Engineers' Needs for Achieving Effective Managerial Performance

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A. Abstract — **Engineers are often well-suited to hold managerial roles throughout their professional careers. It is not uncommon to find engineers in operations or quality management roles. Thus, many engineers move from engineering to managerial positions. This transition poses a challenge for engineers due to the differences in the success criteria between technical and administrative roles. This research examines the extent to which engineers possess three types of managerial skills: technical, conceptual, and human. Then, it examines the association between these skills and the engineers' managerial performance. Further, it investigates whether the working environment moderates this relationship. To achieve this purpose, 170 questionnaires were distributed online to engineers working in administrative positions in the private sector of the West Bank region in Palestine during May and June 2024. Finally, the data of 103 respondents was valid for analysis. Our analyses are based on structural equation modeling to address the research questions. Results show that managerial skills have a positive effect on engineers' performance, particularly through human and conceptual skills. However, technical skills do not show a significant impact. The organizational environment was identified as a moderator, enhancing the relationship between managerial skills and performance. Fostering engineers' soft skills and maintaining a supportive work environment are essential for improving their managerial performance. The study emphasizes the importance of enhancing human and conceptual skills among engineers through targeted training programs. Universities can deepen skill development in the engineering curriculum. Furthermore, employers are advised to create a supportive work environment characterized by a culture of empowerment, which drives improved performance.**

Keywords — Engineers; performance; Managerial Skills; Organizational environment.

II. INTRODUCTION

Recent economic growth has led to significant business expansion, emphasizing the vital role of management in organizing and optimizing resources [1]. Managers foster collaboration to achieve goals by utilizing time, resources, and personnel efficiently. Management has become a popular career, blending technical, interpersonal, and leadership skills [2]. As companies grow, managers are essential for planning, motivating teams, and overseeing operations [3]. This study explores how engineers transition into management roles, the challenges they face, and the skills needed to succeed [4].
Global shifts in economics, politics, and technology demand that organizations adapt for survival [5]. Change management is essential, requiring modern managers to lead with vision and communication while creating value [6], [7]. Many engineers transition into management without formal training in leadership or organizational skills (Katz, 1974 Engineering Management Journal, 2002). Palestinian Universities, particularly engineering programs, are focused heavily on technical education, lacking managerial components [9]. Therefore, this study examines the managerial skills engineers possess and their impact on performance within the Palestinian marketplace. To achieve this purpose, this endeavor attempts to answer the following research questions:

RQ1) How does possessing managerial skills influence the managerial performance of engineers?
RQ2) Does the working environment moderate the relationship between managerial skills and performance?

While engineers are typically well-trained in technical skills, they often lack essential soft skills such as communication, leadership, and interpersonal abilities [10]. This research explores the performance of engineers in managerial roles within private sector companies in the West Bank, Palestine. It aims to identify the managerial skills engineers need to perform effectively, acknowledging that engineering and management are distinct fields [9]. The study investigates how these managerial skills impact performance and whether the organizational environment moderates this effect. The two main research questions focus on the influence of managerial skills and the moderating role of the

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organizational environment. Hypotheses include the effects of human, conceptual, and technical skills on performance, as well as how the working environment may moderate this effect. {Merging Citations}.

The study is based in the Palestinian private sector, where Engineering education began at the university level in 1978. Engineering programs in Palestine primarily emphasize technical training, with limited exposure to management education [9]. According to the Palestinian Central Bureau of Statistics, 10.8% of students are enrolled in engineering programs, with a significant concentration of engineers in Hebron and Nablus [12][13].

This research is significant for both individuals and organizations. Engineers can benefit from the findings to enhance their soft skills, while companies can develop training programs to support an effective transition to managerial positions. Finally, understanding the role of the organizational environment can help employers optimize the working conditions for better performance.

III. Literature review

A. Performance of engineers working as managers

It is well documented in the literature that employees in new managerial roles often encounter difficulties related to leadership, motivation, and cross-departmental coordination, regardless of their technical competence [14]. This challenge becomes more pronounced for engineers transitioning into management roles, a trend that has grown significantly since the 1990s [15]. Most engineers begin assuming managerial responsibilities within a few years of entering the workforce. However, technical expertise alone is not enough. Successful management depends on the integration of knowledge, skills, and attitudes [16].

Historically, engineers were defined as creators of war machinery and fortifications, a role dating back to the Napoleonic era [17].Over time, this definition evolved to describe engineers as individuals who apply science, math, and technology to solve problems and improve human life (Leon Boyd & Leon). The classical view focused more on physical forces and materials rather than human interaction [18]. However, engineering education has long been criticized for neglecting soft skills, focusing instead on technical content like mathematics and abstract science [15][15][19]. In today's globalized world, engineers are expected to possess teamwork, communication, leadership, and problem-solving skills to thrive in professional settings.

Studies emphasize that strong managers must have trust, empathy, motivation, accountability, and clear communication to lead teams effectively [20] . R. L. Katz (1955) identified three essential managerial skills—technical, human, and conceptual—which remain foundational today[21]. Later research expanded this to include analytical, decision-making, interpersonal, communication, and administrative skills. Without these capabilities, engineers often struggle to succeed in managerial roles despite their technical expertise.

R. L. Katz (1955) was the first to define the three essential managerial skills: technical, human, and conceptual. These skills, though interrelated, hold varying degrees of importance depending on the managerial level [8][21]. Technical skills refer to the ability to apply specialized knowledge and are most crucial for lower-level managers, particularly engineers transitioning into managerial roles [22]. However, as managers rise in the hierarchy, the relevance of technical skills diminishes, and soft skills become increasingly important [23]. Human skills involve working effectively with others, building trust, and fostering cooperation—traits that are often underdeveloped in engineers due to the technical nature of their training[24]. Engineers typically receive limited education in interpersonal communication, leadership, and teamwork, which can hinder their performance as managers [11]

Conceptual skills, which enable a manager to understand the organization as a whole and how its parts interrelate, are critical at higher management levels [22][25].These include strategic planning, systems thinking, and problem-solving on a macro scale. While technical expertise may earn an engineer a management position, sustaining and excelling in that role demands a well-rounded skillset that includes human and conceptual capabilities [26]. Research has found that engineer-managers without adequate conceptual and human skills often underperform, especially at the strategic level, where leadership and cross-functional coordination are key [4].Organizations increasingly value emotional intelligence, communication, and adaptability—skills not traditionally emphasized in engineering education [27].Therefore, for engineers to thrive as managers, they must intentionally develop a balance of all three Katz skills.

In today's dynamic business environment, adaptable management approaches that consider individual employee needs and situational variables are preferred. Motivational strategies and a focus on soft skills are essential for enhancing employee performance and achieving organizational goals[28]. Despite their importance, soft skills are often neglected in the workplace. Their development fosters engagement, leadership, and teamwork, driving high performance. Moreover, effective managers must address workplace conflicts, which naturally arise from diverse perspectives[29][30]). Handling such conflicts is critical for maintaining team cohesion and productivity.

Katz's theory on managerial skills, first published in 1974, identified technical, human, and conceptual skills as essential for effective administration, inspiring numerous studies on engineers' managerial competencies[31][32][17]. The theory was revisited by Peterson (2004), who added communication, analytical, decision-making, interpersonal, diagnostic, flexible, and administrative skills to Katz's original framework, reflecting evolving managerial demands [33]. Studies consistently highlight the greater importance of human and conceptual skills over technical skills, especially at higher management levels [21][17][11]

The Palestinian engineering landscape has expanded since 1978, with numerous universities offering engineering

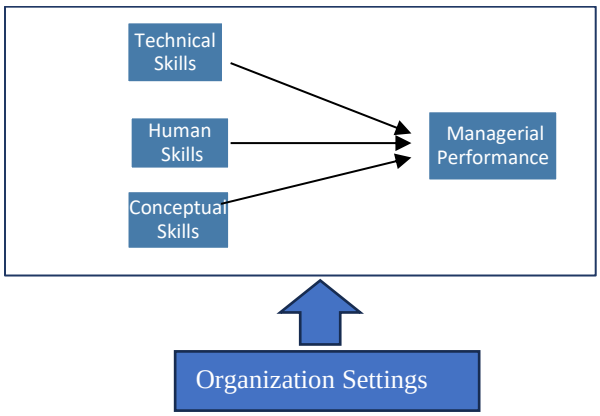
programs and over 30,000 engineers registered with the Palestinian Engineers Association[34][13] . Since the Oslo Accords and the establishment of the Palestinian National Authority, infrastructure and industry growth have increased demand for qualified engineers, many transitioning into managerial roles [35].

Studies in the West Bank construction sector emphasize financial, managerial, and communication skills as critical for project managers, many of whom are engineers [36]. This research aims to analyze how Palestinian engineers in the local labor market adopt Katz's three managerial skills—human, technical, and conceptual—to perform effectively, addressing the gap where engineering education often focuses predominantly on technical knowledge [8][35].

This research focuses on Palestine, especially the West Bank, where many engineering graduates are in high demand across industries[34] . Since engineering education began in 1978, several universities now offer numerous engineering programs, supported by the Palestinian Engineers Association, which facilitates workforce integration[13]. Following the Oslo Accords, labor demand increased due to development projects[35]. Studies show many engineers advance to managerial roles, requiring financial, managerial, and communication skills[36]. This study examines how Palestinian engineers transition into management, emphasizing Katz's three essential skills: human, technical, and conceptual, which are often underdeveloped in engineers focused mainly on technical knowledge

B. Conceptual Framework

Building on previous research, this study focuses on three key managerial competencies—technical, conceptual, and human skills—that influence engineers' managerial performance, as shown in Figure 1. Technical skills involve proficiency in methods, processes, and problem-solving, which are essential mainly for lower-level managers. These skills include understanding drawings, blueprints, quality control, and purchasing [8][23][37]. The organizational environment's impact on performance will also be examined.



Human skills involve effective team management and interpersonal abilities, crucial for communication and collaboration, though engineers often struggle to develop them due to their technical focus [8][38]Conceptual skills enable managers to see the organization as a whole and are vital for high-level planning and problem-solving[22] [32].These skills, along with technical skills, influence engineers' managerial performance. The organizational environment, including culture and policies, acts as a moderating factor, affecting employee productivity and goal achievement [23][28].

IV. Methodology

This chapter outlines the research methodology, including the design, sample, data collection tools, and statistical methods used to test hypotheses and ensure reliability and validity. The study uses a quantitative, cross-sectional design to assess the impact of managerial skills on performance and the moderating role of organizational environment, employing a self-administered questionnaire for data collection.

The population comprises engineers in managerial roles in the private sector across various industries, including construction and services, in the West Bank. Due to the absence of a reliable population database, a non-probability convenience sample was chosen. The sample consists of engineers who were available and willing to participate.

Surveys were distributed online via email and WhatsApp to 172 engineers between May and August 2024. Of the 170 surveys returned, 120 were fully completed, and 13 were excluded due to incompleteness. This resulted in a valid response rate of 77.3%.

This study utilizes a structured questionnaire as the main instrument for collecting quantitative data. The questionnaire was developed based on previous studies and theoretical foundations, adapted to the Palestinian context, and validated by academic and industry experts. It consists of two main sections: the first gathers demographic and work-related data, while the second includes 52 items across five constructs—Human Skills, Technical Skills, Conceptual Skills, Organizational Environment, and Managerial Performance—measured using a five-point Likert scale.

Descriptive statistics were conducted using SPSS v23 to summarize the sample's characteristics and responses. Frequencies and percentages were used for demographic variables, while means and standard deviations were calculated for study constructs. To aid interpretation, mean values were categorized into five levels: very low to very high, based on score intervals [39].

Inferential analysis was performed using SmartPLS4 through Partial Least Squares Structural Equation Modeling (PLS-SEM). PLS-SEM can handle complex models under less restrictive assumptions and is ideal for exploratory research [40][41].

PLS-SEM includes both inner (structural) and outer (measurement) models. Structural models test relationships between latent variables, while measurement models represent the link between constructs and their indicators, using reflective or formative approaches depending on the

nature of the constructs [40]. This methodological choice allows the study to accurately examine the effects of managerial skills and organizational environment on engineers' performance.

A. PLS- SEM Evaluation

The evaluation of the measurement model followed the guidelines of Hair et al. (2017), Fornell and Larcker (1981), and Henseler et al. (2015), confirming the model's reflective nature, meaning the removal of any indicator does not alter the conceptual meaning of the latent construct. The model consists of five first-order latent variables and one second-order latent variable, namely managerial skills. The assessment focused on key aspects, including internal consistency reliability, convergent validity, and discriminant validity, to ensure the quality and accuracy of the measurement model. This comprehensive approach ensures that the latent variables are well-defined and measured accurately by their respective indicators.

All constructs demonstrated satisfactory internal consistency, with Cronbach's Alpha and Composite Reliability (CR) values exceeding the accepted threshold of 0.70. These high reliability coefficients indicate that the indicators within each construct are internally consistent and measure the same underlying concept. This is crucial for the validity of structural equation modeling, as it ensures that the constructs are robust and dependable. Additionally, for the higher-order construct (Managerial Skills), both CA and CR were strong, supporting its structural reliability.

Convergent validity was assessed by examining the outer loadings and AVE values of the constructs. Outer loadings ranged from 0.525 to 0.877, all exceeding the minimum acceptable value of 0.50, demonstrating that individual indicators reliably contribute to their respective constructs. Although the AVE values for Technical Skills and Managerial Skills were slightly above 0.40, they are acceptable due to sufficient composite reliability, as noted by Fornell and Larcker (1981). These results confirm the acceptable convergent validity of all constructs included in the model.

Discriminant validity was evaluated using cross-loadings, the Fornell-Larcker criterion, and the Heterotrait-Monotrait Ratio (HTMT). Indicators loaded highest on their intended constructs, supporting discriminant validity. Furthermore, the square root of AVE for each construct exceeded the inter-construct correlations, satisfying Fornell-Larcker's condition. HTMT values, while not explicitly detailed, were assessed and found to be below the conservative threshold of 0.90, further confirming discriminant validity and supporting the distinctiveness of the model's constructs.

The second-order construct "Managerial Skills" was modeled as a reflective-formative type, comprising three first-order constructs: Human Skills, Technical Skills, and Conceptual Skills. The outer loadings of these components were 0.831, 0.823, and 0.855, respectively, all of which exceed the recommended threshold of 0.70. This indicates that each dimension makes a substantial contribution to the formation of the higher-order construct, confirming the reliability and validity of modeling managerial skills in this manner.

The HTMT criterion was employed to assess discriminant validity between the constructs. As shown in Table 10, all HTMT values remained below the threshold of 0.90, aligning with the standard recommended by Henseler et al. (2015). This result reinforces the conclusion that the constructs are empirically distinct and supports the robustness of the measurement model in differentiating between related but separate constructs.

The measurement model's internal consistency was further confirmed, with Cronbach's Alpha ranging from 0.890 to 0.941 across all constructs, indicating excellent reliability. Additionally, Composite Reliability values exceeded the minimum threshold of 0.70, verifying the consistency and stability of the measures used. These strong reliability indicators also extended to the second-order construct "Managerial Skills," providing additional evidence of the overall strength and coherence of the model's internal structure.

V. RESULTS AND DISCUSSION

This chapter presents data analysis and hypothesis testing based on the research questions. It begins with descriptive statistics, followed by the assessment of the measurement and structural models using PLS-SEM to evaluate the relationships between constructs (Hair et al., 2017). The analysis aims to clarify the responses gathered through the questionnaire and address the core research problem.

A. *Descriptive Statistics*

1) Sample Characteristics

A sample of 104 respondents was analyzed. Males represent 76.7% of the sample, and females 23.3%, reflecting gender imbalance in this sector (UNESCO, 2021). Most participants (73.3%) were between 30 and 50 years, and 49.2% had 11–20 years of engineering experience. Regarding managerial roles, 65.8% had 1–10 years of experience, while only 0.8% had over 20 years. In terms of engineering specialties, civil engineers were the largest group (45.8%), followed by electrical engineers (31.7%) and mechanical engineers (15%). Only 7.5% came from other disciplines. This distribution suggests that civil engineers are more likely to reach managerial or self-employed roles compared to others (World Bank, 2020). These characteristics provide essential context for interpreting the survey data and understanding the research findings (Table 1).

TABLE 1: SAMPLE CHARACTERISTICS

Variables	Options	n	%
Gender	Female	92	76.7

	Male	28	23.3
Age	Less than 30 Years	22	18.3
	30 - less than 50 Years	88	73.4
	More than 50 Years	10	8.3
Working as an engineer (years)	1-10 Years	41	34.2
	11 - 20	59	49.1
	> 20	20	16.7
Working as a manager (years)	1-10 Years	79	65.9
	11 - 20 Years	40	33.3
	> 20 Years	1	0.8
Specialty in eng.	Civil Eng.	55	45.8
	Mechanical Eng.	18	15.0
	Electrical Eng.	38	31.7
	Others	9	7.5

Table 2 presents the characteristics of companies represented in the study. Most respondents (84.2%) do not work in family businesses, indicating a preference for professional independence. The sectors are evenly distributed: 35% in services, 35% in contracting, and 30% in manufacturing, reflecting industry diversity. Regarding company size, 36.7% work in firms with over 50 employees, 32.5% in small firms (1–20 employees), and 30.8% in mid-sized firms (21–50 employees). This indicates a balanced mix of organizational scales. Managerial roles vary: 20.8% are general managers, 20.8% are in other roles, 20% are quality engineers, 15.8% are project managers, 14.2% are production engineers, and only 8.3% are project engineers. Geographically, 62.5% of respondents are based in the North, and 37.5% in the South, indicating a greater concentration of industrial activity in the northern region.

Table 2: The characteristics of the participating companies

Variables	Options	n	%
Business Type	Family business	19	15.8
	No family Business	101	84.2
Business Sector	Services sector	42	35.0
	Manufactory sector	36	30.0
	Contracting sector	42	35.0
Number of employees	1-20 employees	39	32.5
	21-50 Employee	37	30.8
	more than 50 employees	44	36.7
Managerial position	General manager	25	20.8
	production engineer	17	14.2
	quality engineer	24	20.0
	project manager	19	15.8
	project engineer	10	8.4
	Other	25	20.8
Geography	South	45	37.5
	North	75	62.5

2) Factor Analysis

This study examined three key factors affecting managerial performance: managerial skills, organizational work environment, and managerial outcomes. Managerial skills included human, technical, and conceptual skills. The overall managerial skills scored high with a mean of 4.00. Technical skills were highest (4.08), followed by human skills (4.05), and conceptual skills (3.87) (see Table 1).

Human skills were rated high (mean 4.05, 81.0%). The strongest statement was "I listen carefully to my team" (87.6%), while the lowest was "I hold quick morning meetings regularly" (72%) (see Table 2).

Technical skills were also high (mean 4.05, 81.6%). The top practice was "Using technology and task management systems" (85.4%). The lowest was "Selecting team members during plan development" (75.8%) (see Table 3).

Conceptual skills scored moderately high (mean 3.87, 77.4%). "Setting goals before projects" was highest (82.8%), while "Visiting relevant exhibitions" was lowest (71.6%) (see Table 4).

The work environment was rated relatively high (mean 3.57, 71.4%). Highest agreement was on "Regular salary payments" (84%), while "Weekly meetings to discuss employee challenges" scored lowest (59.8%) (see Table 5).

Managerial performance showed high levels (mean 4.04, 80.8%). The highest rated was "Solving problems during work" (85.6%), and the lowest was "Projects achieving good profits" (76.2%) (see Table 6).

3) Hypothesis Testing

The final stage of the structural model evaluation tested the proposed hypotheses using bootstrapping (5000 subsamples) based on Hair et al. (2017).

a) Effect of Managerial Skills on Managerial Performance

Table 4 shows that managerial skills have a significant positive effect on managerial performance ($\beta = 0.223$, $p = 0.064 < 0.10$). This supports Hypothesis 1 (H_1). Increasing managerial skills by one unit leads to a 0.223 increase in managerial performance.

Conceptual Skills; TS: Technical Skills; and MP: Managerial Performance.

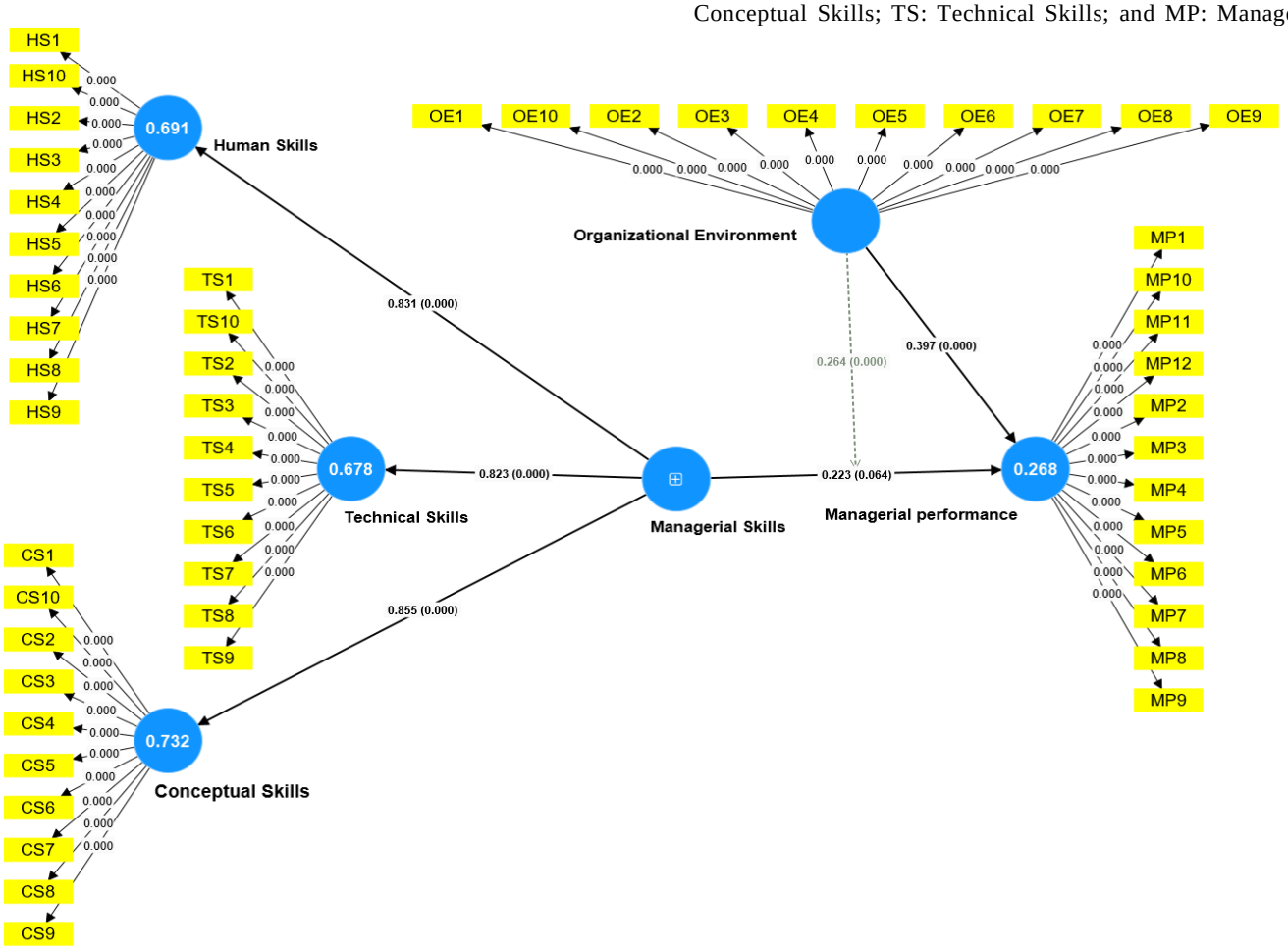


Table 4: Result of the first hypothesis

No.	Hypothesis	(***β***)	Std.	***t*** value	***p*** value	Result
$H_{1.a}$	MS -> MP	0.223	0.120	1.850	0.064*	Sig.

b) Effect of Skills Dimensions on Managerial Performance

Table 5 summarizes the sub-hypotheses. Human skills (β=0.247, p=0.038) and conceptual skills (β=0.269, p=0.065) significantly impact performance, supporting $H_{1.1}$ and $H_{1.2}$. Technical skills do not have a significant effect (p = 0.447), rejecting $H_{1.3}$.

TABLE 5: TESTING THE EFFECTS OF MANAGERIAL SKILLS

No.	Hypotheses	(***β***)	Std.	***t*** value	***p*** value	Result
$H_{1.1}$	HS-> MP	0.247	0.119	2.073	0.038**	Sig.
$H_{1.2}$	CS -> MP	0.269	0.146	1.847	0.065*	Sig.
$H_{1.3}$	TS -> MP	0.172	0.226	0.761	0.447	rejected

Note: ** and * represent statistical significance at 5% and 10%, respectively; β: Regression coefficient; HS: Human Skills; CS:

c) Moderating Role of Organizational Environment

TABLE 6: RESULT OF THE SECOND HYPOTHESIS

No.	Hypothesis	***β***	Std.	***t*** value	***p*** value	Result
H_2	OE × MS -> MP	0.264	0.060	4.381	0.000**	Sig.

Note: ** and * represent statistical significance at 5% and 10% levels, respectively; β: Regression coefficient; MP: Managerial Performance; MS: Managerial Skills; OE: Organizational Environment.

d) Moderating Role of Organizational Environment on Skills Dimensions

Table 7 reveals that the organizational environment moderates the effect of human skills (p = 0.098) and conceptual skills (p = 0.002) on performance, supporting $H_{2.1}$ and $H_{2.2}$. It does not moderate technical skills (p = 0.330), rejecting H_{23}.

No.	Hypotheses	$\boldsymbol{\beta}$	Std.	$\boldsymbol{t}$ value	$\boldsymbol{p}$ value	Result
$H_{2.1}$	OE × HS-> MP	0.154	0.093	1.655	0.098 *	Supported
$H_{2.2}$	OE × CS -> MP	0.302	0.099	3.050	0.002 **	Supported
$H_{2.3}$	OE × TS -> MP	0.128	0.131	0.975	0.330	rejected

VI. Conclusion

The study concludes that Palestinian engineers possess a high level of managerial skills, with technical skills being the strongest, followed by human and conceptual skills. The organizational environment in their companies is generally supportive, contributing positively to managerial performance. Managerial skills overall have a significant positive effect on performance, particularly in terms of human and conceptual skills, while technical skills show no significant impact on managerial outcomes. Furthermore, the organizational environment acts as a moderator, strengthening the positive effects of managerial skills, especially human and conceptual skills, on performance. These findings underscore the growing significance of soft skills and environmental factors in engineering management roles.

Based on these conclusions, it is recommended that employers focus on developing human and conceptual skills through targeted training and mentorship, while fostering a supportive and communicative organizational culture. Universities should integrate leadership and strategic thinking into engineering curricula to better prepare students for managerial roles. Engineers' associations can enhance professional development by offering continuous learning in management skills. Engineers themselves should prioritize building interpersonal and strategic abilities as they progress in their careers. Future research should examine how technical skills evolve in senior management, consider diverse organizational contexts, and explore the role of communication in boosting managerial effectiveness.

VII. References

[1] W. E. Barber and J. N. Taylor, "The importance of goals, objectives, and values in the fisheries management process and organization: a review," *North Am. J. Fish. Manag.*, vol. 10, no. 4, pp. 365–373, 1990.

[2] P. Verma, "Transitioning from Software Engineer to Engineering Manager (A Journey of Paradigm Shift)".

[3] P. Boxall and J. Gilbert, "The management of managers: A review and conceptual framework," *Int. J. Manag. Rev.*, vol. 9, no. 2, pp. 95–115, 2007.

[4] R. Seethamraju and R. Agrawal, "Engineers as managers: a conceptual model of transition," Institute of Electrical and Electronics Engineers (IEEE), Jan. 2003, pp. 293–297. doi: 10.1109/picmet.1999.787818.

[5] K. Ristovska and A. Ristovska, "The impact of globalization on the business," *Econ. Anal.*, vol. 47, no. 3–4, pp. 83–89, 2014.

[6] G. Tovmasyan, "The Role of Managers in Organizations: Psychological Aspects," *Bus. Ethics Leadersh.*, vol. 1, no. 3, pp. 20–26, 2017, doi: 10.21272/bel.1(3).20-26.2017.

[7] G. Santos *et al.*, "New needed quality management skills for quality managers 4.0," *Sustainability*, vol. 13, no. 11, p. 6149, 2021.

[8] R. L. Katz, "Harvard Business Review," *Obtenido Ski. an Eff. Adm. https//hbr. org/1974/09/skills-of-an-effective-administrator*, 1974.

[9] A. Hasan, A. Abu Hanieh, and S. Abdelall, "Integration of Sustainability in Engineering Education in Palestine," 2015.

[10] A. Dudman and S. Wearne, *Professional engineers' needs for managerial skills and expertise*. Centre for Research in the Management of Projects Manchester, 2003.

[11] M. H. Othman, M. A. Sulor, and M. Haidar, "A Review of Recent Skills Required as Engineering Project Managers," *J. Adv. Mech. Eng. Appl.*, vol. 3, no. 1, pp. 1–5, 2022, doi: 10.30880/ijie.2022.03.01.001.

[12] P. C. B. of Statistics, "Fields of study and relationship to the labor market for individuals 20-29 years old," 2021. https://www.pcbs.gov.ps/postar.aspx?lang=ar&ItemID=4278

[13] E. Association, "ANNUAL REPORT 2022," p. 224, 2022.

[14] Michael D. Watkins, "How Managers Become Leaders," *Business Review, Harvard*, 2017.

[15] Jesiek.K.B & Nittala. S, "Work Experiemces of Engineering Managers Challenges, Strategies, Compentencies.," 2018.

[16] Visser Hercules, Naude Louis, and Schepers Johann, "TRANSFORMATION OF MANAGERIAL SKILLS OF ENGINEER," 2004.

[17] A. Roger, "Which Human Skills Are Necessary for Engineers?," *Ski. Manag. New Appl. New Quest.*, vol. 1, pp. 47–65, 2018.

[18] C. Mitcham and E. Schatzberg, "Defining Technology and the Engineering Sciences," in *Philosophy of Technology and Engineering Sciences*, Elsevier, 2009, pp. 27–63. doi: 10.1016/B978-0-444-51667-1.50006-9.

[19] P. Lappalainen, "Communication as part of the engineering skills set," *Eur. J. Eng. Educ.*, vol. 34, no. 2, pp. 123–129, 2009, doi: 10.1080/03043790902752038.

[20] S. Craps, M. Pinxten, H. Knipprath, and G. Langie, "Different roles, different demands. A competency-based professional roles model for early career engineers, validated in industry and higher

education," *Eur. J. Eng. Educ.*, vol. 47, no. 1, pp. 144–163, 2022, doi: 10.1080/03043797.2021.1889468.
[21] L. Lovrencic Butkovic, "MANAGERIAL SKILLS FOR IMPROVING PROFESSIONAL PERFORMANCE: A PERSPECTIVE FROM ENGINEERS IN CONSTRUCTION," 2018.
[22] A. S. Gutterman, "Management Skills," 2023. https://ssrn.com/abstract=4393214 (accessed Jan. 20, 2024).
[23] M. Atiqur *et al.*, "Soft Skills Practiced by Managers for Employee Job Performance in Ready Made Garments (RMG) Sector of Bangladesh," 2019.
[24] H. Visser, L. Naude, and J. Schepers, "Transformation of managerial skills of engineers," *SA J. Hum. Resour. Manag.*, vol. 2, no. 2, pp. 17–23, 2004.
[25] M. H. Othman, M. A. Sulor, and M. Haidar, "A Review of Recent Skills Required as Engineering Project Managers," *J. Adv. Mech. Eng. Appl.*, vol. 3, no. 1, pp. 1–5, 2022.
[26] W. E. Hopkins, "ENGINEERS AS STRATEGIC MANAGERS: PERFORMANCE ASSESSMENT," 1991.
[27] S. Gillard, "Soft Skills and Technical Expertise of Effective Project Managers," 2009.
[28] M. L. Bratu and L. I. Cioca, "Adaptation of managerial style to the personality of engineers, in order to increase performance in the workplace," *Polish J. Manag. Stud.*, vol. 17, no. 1, pp. 67–77, 2018, doi: 10.17512/pjms.2018.17.1.06.
[29] J. S. Brown Woodbridge, V. And, C. W. Grant, and M. J. Patton, "A CPI Comparison of Engineers and Managers," 1981.
[30] G. Mustafa, B. Mahmood, M. Yousaf Malik, M. Muhammad Sohail, and S. Saeed, "IMPACT OF POLICIES, LEADERSHIP AND GROUP WORK IN ORGANIZATION ON EMPLOYEE'S PERFORMANCE-Searching The Factors Behind Employee's Conflict," 2012. [Online]. Available: https://www.researchgate.net/publication/235743236
[31] J. A. Halliday, "engineers into Managers, howto Effect the Transetion of competent technical proffissonal into a competent manager," 1996.
[32] I. Mukarromah, M. Mudjito, and E. Purbaningrum, "The Effect of managerial skills (conceptual, human, and technical) of headmasters to the effectiveness of islamic senior high schools in jombang district," *Int. J. Educ. Vocat. Stud.*, vol. 1, no. 6, pp. 539–544, 2019.
[33] P. Childs and P. Gibson, "Graduating Professional Engineers and Management Skills-are they adequate for the workplace?," 2010.
[34] R. and S. H. Abdel-Karim, "Assessment of the Practical Training Requirement in Engineering Education in Palestinian Universities," in *Academic Colloquium 2010 Building Partnership in Teaching Excellence*, 2010, p. 152.
[35] S. A. Abu-Eisheh, "Assessment of the output of local engineering education programs in meeting the needs of the private sector for economies in transition: The Palestinian territories case," *Int. J. Eng. Educ.*, vol. 20, no. 6, pp. 1042–1054, 2004.
[36] A. Omran and A. Suleiman, "Identifying the competence components of the construction project managers in the Palestinian construction industry," *Eng. Proj. Organ. J.*, vol. 7, no. 2, pp. 2–27, 2017.
[37] S. J. Hysong, "The role of technical skill in perceptions of managerial performance," *J. Manag. Dev.*, vol. 27, no. 3, pp. 275–290, 2008, doi: 10.1108/02621710810858605.
[38] S. Abdel-Karim,Riyad & Helou, "The Future of Engineering Education in Palestine," *Procedia - Soc. Behav. Sci.*, vol. 102, pp. 482–489, Nov. 2013, doi: 10.1016/j.sbspro.2013.10.764.
[39] G. Santos *et al.*, "New needed quality management skills for quality managers 4.0," *Sustain.*, vol. 13, no. 11, Jun. 2021, doi: 10.3390/su13116149.
[40] J. F. Hair Jr, M. Sarstedt, L. Hopkins, and V. G. Kuppelwieser, "Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research," *Eur. Bus. Rev.*, vol. 26, no. 2, pp. 106–121, 2014.
[41] A. L. Comrey and H. B. Lee, "A first course in Factor Analysis, Hillsdale: NJ: Eribaum." DOI, 1992.
[1] W. E. Barber and J. N. Taylor, "The importance of goals, objectives, and values in the fisheries management process and organization: a review," *North Am. J. Fish. Manag.*, vol. 10, no. 4, pp. 365–373, 1990.
[2] P. Verma, "Transitioning from Software Engineer to Engineering Manager (A Journey of Paradigm Shift)".
[3] P. Boxall and J. Gilbert, "The management of managers: A review and conceptual framework," *Int. J. Manag. Rev.*, vol. 9, no. 2, pp. 95–115, 2007.
[4] R. Seethamraju and R. Agrawal, "Engineers as managers: a conceptual model of transition," Institute of Electrical and Electronics Engineers (IEEE), Jan. 2003, pp. 293–297. doi: 10.1109/picmet.1999.787818.
[5] K. Ristovska and A. Ristovska, "The impact of globalization on the business," *Econ. Anal.*, vol. 47, no. 3–4, pp. 83–89, 2014.
[6] G. Tovmasyan, "The Role of Managers in Organizations: Psychological Aspects," *Bus. Ethics Leadersh.*, vol. 1, no. 3, pp. 20–26, 2017, doi: 10.21272/bel.1(3).20-26.2017.
[7] G. Santos *et al.*, "New needed quality management skills for quality managers 4.0," *Sustainability*, vol. 13, no. 11, p. 6149, 2021.
[8] R. L. Katz, "Harvard Business Review," *Obtenido Ski. an Eff. Adm. https//hbr. org/1974/09/skills-of-an-effective-administrator*, 1974.
[9] A. Hasan, A. Abu Hanieh, and S. Abdelall, "Integration of Sustainability in Engineering

Education in Palestine," 2015.
[10] A. Dudman and S. Wearne, *Professional engineers' needs for managerial skills and expertise*. Centre for Research in the Management of Projects Manchester, 2003.
[11] M. H. Othman, M. A. Sulor, and M. Haidar, "A Review of Recent Skills Required as Engineering Project Managers," *J. Adv. Mech. Eng. Appl.*, vol. 3, no. 1, pp. 1–5, 2022, doi: 10.30880/ijie.2022.03.01.001.
[12] P. C. B. of Statistics, "Fields of study and relationship to the labor market for individuals 20-29 years old," 2021. https://www.pcbs.gov.ps/postar.aspx?lang=ar&ItemID=4278
[13] E. Association, "ANNUAL REPORT 2022," p. 224, 2022.
[14] Michael D. Watkins, "How Managers Become Leaders," *Business Review, Harvard*, 2017.
[15] Jesiek.K.B & Nittala. S, "Work Experiemces of Engineering Managers Challenges, Strategies, Compentencies.," 2018.
[16] Visser Hercules, Naude Louis, and Schepers Johann, "TRANSFORMATION OF MANAGERIAL SKILLS OF ENGINEER," 2004.
[17] A. Roger, "Which Human Skills Are Necessary for Engineers?," *Ski. Manag. New Appl. New Quest.*, vol. 1, pp. 47–65, 2018.
[18] C. Mitcham and E. Schatzberg, "Defining Technology and the Engineering Sciences," in *Philosophy of Technology and Engineering Sciences*, Elsevier, 2009, pp. 27–63. doi: 10.1016/B978-0-444-51667-1.50006-9.
[19] P. Lappalainen, "Communication as part of the engineering skills set," *Eur. J. Eng. Educ.*, vol. 34, no. 2, pp. 123–129, 2009, doi: 10.1080/03043790902752038.
[20] S. Craps, M. Pinxten, H. Knipprath, and G. Langie, "Different roles, different demands. A competency-based professional roles model for early career engineers, validated in industry and higher education," *Eur. J. Eng. Educ.*, vol. 47, no. 1, pp. 144–163, 2022, doi: 10.1080/03043797.2021.1889468.
[21] L. Lovrencic Butkovic, "MANAGERIAL SKILLS FOR IMPROVING PROFESSIONAL PERFORMANCE: A PERSPECTIVE FROM ENGINEERS IN CONSTRUCTION," 2018.
[22] A. S. Gutterman, "Management Skills," 2023. https://ssrn.com/abstract=4393214 (accessed Jan. 20, 2024).
[23] M. Atiqur *et al.*, "Soft Skills Practiced by Managers for Employee Job Performance in Ready Made Garments (RMG) Sector of Bangladesh," 2019.
[24] H. Visser, L. Naude, and J. Schepers, "Transformation of managerial skills of engineers," *SA J. Hum. Resour. Manag.*, vol. 2, no. 2, pp. 17–23, 2004.
[25] M. H. Othman, M. A. Sulor, and M. Haidar, "A Review of Recent Skills Required as Engineering Project Managers," *J. Adv. Mech. Eng. Appl.*, vol. 3, no. 1, pp. 1–5, 2022.
[26] W. E. Hopkins, "ENGINEERS AS STRATEGIC MANAGERS: PERFORMANCE ASSESSMENT," 1991.
[27] S. Gillard, "Soft Skills and Technical Expertise of Effective Project Managers," 2009.
[28] M. L. Bratu and L. I. Cioca, "Adaptation of managerial style to the personality of engineers, in order to increase performance in the workplace," *Polish J. Manag. Stud.*, vol. 17, no. 1, pp. 67–77, 2018, doi: 10.17512/pjms.2018.17.1.06.
[29] J. S. Brown Woodbridge, V. And, C. W. Grant, and M. J. Patton, "A CPI Comparison of Engineers and Managers," 1981.
[30] G. Mustafa, B. Mahmood, M. Yousaf Malik, M. Muhammad Sohail, and S. Saeed, "IMPACT OF POLICIES, LEADERSHIP AND GROUP WORK IN ORGANIZATION ON EMPLOYEE'S PERFORMANCE-Searching The Factors Behind Employee's Conflict," 2012. [Online]. Available: https://www.researchgate.net/publication/235743236
[31] J. A. Halliday, "engineers into Managers, howto Effect the Transetion of competent technical proffissonal into a competent manager," 1996.
[32] I. Mukarromah, M. Mudjito, and E. Purbaningrum, "The Effect of managerial skills (conceptual, human, and technical) of headmasters to the effectiveness of islamic senior high schools in jombang district," *Int. J. Educ. Vocat. Stud.*, vol. 1, no. 6, pp. 539–544, 2019.
[33] P. Childs and P. Gibson, "Graduating Professional Engineers and Management Skills-are they adequate for the workplace?," 2010.
[34] R. and S. H. Abdel-Karim, "Assessment of the Practical Training Requirement in Engineering Education in Palestinian Universities," in *Academic Colloquium 2010 Building Partnership in Teaching Excellence*, 2010, p. 152.
[35] S. A. Abu-Eisheh, "Assessment of the output of local engineering education programs in meeting the needs of the private sector for economies in transition: The Palestinian territories case," *Int. J. Eng. Educ.*, vol. 20, no. 6, pp. 1042–1054, 2004.
[36] A. Omran and A. Suleiman, "Identifying the competence components of the construction project managers in the Palestinian construction industry," *Eng. Proj. Organ. J.*, vol. 7, no. 2, pp. 2–27, 2017.
[37] S. J. Hysong, "The role of technical skill in perceptions of managerial performance," *J. Manag. Dev.*, vol. 27, no. 3, pp. 275–290, 2008, doi: 10.1108/02621710810858605.
[38] S. Abdel-Karim,Riyad & Helou, "The Future of Engineering Education in Palestine," *Procedia - Soc. Behav. Sci.*, vol. 102, pp. 482–489, Nov. 2013, doi: 10.1016/j.sbspro.2013.10.764.
[39] G. Santos *et al.*, "New needed quality management

skills for quality managers 4.0," *Sustain.*, vol. 13, no. 11, Jun. 2021, doi: 10.3390/su13116149.

[40] J. F. Hair Jr, M. Sarstedt, L. Hopkins, and V. G. Kuppelwieser, "Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research," *Eur. Bus. Rev.*, vol. 26, no. 2, pp. 106–121, 2014.

[41] A. L. Comrey and H. B. Lee, "A first course in Factor Analysis, Hillsdale: NJ: Eribaum." DOI, 1992.