

Web-based Expert Bots System in Identifying Complementary Personality Traits and Recommending Optimal Team Composition

Web-based Expert Bots System for Optimal Team Composition

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Abstract—The use of web-based expert systems in the workplace has become increasingly common in recent years, with companies using these automated tools to streamline a range of tasks, from customer service to employee training. However, the potential of web-based expert bots systems to help build more effective teams by identifying employees with complementary personality traits and providing recommendations for team composition has received less attention. This paper investigates the application of a web-based expert bots' system in identifying complementary personality traits among employees to recommend optimal team compositions. We developed a web-based expert bot system, augmented by a chatbot interface, to evaluate and synthesize employee personality profiles for improved team alignment. The results, derived from questionnaire feedback and prototype assessments, demonstrate the system's capability to enhance team performance metrics and behavioral competencies. The discussion outlines the system's advantages, and its potential in organizational settings, and acknowledges its limitations. Web-based expert systems with chatbots that exhibit unique personalities tend to be more engaging and effective. Consequently, this system is expected to not only foster better team cohesion but also to increase user involvement and satisfaction. Future work is dedicated to expanding the system's capabilities and conducting extensive field testing to establish its practical effectiveness.

Keywords—Web-based expert system; personality traits; team composition; workplace efficiency and chatbot integration

I. INTRODUCTION

Team composition is a multifaceted challenge, requiring a delicate balance of skill sets, personality traits, and roles [1]. This complexity is further underscored by the influence of individual differences, such as personality traits, values, and demographics, on team dynamics and performance [2]. In the context of software engineering project courses, team composition is particularly challenging due to the need to consider practical constraints, skill distribution, and project motivation [3]. The difficulty lies not only in identifying these characteristics but also in predicting the dynamic interplay between them, which can significantly impact team cohesion, adaptability, and ultimately, the success of the team's objectives. Effective team composition requires a nuanced

approach that takes into account the individual and collective needs of the team and the goals of the project.

The evolution of web-based expert systems in organizational settings has been marked by significant advancements in artificial intelligence and machine learning. Initially, these systems focused on automating simple tasks and evolved to perform complex functions like data analysis and decision support. Currently, they are integral in streamlining operations, enhancing decision-making, and providing predictive insights across various business functions. Their ability to process vast amounts of data with sophisticated algorithms allows for unprecedented accuracy in tasks such as market analysis, customer service, and strategic planning, making them indispensable in modern organizational infrastructure.

Research on the significance of expert systems in human resources, particularly in identifying and harnessing complementary personality traits for team composition, has yielded valuable insights. Radović et al. [4] found that a combination of extraversion and openness to experience is crucial for team performance, while Gilal et al. [5] identified extroversion as a dominant personality type for effective software team roles. It has been emphasized the importance of emotional stability, agreeableness, and a predisposition to be a team player in predicting task performance and cohesion [6]. These findings underscore the potential of expert systems in optimizing team composition by considering these key personality traits.

Moreover, the use of chatbots in team optimization has been explored in various studies. It has been highlighted the potential of chatbots to enhance team performance [7], [8]. Bansal et al. [9] takes this a step further by proposing the optimization of AI systems for teamwork, emphasizing the need for human-centered design. Tennent et al. [10] introduces the concept of a peripheral robotic object, Micbot, which has been shown to improve group engagement and problem-solving performance. These studies collectively underscore the potential of chatbots and AI systems in team optimization, particularly in the areas of emotion management, and productivity in workplace environments.

The primary aim of this study is to explore the efficacy of web-based expert bots systems in enhancing team effectiveness within organizations. This inquiry is driven by the central research question: How can web-based expert bots systems help employers build more effective teams by identifying employees with complementary personality traits, team performance, team behavioral competencies and providing recommendations for team composition? To achieve this aim, the study is guided by several key objectives: Firstly, to create a robust knowledge base that informs team composition, derived from three distinct assessment methods. Secondly, to develop an interactive chatbot tailored for individual employer assessments. Finally, to construct a prototype web-based expert bot system capable of accurately identifying crucial factors such as personality traits, team performance metrics, and team behavioral competencies. Through these objectives, the study seeks to contribute significantly to the field of organizational psychology and team dynamics, leveraging advanced technology to foster more efficient, cohesive, and productive workplace environments.

The subsequent section provides an overview of team composition strategies. It is followed by a methodology section that outlines the framework of the integrated system, comprising a rule-based chatbot for personality analysis and a comprehensive web-based expert system equipped with team management and assessment tools. Results from questionnaires and prototype evaluations are presented next. The discussion emphasizes the system's benefits and acknowledges its limitations. The paper concludes by reflecting on the findings and suggesting directions for future research.

II. BACKGROUND

Building productive teams is vital for organizations looking to maximize productivity and innovation in the dynamic, collaborative work environments of today. The personality alignment of team members is a crucial factor to consider because it affects team performance. Team dynamics, creativity, and problem-solving skills have all been shown to improve when team members have complementary personality traits. Radović et al. [4] stated that a team's performance may be influenced by a combination of personality qualities. While there has been much research on how team dynamics and members' personality traits affect team performance,

A team employee refers to an individual who is part of a team within an organization and works collaboratively with other team members to achieve shared goals and objectives. Unlike individual contributors who work independently, team employees actively engage in group dynamics, contribute their skills and expertise, and collaborate with others to accomplish tasks and projects. The term "team composition" describes the composition or structure of a team, including the traits, competencies, and roles of each member. It entails carefully selecting and assigning people in order to create a strong team that can work together to accomplish its goals.

This study focuses on three assessment ways which are: personality traits, team performance, and team behavioral competencies. Firstly, personality traits are recurring patterns

of ideas, emotions, and actions that define a person's distinct and persistent psychological profile. These characteristics shape people's attitudes, motives, and behaviors in a variety of circumstances and contexts by affecting how they perceive and engage with the world around them. Secondly, team performance is the overall efficiency and accomplishment of a group of people working together to achieve a common goal or aim. To produce high-quality outputs and obtain desired goals, a team must be able to cooperate, communicate, and coordinate their efforts. Thirdly, behavioral competencies commonly referred to as soft skills or interpersonal skills, are a collection of personal traits, characteristics, and behaviors that enable people to work with others, carry out tasks, and achieve goals in a professional or social setting. Issues with team composition can come up while putting together a team and selecting the most compatible members to work with. Finding a balance between team dynamics and individual competencies can be difficult when putting together a team. Conflicts between team members or clashing personalities can cause a breakdown in communication, lower motivation, and lessen production. As a result, putting together a team would be simpler and more effective with the usage of the previous three assessment methods, and the results would be high quality.

III. LITERATURE REVIEW

Recent developments in artificial intelligence (AI) have made it possible for we-based expert systems and chatbots to become useful tools for a variety of applications. By utilizing their capacity to assess and interpret personality traits, such systems have the potential to assist companies in creating more productive teams.

According to Aonghusa and Michie [11], the use of AI in behavioral research is still in its early stages, and changing present procedures is necessary to fully realize AI's potential. AI technology offers significant potential in behavioral science by enabling researchers to analyze vast amounts of data, make predictions, simulate human behavior, and develop personalized interventions. Aonghusa and Michie [11] stated that the goal of predicting behavior change intervention results using data that is automatically retrieved from intervention evaluation reports is one that AI offers great potential for achieving. AI enables researchers in behavioral sciences to gain insights into various aspects of human behavior, improve data analysis, and enhance the understanding of complex behavioral phenomena.

A web-based expert system is a software application that applies artificial intelligence principles to deliver professional-level information and judgment through a web interface. Ramadhani et al. [12] conducted a study using knowledge-based web-based expert systems to help them achieve their goals, and the research analyses the efficacy and accuracy of the web-based expert system. Saiful and Nur [13] stated that in general, expert systems are systems that attempt to convey human knowledge to computers so that computers can solve issues the way experts often do. Data can be gathered by expert systems that keep the expertise of one or more experts on a computer. According to Thorat and Jadhav [14], a common method for managing conversations is chatbots.

However, A damopoulou and Moussiades [15] stated that although chatbots can simulate human communication and amuse users; this is not their only purpose. Wolff et al. [16] and Singh et al. [17] both highlight the potential of rule-based chatbots in workplace settings, with the former identifying support and self-service as key areas of application, and the latter demonstrating the use of a rule-based chatbot for student enquiries. Handel et al. [18] provides a broader perspective on the use of synchronous messaging applications, including chatbots, in workplace teams, emphasizing their role in supporting work tasks and negotiating availability. Hwang and Won [19] further explores the potential of chatbots in team creativity, finding that participants contributed more ideas and of higher quality when they perceived their partner to be a chatbot. These studies collectively suggest that rule-based chatbots can be effectively integrated into workplace environments to facilitate team composition, support work tasks, and enhance team creativity.

Current research in web-based expert systems and team dynamics primarily focuses on the harnessing of collective intelligence for team formation and the intricate impact of these systems on job evaluation and psychological design considerations. Research on web-based expert systems and team dynamics has explored the use of collective intelligence in team formation [20], the impact of expert systems on job evaluation and decision-making [21], and the psychological issues in the design of these systems [22]. These studies highlight the potential of web-based expert systems in optimizing team dynamics by leveraging collective intelligence and providing decision support. However, there is a need for further research at the intersection of artificial intelligence and personality trait analysis to fully understand the role of these systems in team optimization.

A range of studies have explored the use of web-based expert bots to identify complementary personality traits and recommend optimal team compositions. N et al. [23] developed a recommendation engine using the Myers-Briggs Type Indicator (MBTI) and deep learning to accurately predict personality traits and suggest team compositions. Davoodi et.al. [24] proposed a hybrid expert recommendation system that considers both content-based profiles and social network-based collaborative filtering to improve recommendation accuracy. Oliveira et. al. [25] focused on a model for analyzing personality traits to support project team recommendations based on complementarity. Lastly, Gilal et al. [26] used a rule-based approach to identify effective personality types and diversity in software team roles, finding that extrovert personality types and team homogeneity or heterogeneity play key roles. These studies collectively highlight the potential of web-based expert bots in identifying complementary personality traits and recommending optimal team compositions.

IV. METHODS

A. Web-based Expert Bot System Framework

The framework of the web-based expert system developed in this study consists of two principal components (see Fig. 1): a rule-based chatbot and a comprehensive web-based expert system. The rule-based chatbot is intricately designed with a

knowledge engineer at its core, facilitating the accumulation and organization of expertise. It is supported by a robust knowledge base and specialized personality knowledge resources, which are essential for accurate personality trait analysis. An inference engine is integrated into the chatbot, enabling it to intelligently process user inputs. This chatbot functions through an interactive interface, engaging users via a series of questions and answers, thereby gathering essential data for team composition analysis. The second component of the framework extends beyond the chatbot, encompassing the company team manager and a diverse team group. This component is equipped with a dynamic assessment notification system, a comprehensive database for storing and retrieving data, and functionalities for both new assessments and reassessments of team dynamics. It specifically addresses the nuances of first-time group formations and role-specific group assemblies. The entire framework is seamlessly integrated into a user-friendly website interface, ensuring ease of access and interaction for all users, from team managers to individual team members. This dual-component framework aims to provide a thorough and interactive experience, leveraging both rule-based and expert system technologies to optimize team composition and performance in the workplace.

1) *Knowledge base and personality knowledge resources:* To inform the development of our knowledge base and ensure it is attuned to the needs of the workplace, a comprehensive survey was conducted. This survey targeted employers and team leaders, with the objective of gathering insights into their experiences and perspectives on the significance of personality traits, teamwork, and leadership within their organizational contexts. Respondents were presented with queries regarding teamwork dynamics, common workplace challenges, and their openness to utilizing the website developed through this research. The data collected from this survey serves as a vital component of our knowledge base, influencing the design and functionality of the expert system to better address the intricacies of workplace interactions and team efficiency.

Regarding the structural aspect of our knowledge base, this study has adopted frames as the method of knowledge representation. Frames offer a dynamic way to encapsulate knowledge about various concepts, ideas, or situations through their two fundamental elements: components and slots. Components are responsible for providing specific values for certain attributes, while slots are designed to denote the attributes or characteristics themselves. This structured approach allows for the intricate organization and representation of complex knowledge within the system. Within our knowledge base, frames have been instrumental in organizing three distinct assessment methods: personality traits assessments (X), team performance assessments (Y), and team behavioral competencies assessments (Z).

2) *Knowledge engineer:* A knowledge engineer is an individual who creates and develops systems to successfully gather, arrange, and use information. They make sure that knowledge is accessible to and effectively used by both humans and machines.

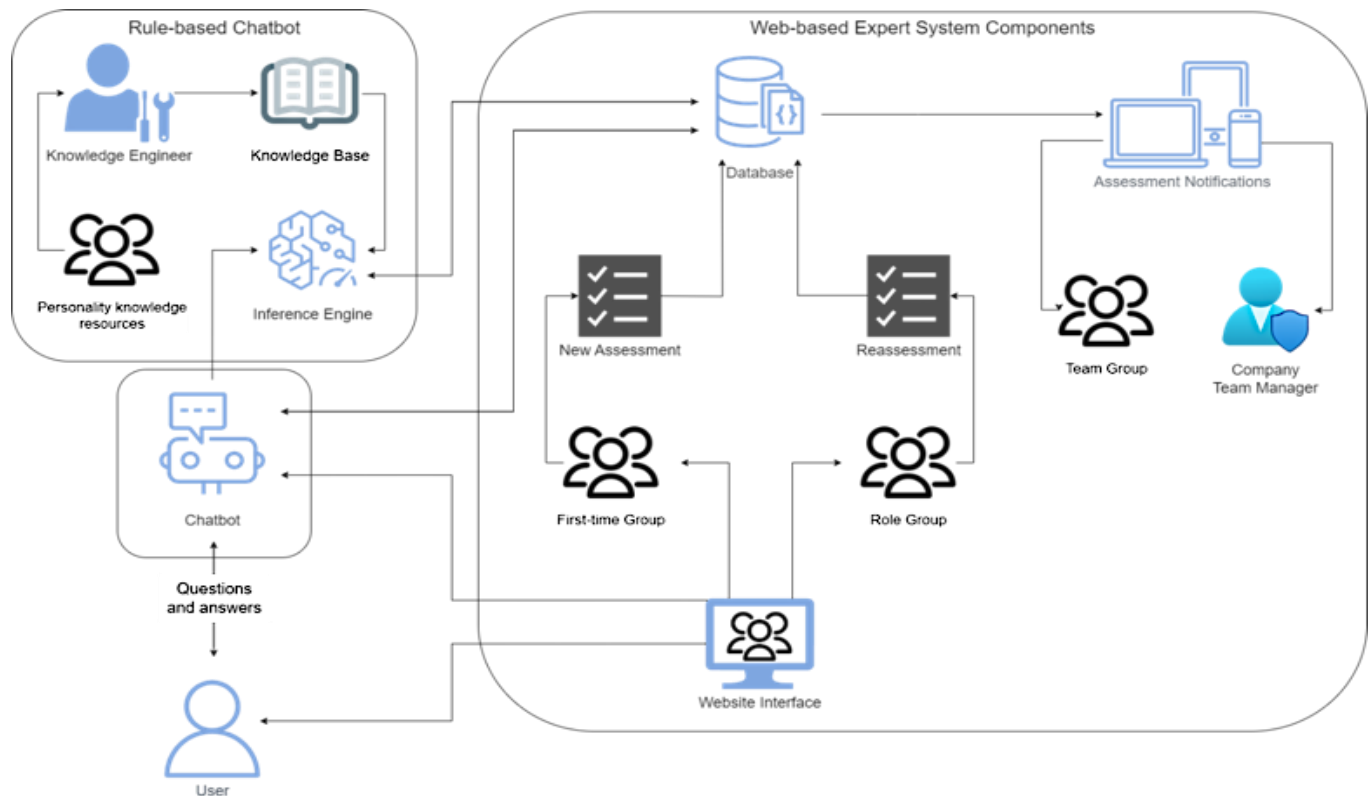


Fig. 1. Web-based expert bot system framework.

3) *Inference engine:* Two common methods used in inference engines to draw conclusions and make inferences based on existing knowledge are forward chaining and backward chaining. However, the forward chaining approach is the main focus of this paper. Forward chaining starts with a base set of predetermined facts or data and then applies rules that apply to those facts to produce new data. The knowledge base is expanded with the generated data, which is then used to make additional inferences.

4) *Chatbot:* In the context of this study, we have utilized the Landbot platform to design our chatbot. Landbot stands out as a user-friendly platform that enables the creation of conversational chatbots and interactive experiences tailored for website integration. Its appeal lies in its accessibility, as it requires no coding or technical expertise, making it an ideal choice for creating a chatbot suited to our research needs. This chatbot plays a pivotal role in our study, engaging with users in an intuitive and seamless manner, thereby facilitating the collection of data and enhancing the user experience without necessitating complex programming skills. The choice of Landbot for our chatbot design underscores our commitment to leveraging advanced yet accessible technology to achieve our research objectives effectively.

5) *Database:* Oracle Database is utilized to facilitate our data management requirements. Oracle Database is known for its efficiency and versatility as a proprietary multi-model database management system, produced and marketed by Oracle Corporation. It is especially suited for handling complex datasets and supporting the sophisticated queries that our study demands. Fig. 2 presents the ER schema diagram, illustrating the relational structure among the nine entities central to our study: Team, Team Member, Company, Project, Assessment Test, Assessment Results, Behavioral Competence Criteria, Team Performance Criteria, and Personality Trait Criteria. Within this structure, a Company creates a Project, which is overseen by a Team Manager. The Team Manager is responsible for assembling a Team, selected based on Assessment Results derived from Assessment Tests. The Company is tasked with establishing the Criteria for Behavioral Competence, Team Performance, and Personality Traits, which are critical for the project's success. This relational database design is crucial for capturing the intricate relationships and dependencies among these entities, ensuring that data integrity and access efficiency are maintained throughout the study.

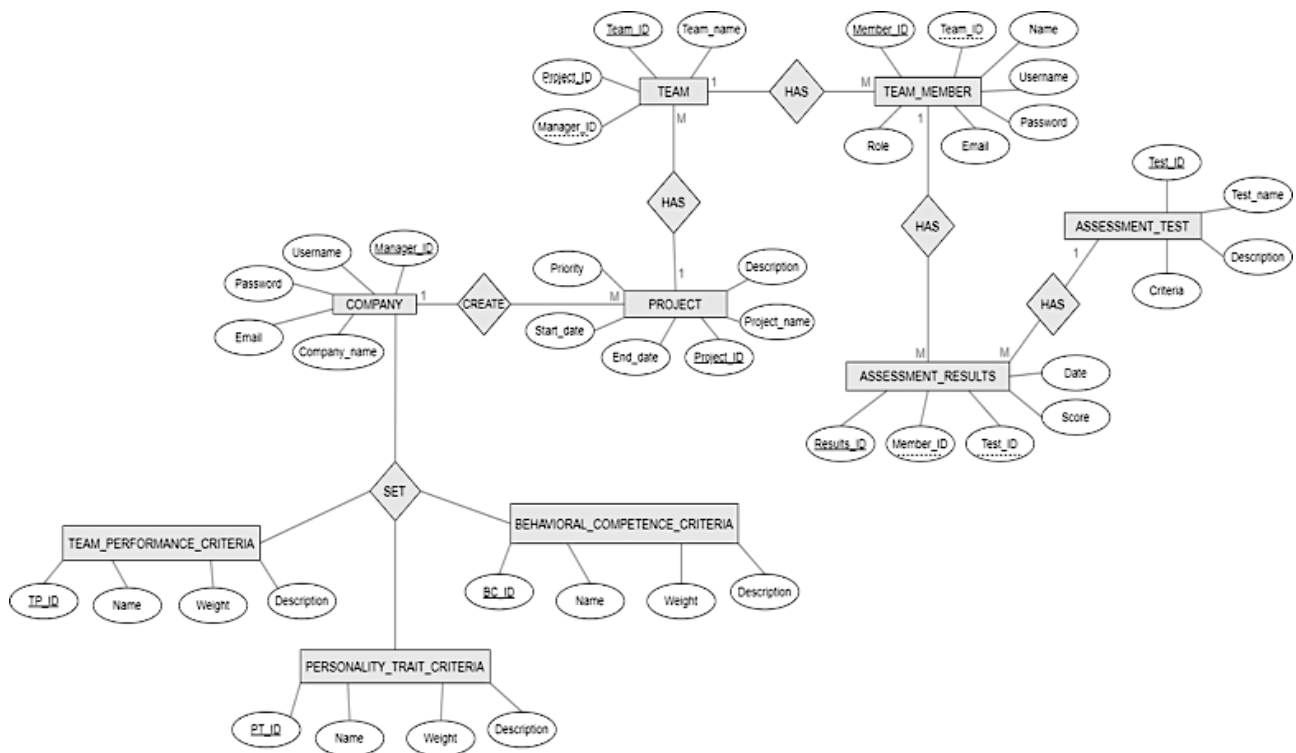


Fig. 2. The ER schema diagram.

6) *User interfaces*: The design considerations and functionalities of the interface are detailed from the perspectives of two types of users: the Company Team Manager and the Team Member. These roles are integral to the interaction with our web-based expert bot system and are outlined as follows:

- **Company Team Manager**: This user is granted comprehensive access to the company's account on the platform. The interface is designed to be intuitive, allowing the team manager to seamlessly set up and input data for projects and employee profiles. A key feature of this role is the ability to view and analyze test results from every employee, enabling the manager to make informed decisions based on the robust team recommendations generated by the system. The interface is crafted to ensure that the manager can easily navigate through various projects, manage teams, and access a holistic view of employee assessments and recommendations.
- **Team Member**: The team member's user interface is tailored to provide individual access to specific functionalities. Through this interface, a team member can receive and respond to tests dispatched by the company's team manager. Post-assessment, the interface allows team members to view their own personality assessments and understand the context of their roles within the team's recommendations. The design of the team member interface is focused on user-friendliness and personal data security, ensuring that team members can engage with the assessment process in a straightforward and secure manner.

To encapsulate the various interactions each user type will have with our system, Table I is provided, which details user types and their corresponding functions. This table serves as a reference for the access levels and capabilities that each user type possesses, ensuring clarity in the system's functionality and user privileges. The user interface is developed with a focus on clarity and ease of use, to facilitate efficient interaction with the system's comprehensive functionalities.

B. Prototype

For this study, we have utilized Proto.io, a highly versatile platform that specializes in creating interactive and high-fidelity prototypes for websites. Proto.io has enabled us to design and iterate upon our website's prototype rapidly, allowing us to explore various user interface designs and functionalities in a real-world, interactive environment. This approach has been instrumental in refining our concept into a tangible and testable product. By using Proto.io, we have effectively bridged the gap between theoretical design and practical application, providing us with valuable insights into user experience and system performance prior to the full-scale development and deployment of the system.

V. RESULTS

A. Knowledge Base and Personality Knowledge

The findings from a survey was presented to understand the perceptions of employers and team leaders regarding the dynamics of the workplace. This survey, which gathered around 140 responses, probed the value placed on personality traits, teamwork, and leadership, and evaluated the potential adoption of the research website developed for team composition and management. A significant majority of

participants, 59.6%, affirmed that effective teamwork stands out as one of the paramount strengths within a workplace, as highlighted in question (1) of the survey. Delving into the challenges of teamwork, question (6) revealed a compelling consensus with 93.6% of respondents agreeing that conflicts among team members are a predominant barrier to meeting organizational goals. Further insights from question (7) indicated that 37.6% of respondents attribute team member conflicts to ineffective leadership and management, while 27% cited personality clashes as a crucial factor, thereby substantiating the rationale behind this research.

Moreover, the survey brought to light a near-universal acknowledgment of the uniqueness of individual personality attributes, with 99.3% of respondents concurring with this view in response to question (9). This perspective is complemented by findings from question (2), where 49.6% of participants identified poor leadership as a pivotal issue in failing to achieve goals. Question (8) underscored the eagerness of leaders to understand the personality traits of their team members, with a remarkable 97.9% expressing the desire to gain a deeper insight into their teams.

Finally, the concept of the research website garnered robust support, with over 85% of respondents affirming the utility of such a tool in questions (10) and (11). This overwhelming approval validates the direction and objectives of our research, highlighting the demand for innovative solutions in understanding and harnessing the potential of workplace dynamics. The results from the survey are not only reflective of current workplace sentiments but also reinforce the need for the tools and analyses provided by our web-based expert system in optimizing team performance. Read A1 section of the supplement file for detailed survey results while the following were the survey questions:

- 1) What is the strongest strength of any workplace?
- 2) What is a big reason for not achieving goals at work?
- 3) Do you think that communication is one of the reasons for failure to achieve goals?
- 4) What is the most basic skill for achieving effective communication?
- 5) Do you think that misunderstanding and miscommunication are due to your lack of understanding of the other person?
- 6) Do you think that one of the reasons for the failure of work teams to achieve goals is due to conflicts and differences between team members?
- 7) What do you think the most important reason for differences and conflicts among team members?
- 8) If you have a project to complete and you are the team leader, do you think it is important to understand the personalities of the team members so that it is easier for you to distribute tasks?
- 9) Do you believe that every individual has a personality?
- 10) If there was a website that studied the personalities of your employees, would you use it?
- 11) If there is a website that helps a manager achieve the goals of a project through analyzing the project, its objectives,

its implementation plan, and analyzing the personalities who help in completing the project, would you use it?

In this research, the decision to not collect demographic information was deliberate and based on several considerations. First and foremost, the focus of the study was to gauge attitudes and opinions on teamwork and leadership in the workplace, which are aspects that transcend demographic categories such as age, gender, or ethnicity. By omitting demographic questions, we aimed to prevent any potential bias that could arise from preconceived notions about certain demographic groups and their relationship with the workplace dynamics being studied. Furthermore, the anonymity of responses was prioritized to ensure that participants felt comfortable sharing honest opinions without concern for personal identifiers being used in the analysis. This approach was intended to enhance the integrity and applicability of the data across diverse workplace settings, making the findings more universally relevant and reducing the risk of demographic data skewing the interpretation of the core research questions.

TABLE I. USERS TYPE AND THE RELATED FUNCTIONS

Users Type	Functions
Company team manager	<ol style="list-style-type: none"> 1. Sign in/up to the company's account as a manager. 2. Fill out the manager's personal information. 3. Set employee criteria, the weight of each criterion. 4. Set project requirements (project name, description, start date, end date, and priority). 5. Set team information. 6. Send the assessment test link to employees. 7. Display the team recommendations.
Team member	<ol style="list-style-type: none"> 1. Sign in/up to the company's account as an employee. 2. Fill out personal information. 3. Display test results. 4. Receive assessments test (new or retake). 5. Receive team recommendations. 6. Display registered team. 7. Receive notification if chosen for the team.

Fig. 3 provides a detailed visual representation of the architecture underlying the knowledge base and personality knowledge resources utilized in our study. It meticulously outlines how frames are employed to structure and organize the complex information integral to the research. These frames act as the building blocks of our knowledge base, enabling us to systematically categorize and access data on personality traits, team performance, and behavioral competencies. The figure serves to demonstrate the interconnectivity and flow of information within the system, ensuring that data retrieval is both logical and efficient. For an in-depth understanding of the specific personality knowledge frames, read section A2 of the supplementary files, where each frame is delineated, providing transparency and further insight into the foundational elements that support our expert system. This delineation is crucial for appreciating the sophistication and nuance of the system's design and its capacity for contributing to the field of team dynamics and organizational psychology.

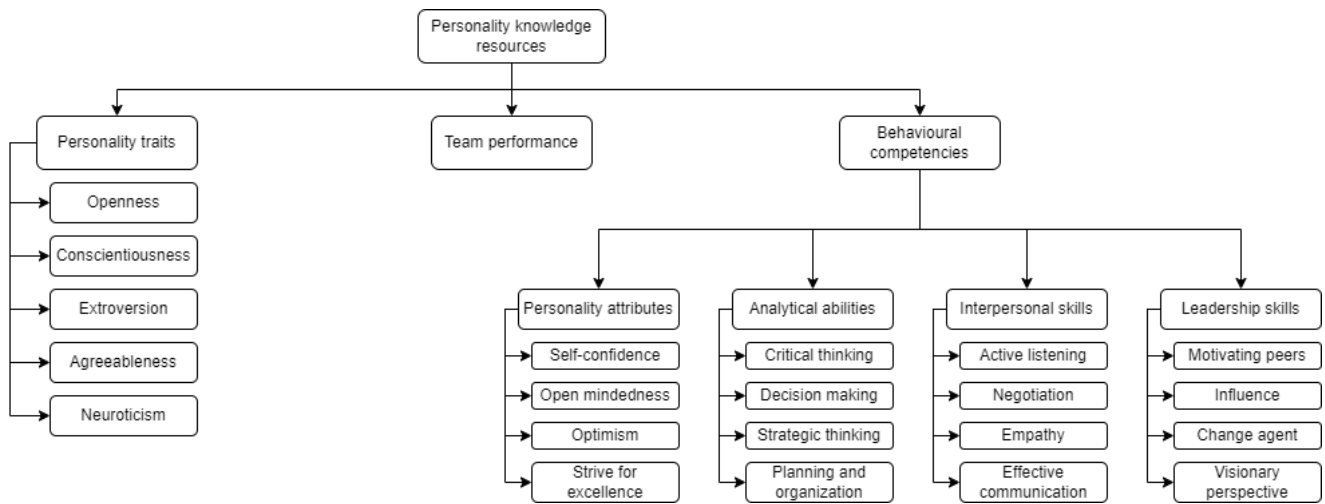


Fig. 3. The components of the knowledge base and personality knowledge.

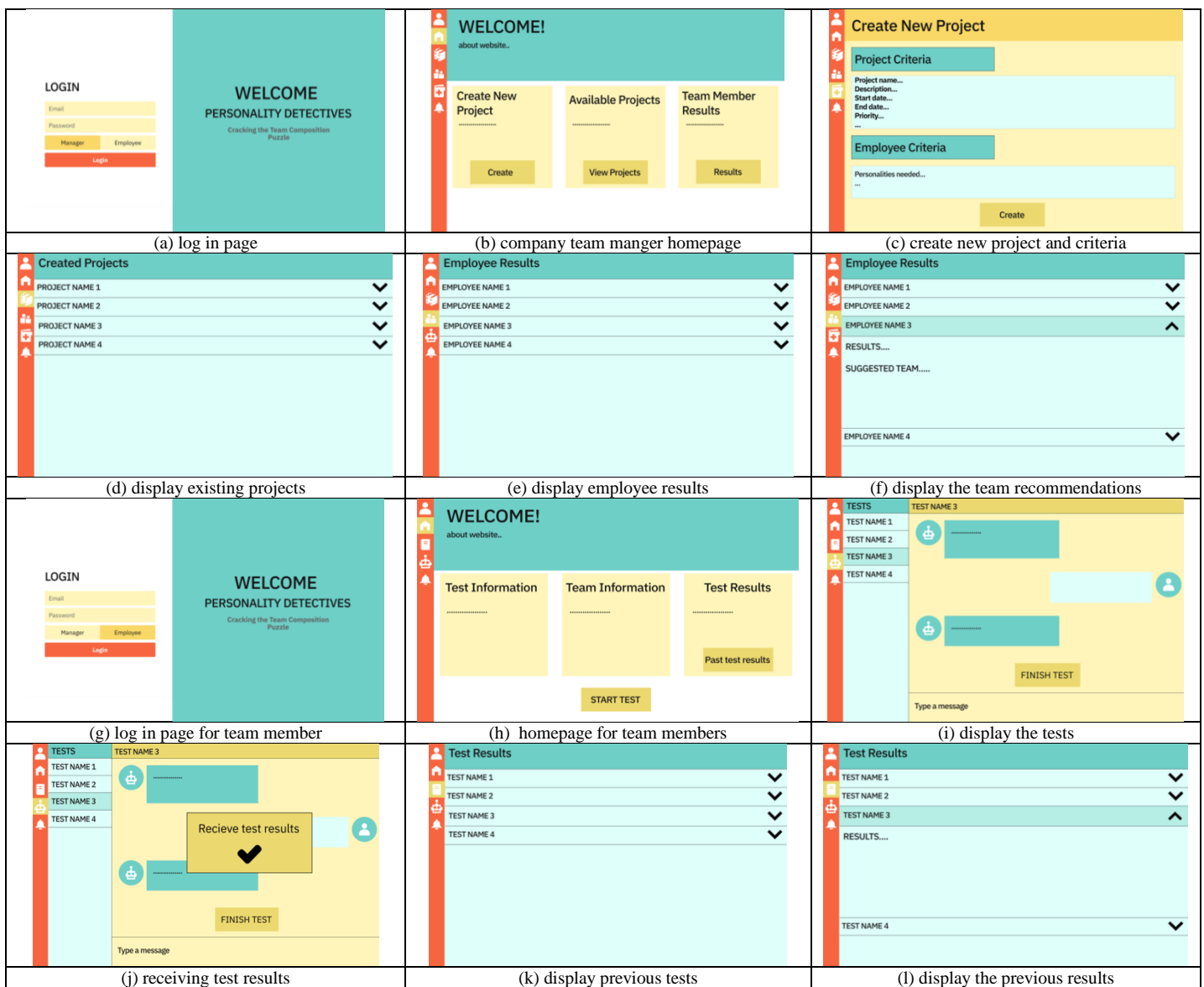


Fig. 4. Web-based expert bot system user interfaces.

B. Web-based Expert Bot System Prototype

The prototype of the Web-based Expert Bot System is presented, focusing on its user interface design for two distinct user roles: the Team Member and the Team Manager. Fig. 4 provides a comprehensive visual breakdown of the user interfaces, meticulously detailing the functionalities and navigational flow tailored to each type of user. The interfaces designated for the Company Team Manager are shown in print screen (a) through (f) of Fig. 4. These segments illustrate the breadth of control and oversight that a team manager possesses within the system, from project initiation and data management to team assessment and recommendations. On the other hand, the Team Member's interface is presented in printscreen (g) through (l), emphasizing the user-centric design that provides team members with access to personality assessments, team evaluations, and managerial feedback. This delineation within Fig. 4 not only demonstrates the system's dual-interface capability but also highlights the intuitive design and functionality that cater to the specific needs and roles of the users within a team-oriented workplace setting.

C. Chatbot Prototype

The development of the chatbot prototype plays a significant role using the Landbot platform, this prototype exemplifies a user-friendly approach to engaging with users in an interactive and conversational manner. One of the key features of our chatbot is its integration of personality knowledge, which is crucial for identifying and administering personality tests in an accessible and engaging way.

Through this chatbot, users are navigated through a series of questions enabling the system to gather essential information on individual personality traits. The design of the chatbot prioritizes ease of use and interactivity, ensuring that users can participate in the assessment process without the need for extensive instructions or guidance. This approach not only enhances user engagement but also improves the accuracy and relevance of the data collected.

For a more comprehensive understanding of how the chatbot functions and interacts with users, we invite readers to explore the live prototype available at (<https://landbot.online/v3/H-1692227-0Q820B5ZRGJJXKW7/index.html>).

VI. DISCUSSION

The development of a web-based expert bot system, augmented by a chatbot interface, for evaluating and synthesizing employee personality profiles can offer several advantages. Research has shown that incorporating personality into chatbot design can significantly improve user experience [27]. This is particularly relevant in the context of employee mental health assessments, where chatbots have been found to be highly engaging and effective [28]. Furthermore, the use of chatbots with distinct personalities can enhance the naturalness and effectiveness of the system [29]. Therefore, the proposed system has the potential to not only improve team alignment but also enhance user experience and engagement.

Acknowledging the limitations of our research is vital to contextualize our findings within the scope of their applicability. In our study, the use of a web-based expert bot system for enhancing workplace team dynamics is an innovative approach; however, it is not without constraints. Primarily, the system's reliance on self-reported data could introduce biases, as participants might provide socially desirable responses rather than accurate portrayals of their personality traits. Additionally, while our sample size was adequate to establish preliminary insights, a larger and more diverse cohort would be necessary to affirm the robustness of our findings across different industries and organizational cultures. Our framework's current configuration is tailored to specific personality models and team roles, which might not be universally applicable or reflective of all workplace environments. Future research could focus on expanding the adaptability of the system to include a broader range of psychological theories and occupational settings. Moreover, as our study is cross-sectional, it limits the ability to infer causality between team composition and performance outcomes. Longitudinal studies could provide a deeper understanding of these dynamics over time. By addressing these limitations in subsequent research, we can refine the application of expert bot systems to more accurately predict and enhance team performance.

VII. CONCLUSION

The conclusion of this study underscores the critical importance of building effective teams for companies looking to optimize production and foster innovation. The interplay between individual personality traits and team dynamics plays a significant role in team performance, warranting thorough examination and understanding. While numerous studies have investigated these elements, this research extends the discourse by incorporating a knowledge-based system and a rule-based chatbot into the organizational environment.

Our findings illuminate the transformative potential of web-based expert bot systems in assembling more productive teams. By leveraging the systems' sophisticated capabilities to identify complementary personality traits and assess team performance and behavioral competencies, organizations are empowered to make informed, data-driven decisions. This approach facilitates enhanced team dynamics, elevates performance levels, and ensures a more effective allocation of organizational resources.

However, the adoption of these technologies is not without its challenges. To truly reap their benefits and mitigate any potential drawbacks, a deliberate and informed implementation strategy is essential. Further research is also necessary to continue refining these systems, addressing any issues that arise, and expanding their applicability within diverse organizational contexts. In this pursuit, the future of work may be shaped by a more intelligent, intuitive, and data-oriented approach to team composition and management.

AUTHORS' CONTRIBUTIONS

Conceptualization, H.B. and M.F.; Methodology, H.B. and M.F.; Software, M.F.; Validation, H.B. and M.F.; Investigation, M.F.; Resources, H.B. and M.F.; Data

Curation, M.F.; Writing – Original Draft Preparation, M.F. ; Writing – Review & Editing, H.B. and M.F.; Visualization, M.F.; Supervision, H.B.; Project Administration, H.B.; Funding Acquisition, H.B.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

REFERENCES

- [1] S. A. Licorish, A. Philpott, and S. G. MacDonell, "Supporting agile team composition: A prototype tool for identifying personality (In)compatibilities," 2009 ICSE Work. Coop. Hum. Asp. Softw. Eng., pp. 66–73, 2009, [Online]. Available: <https://api.semanticscholar.org/CorpusID:13635539>.
- [2] S. T. Bell and M. Vazquez, "Team Composition," Management, 2019, [Online]. Available: <https://api.semanticscholar.org/CorpusID:242521902>.
- [3] D. Dzvoniar, L. Alperowitz, D. Henze, and B. Brügge, "Team Composition in Software Engineering Project Courses," 2018 IEEE/ACM Int. Work. Softw. Eng. Educ. Millenn., pp. 16–23, 2018, [Online]. Available: <https://api.semanticscholar.org/CorpusID:49867456>.
- [4] S. Radović, J. Sladojević Matić, and G. Opačić, "Personality Traits Composition and Team Performance," Manag. Sustain. Bus. Manag. Solut. Emerg. Econ., vol. 25, no. 3, p. 33, 2020, doi: 10.7595/management.fon.2020.0006.
- [5] A. R. Gilal, M. Omar, and K. I. M. Sharif, "Discovering personality types and diversity based on software team roles," 2013, [Online]. Available: <https://api.semanticscholar.org/CorpusID:41965533>.
- [6] T. A. O'Neill and T. J. B. Kline, "Personality as a Predictor of Teamwork: A Business Simulator Study," N. Am. J. Psychol., vol. 10, p. 65, 2008, [Online]. Available: <https://api.semanticscholar.org/CorpusID:142441138>.
- [7] I. Benke, M. T. Knierim, and A. Maedche, "Chatbot-based Emotion Management for Distributed Teams," Proc. ACM Human-Computer Interact., vol. 4, pp. 1–30, 2020, [Online]. Available: <https://api.semanticscholar.org/CorpusID:224804813>.
- [8] D. Konradl and S. Leist, "Chatbot Design Features to Increase Productivity," 2022, [Online]. Available: <https://api.semanticscholar.org/CorpusID:253478354>.
- [9] G. Bansal, B. Nushi, E. Kamar, E. Horvitz, and D. S. Weld, "Optimizing AI for Teamwork," ArXiv, vol. abs/2004.13102, 2020, [Online]. Available: <https://api.semanticscholar.org/CorpusID:216562809>.
- [10] H. Tennent, S. Shen, and M. F. Jung, "Micbot: A Peripheral Robotic Object to Shape Conversational Dynamics and Team Performance," 2019 14th ACM/IEEE Int. Conf. Human-Robot Interact., pp. 133–142, 2019, [Online]. Available: <https://api.semanticscholar.org/CorpusID:85501141>.
- [11] P. Mac Aonghusa and S. Michie, "Artificial Intelligence and Behavioral Science Through the Looking Glass: Challenges for Real-World Application," Ann. Behav. Med., vol. 54, no. 12, pp. 942–947, 2020, doi: 10.1093/abm/kaaa095.
- [12] E. Ramadhani, H. R. Pratama, and E. G. Wahyuni, "Web-based expert system to determine digital forensics tool using rule-based reasoning approach," J. Phys. Conf. Ser., vol. 1918, no. 4, 2021, doi: 10.1088/1742-6596/1918/4/042003.
- [13] M. Saiful and A. Muliawan Nur, "Application of Expert System with Web-Based Forward Chaining Method in Diagnosing Corn Plant Disease," J. Phys. Conf. Ser., vol. 1539, no. 1, 2020, doi: 10.1088/1742-6596/1539/1/012019.
- [14] S. A. Thorat and V. D. Jadhav, "A Review on Implementation Issues of Rule-based Chatbot Systems," no. Icicc, pp. 1–6, 2020.
- [15] E. Adamopoulou and L. Moussiades, An Overview of Chatbot Technology. Springer International Publishing, 2020.
- [16] R. M. von Wolff, S. Hobert, K. Masuch, and M. Schumann, "Chatbots at Digital Workplaces - A Grounded-Theory Approach for Surveying Application Areas and Objectives," Pac. Asia J. Assoc. Inf. Syst., vol. 12, p. 3, 2020, [Online]. Available: <https://api.semanticscholar.org/CorpusID:220847030>.
- [17] J. K. A. P. G. Singh, M. H. Joesph, and K. B. A. Jabbar, "Rule-based chatbot for student enquiries," J. Phys. Conf. Ser., vol. 1228, 2019, [Online]. Available: <https://api.semanticscholar.org/CorpusID:195581382>.
- [18] M. J. Handel and J. D. Herbsleb, "What is chat doing in the workplace?," 2002, [Online]. Available: <https://api.semanticscholar.org/CorpusID:16205064>.
- [19] A. H.-C. Hwang and A. S. Won, "IdeaBot: Investigating Social Facilitation in Human-Machine Team Creativity," Proc. 2021 CHI Conf. Hum. Factors Comput. Syst., 2021, [Online]. Available: <https://api.semanticscholar.org/CorpusID:233987752>.
- [20] G. K. Awal and K. K. Bharadwaj, "Team formation in social networks based on collective intelligence – an evolutionary approach," Appl. Intell., vol. 41, pp. 627–648, 2014, [Online]. Available: <https://api.semanticscholar.org/CorpusID:254230235>.
- [21] J. J. Lawler and R. Elliot, "Artificial Intelligence in HRM: An Experimental Study of an Expert System," J. Manage., vol. 22, pp. 111–85, 1993, [Online]. Available: <https://api.semanticscholar.org/CorpusID:17397665>.
- [22] B. W. Hamill, "Psychological Issues in the Design of Expert Systems," Proc. Hum. Factors Ergon. Soc. Annu. Meet., vol. 28, pp. 73–77, 1984, [Online]. Available: <https://api.semanticscholar.org/CorpusID:62729232>.
- [23] S. N. M. R. V. V. R. M. V. Subbarao, M. Pradeep, C. R. Grandhi, and A. Karunasri, "A Robust Team Building Recommendation System by Leveraging Personality Traits Through MBTI and Deep Learning Frameworks," 2023 Int. Conf. IoT, Commun. Autom. Technol., pp. 1–6, 2023, [Online]. Available: <https://api.semanticscholar.org/CorpusID:263628742>.
- [24] E. Davoodi, K. Kianmehr, and M. Afsharchi, "A semantic social network-based expert recommender system," Appl. Intell., vol. 39, pp. 1–13, 2013, [Online]. Available: <https://api.semanticscholar.org/CorpusID:14913431>.
- [25] G. W. Oliveira et al., "Model for Analysis of Personality Traits in Support of Team Recommendation," 2019, [Online]. Available: <https://api.semanticscholar.org/CorpusID:195856614>.
- [26] A. R. Gilal, M. Omar, and K. I. M. Sharif, "A rule-based approach for discovering effective software team composition," 2014, [Online]. Available: <https://api.semanticscholar.org/CorpusID:114399065>.
- [27] T. L. Smestad, "Personality Matters! Improving The User Experience of Chatbot Interfaces - Personality provides a stable pattern to guide the design and behaviour of conversational agents," 2018, [Online]. Available: <https://api.semanticscholar.org/CorpusID:150097521>.
- [28] I. Hungerbuehler, K. Daley, K. Cavanagh, H. G. Claro, and M. Kapps, "Chatbot-Based Assessment of Employees' Mental Health: Design Process and Pilot Implementation," JMIR Form. Res., vol. 5, 2021, [Online]. Available: <https://api.semanticscholar.org/CorpusID:233326632>.
- [29] H. Nguyen and D. Morales, "A Neural Chatbot with Personality," 2017, [Online]. Available: <https://api.semanticscholar.org/CorpusID:6522174>.

SUPPLEMENTARY MATERIAL

Supplementary Material: Knowledge base and personality knowledge

A. Survey Results

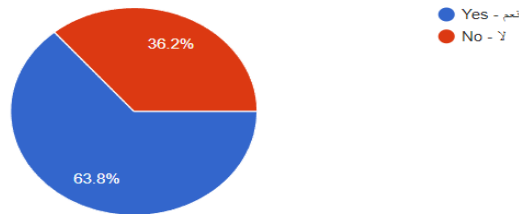
12) What is the strongest strength of any workplace?



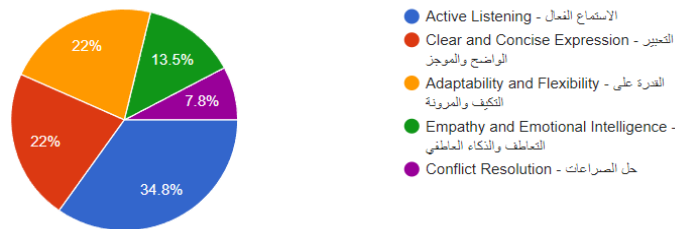
13) What is a big reason for not achieving goals at work?



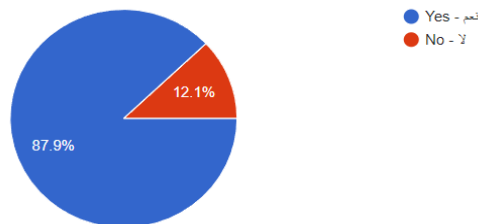
14) Do you think that communication is one of the reasons for failure to achieve goals?



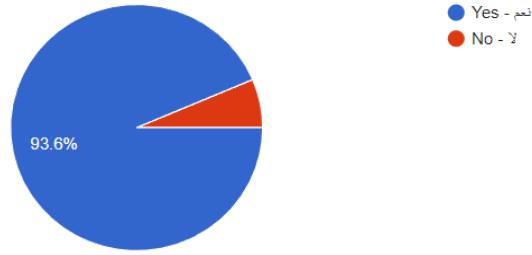
15) What is the most basic skill for achieving effective communication?



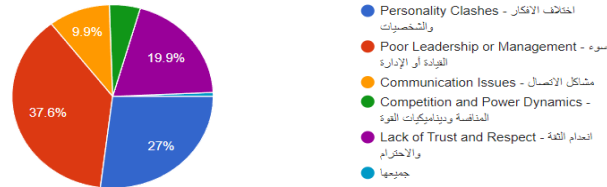
16) Do you think that misunderstanding and miscommunication are due to your lack of understanding of the other person?



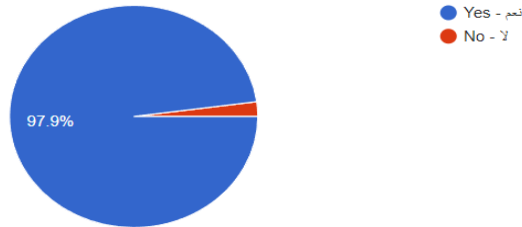
17) Do you think that one of the reasons for the failure of work teams to achieve goals is due to conflicts and differences between team members?



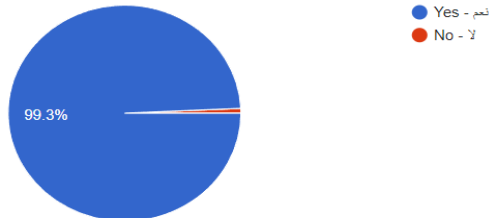
18) What do you think the most important reason for differences and conflicts among team members?



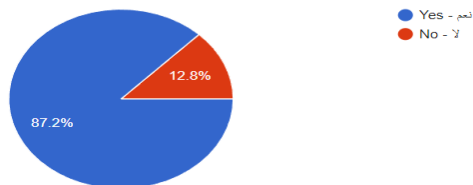
19) If you have a project to complete and you are the team leader, do you think it is important to understand the personalities of the team members so that it is easier for you to distribute tasks?



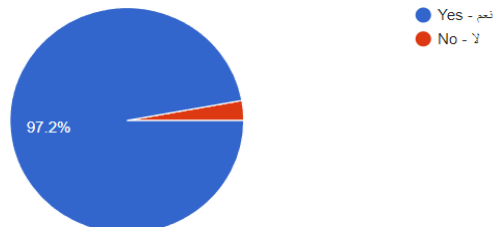
20) Do you believe that every individual has a personality?



21) If there was a website that studied the personalities of your employees, would you use it?



22) If there is a website that helps a manager achieve the goals of a project through analyzing the project, its objectives, its implementation plan, and analyzing the personalities who help in completing the project, would you use it?



A2. Personality Knowledge Frames

Assessment	Phases	Variables	Questions	Possible answers	Chatbot output
Personality traits	Phase 1	Personality trait 1: Openness	1. I see myself as someone who is original, unique, and comes up with new ideas.	yes \geq 4	You have the "openness" personality trait.
			2. I see myself as someone who is curious about many different things.	yes $<$ 4	You do not have the "openness" personality trait.
	Phase 2	Personality trait 2: Conscientiousness	3. I see myself as someone who is sophisticated in art, music, or literature.	yes \geq 6	You have the "conscientiousness" personality trait.
			4. I see myself as someone who has a lot of artistic interests.		
	Phase 3	Personality trait 3: Extroversion	5. I see myself as someone who has an active imagination.	yes \geq 5	You have the "extroversion" personality trait.
			6. I see myself as someone who values artistic and creative experiences.		
	Phase 4	Personality trait 4: Agreeableness	7. I see myself as someone who is inventive.	yes \geq 5	You have the "agreeableness" personality trait.
			8. I see myself as someone who does a thorough job.		
	Phase 5	Personality trait 5: Neuroticism	9. I see myself as someone who does things efficiently.	yes \geq 5	You have the "neuroticism" personality trait.
			10. I see myself as someone who perseveres until the task is finished.		
			11. I see myself as someone who prefers work that is routine.		
			12. I see myself as someone who is cerebral and enjoys thinking deeply.		
			13. I see myself as someone who makes plans and follows through with them.		
			14. I see myself as someone who is not easily distracted.		
			15. I see myself as someone who is outgoing.		
			16. I see myself as someone who is full of energy.		
			17. I see myself as someone who generates a lot of enthusiasm.		
			18. I see myself as someone who tends to be loud.		
			19. I see myself as someone who has an assertive personality.		
			20. I see myself as someone who can be warm and friendly.		
			21. I see myself as someone who likes to reflect and ponder different ideas.		
			22. I see myself as someone who is outgoing and sociable.		
			23. I see myself as someone who is talkative.		
			24. I see myself as someone who is helpful and unselfish when it comes to others.		
			25. I see myself as someone who avoids arguments with others.		
			26. I see myself as someone who has a forgiving nature.		
			27. I see myself as someone who is considerate and kind to almost everyone.		
			28. I see myself as someone who likes to cooperate with others.		
			29. I see myself as someone who is rarely rude to others.		
			30. I see myself as someone who is generally trusting.		
			31. I see myself as someone who does not look for fault in others.		
			32. I see myself as someone who is depressed.		
			33. I see myself as someone who can be tense.		
			34. I see myself as someone who worries a lot.		
			35. I see myself as someone who is emotionally stable and doesn't get upset easily.		
			36. I see myself as someone who can be moody.		
			37. I see myself as someone who is sometimes shy and inhibited.		

				7. I see myself as someone who gets nervous easily. 8. I see myself as someone who does not remain calm in high-pressure situations. 9. I see myself as someone who does not remain calm in tense situations.		
Team performance	Phase 6			1. Do you provide regular feedback and guidance to help improve team performance? 2. Are you able to identify and leverage the strengths of your team members to enhance overall performance? 3. Are you able to address and resolve conflicts or issues that may impact team performance? 4. Are you able to identify and address any barriers or challenges that may hinder team performance? 5. Do you set clear performance expectations for your team members?	yes>=3	You have team performance traits. Proceed to phase 7
					yes<3	Proceed to phase 7
Team behavioral competence	Phase 7	1-Personality attributes	PA 1: Self-confidence	1. Do you generally feel confident when facing new challenges? 2. Do you tend to trust your abilities and judgment in decision-making? 3. Can setbacks or failures shake your self-confidence easily? 4. Do you feel comfortable expressing your opinions and ideas in group settings? 5. Do you find it easier to take risks when you have a high level of self-confidence?	yes>=3	Proceed to next part
				yes<3		
			PA 2: Open mindedness	1. Are you open to considering different perspectives and opinions? 2. Do you actively seek out new experiences and ideas? 3. Do you enjoy engaging in discussions with people who have different viewpoints? 4. Do you find it easy to adapt to new situations and environments? 5. Are you willing to change your beliefs or opinions when presented with new evidence?	yes>=3	Proceed to next part
				yes<3		
	PA 3: Optimism	1. Do you generally maintain a positive outlook on life? 2. Are you generally hopeful about the outcomes of your efforts? 3. Do you tend to focus on solutions rather than dwelling on problems? 4. Are you able to maintain an optimistic attitude even in the face of uncertainty? 5. Do you believe that setbacks are temporary and can lead to growth and learning?	yes>=3	Proceed to next part		
		yes<3				
		PA 4: Strive for excellence	1. Do you consistently set high standards for yourself? 2. Are you motivated to constantly improve and achieve your personal best? 3. Are you willing to put in extra effort to achieve exceptional results? 4. Are you driven by a desire to surpass expectations? 5. Are you willing to go above and beyond what is expected of you?	yes>=3	You have 3/4 of personality attributes.	
				yes<3	Proceed to phase 8	
Phase 8	2-Analytical abilities	AA 1: Critical thinking	1. Are you skilled at analyzing complex problems and breaking them down into manageable parts? 2. Are you able to identify logical inconsistencies or flaws in arguments? 3. Can you effectively separate facts from opinions or biases? 4. Are you open to changing your beliefs based on new evidence or persuasive arguments? 5. Do you question assumptions and seek evidence before forming conclusions?	yes>=3	Proceed to next part	
			yes<3			
		AA 2: Planning and organization	1. Do you create detailed plans and schedules to guide your work? 2. Are you able to prioritize tasks effectively based on their importance and urgency? 3. Are you skilled at breaking down complex projects	yes>=3	Proceed to next part	
			yes<3			

				into smaller, manageable tasks? 4. Are you able to meet deadlines consistently through effective planning and time management? 5. Do you value planning and organization as important factors in achieving success?		
			AA 3: Decision making	1. Do you carefully consider available options before making decisions? 2. Are you comfortable with making decisions based on data and evidence? 3. Do you weigh the potential risks and benefits before making a decision? 4. Are you able to analyze and evaluate the potential outcomes of different choices? 5. Are you able to make decisions efficiently, even under time constraints?	yes>=3 yes<3	Proceed to next part
			AA4: Strategic thinking	1. Do you consider the long-term implications and consequences of your actions? 2. Do you proactively identify opportunities and challenges that may arise in the future? 3. Are you able to develop and communicate a clear vision for achieving desired outcomes? 4. Are you skilled at analyzing trends and patterns to inform strategic decisions? 5. Do you consider multiple possible scenarios and their potential outcomes when making decisions?	yes>=3 yes<3	You have _/4 of analytical abilities. Proceed to phase 9
			IS 1: Effective communication	1. Are you able to clearly articulate your thoughts and ideas? 2. Are you skilled at adapting your communication style to different audiences? 3. Are you able to resolve conflicts and negotiate with others through communication? 4. Do you ask clarifying questions to ensure understanding during conversations? 5. Are you able to convey information in a concise and organized manner?	yes>=3 yes<3	Proceed to next part
			IS 2: Active listening	1. Do you focus your attention on the speaker and avoid distractions when engaging in a conversation? 2. Do you refrain from interrupting or speaking over others when they are expressing their thoughts? 3. Do you ask relevant and probing questions to gain further clarity and encourage the speaker to share more? 4. Are you patient and willing to give the speaker sufficient time to express their thoughts fully? 5. Are you able to maintain eye contact and show nonverbal cues that indicate your active listening?	yes>=3 yes<3	Proceed to next part
			IS 3: Empathy	1. Do you actively listen to others to understand their emotions and experiences? 2. Are you able to put yourself in someone else's shoes to see things from their perspective? 3. Do you show genuine care and concern for the well-being of others? 4. Are you able to detect subtle cues and signals to understand how others are feeling? 5. Are you skilled at providing emotional support and encouragement to others?	yes>=3 yes<3	Proceed to next part
			IS 4: Negotiation	1. Are you skilled at finding common ground and areas of agreement during negotiations? 2. Are you able to effectively communicate your own needs and interests during negotiations? 3. Are you able to manage conflicts and reach compromises during negotiations? 4. Do you listen actively to the perspectives and concerns of the other party during negotiations? 5. Are you able to identify and understand the needs and interests of others during negotiations?	yes>=3 yes<3	You have _/4 of interpersonal skills. Proceed to next phase 10
Phase 9	3-Interpersonal skills					

Phase 10	4-Leadership skills	LS 1: Motivating peers	<ol style="list-style-type: none"> 1. Do you actively encourage and inspire your peers to achieve their best? 2. Are you able to identify and leverage the strengths of your peers to motivate them? 3. Do you offer support and guidance to help your peers overcome obstacles and challenges? 4. Do you lead by example, displaying a high level of motivation and enthusiasm yourself? 5. Are you able to effectively communicate the purpose and vision of the team to motivate your peers? 	<p>yes\geq3</p> <p>yes<3</p>	Proceed to next part
		LS 2: Influence	<ol style="list-style-type: none"> 1. Are you able to effectively persuade and convince others to adopt your ideas or viewpoints? 2. Are you skilled at building strong relationships and networks that allow you to influence others? 3. Do you have the ability to inspire and motivate others to take action? 4. Are you able to adapt your communication style to connect with different individuals and groups? 5. Are you comfortable challenging the status quo and proposing innovative ideas to influence change? 	<p>yes\geq3</p> <p>yes<3</p>	Proceed to next part
		LS 3: Visionary perspective	<ol style="list-style-type: none"> 1. Do you have a clear and inspiring vision for the future of your team or organization? 2. Do you regularly assess and reassess your vision to ensure it remains relevant and aligned with changing circumstances? 3. Do you actively seek input and feedback from others to shape and refine your vision? 4. Are you able to break down your vision into actionable steps and goals? 5. Are you able to effectively communicate your vision to others? 	<p>yes\geq3</p> <p>yes<3</p>	Proceed to next part
		LS 4: Change agent	<ol style="list-style-type: none"> 1. Do you actively seek opportunities to drive positive change within your team or organization? 2. Do you lead by example, demonstrating a willingness to embrace and adapt to change yourself? 3. Do you value continuous improvement and actively seek ways to innovate and evolve? 4. Do you encourage and support others in embracing and adapting to change? 5. Are you skilled at identifying and addressing resistance to change? 	<p>yes\geq3</p> <p>yes<3</p>	<p>You have $\frac{_}{4}$ of leadership skills.</p> <p>FINISH</p>