academic performance', *FMDB Transactions on Sustainable Techno Learning*, Vol. 1, No. 2, pp.111–124.
- Venkatasubramanian, S., Sakthikeerthika, T. and Saltanat Yerbolovna, K. (2023) 'Examine the relationship between online learning students' screen time, digital fatigue, and mental health issues', *FMDB Transactions on Sustainable Techno Learning*, Vol. 1, No. 4, pp.179–188.
- Venkateswaran, P.S., Dharshini, S.D., Kumar, S.K., Lakshmi, D., Balan, D. and Sachani, D.K. (2024) 'A study on market share analysis of select food products: identifying key drivers and barriers to growth', *AVE Trends In Intelligent Social Letters*, Vol. 1, No. 1, pp.1–12.
- Venkateswaran, P.S., Sudha, P., Rafiq, M. and Żywiołek, J. (2023) 'Branding strategies in luxury markets: a comparative analysis', *FMDB Transactions on Sustainable Management Letters*, Vol. 1, No. 3, pp.114–124.
- Walker, E.R., Lang, D.L., Caruso, B.A. and Salas-Hernández, L. (2020) 'Role of team dynamics in the learning process: a mixed-methods evaluation of a modified team-based learning approach in a behavioral research methods course', *Advances in Health Sciences Education*, Vol. 25, No. 10, pp.383–399.
- Wiegiers, K.E. and Beatty, J. (2013) *Software Requirements*. Pearson Education, London, UK.

- Yaseen, M., Baseer, S. and Sherin, S. (2015) 'Critical challenges for requirement implementation in context of global software development: a systematic literature review', *2015 International Conference on Open Source Systems and Technologies (ICOSST)*, IEEE, Lahore, Pakistan, pp.120–125.
- Zhang, Z. (2007) 'Effective requirements development-a comparison of requirements elicitation techniques', *Software Quality Management XV: Software Quality in the Knowledge Society*, INSPIRE, Tampere, Finland, pp.225–240.