Journal of Namibian Studies, 33 S2(2023): 5770-5795 ISSN: 2197-5523 (online)

Path Analysis Of Mediator Role For Code & Fields Of Professional Conduct In The Relationship Between Engineer Professional Performance And Consulting Engineering Services At Ministry Of Infrastructure And Urban Development In The Northern State

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Abstract:

This study aimed to investigate the path analysis of mediator role for rules & fields of professional behavior in the relationship between engineer professional performance and consulting engineering services at t of Infrastructure and Urban Development in The Northern State. It focuses on weakness level of adherence to rules & fields of professional behavior at the Ministry. The descriptive approach was used and a questionnaire was designed for data collection. The results reflected a partial mediator role of the rules & fields of professional behavior in the relationship between engineer professional performance and consulting engineering services with an indirect (mediated) effect of (0.46). The study emphasized that there is a need to increase the awareness of managers and engineers with regard to the importance of developing engineer professional performance to reflex on adherence to rules and fields of professional behavior & improving consulting engineering services.

Keywords: Path Analysis; Mediator Role; Rules & Fields of Professional Behavior; Engineer Professional Performance; Consulting Engineering

Services; The Ministry of Infrastructure and Urban Development in The Northern State (Ministry).

1 Introduction:

The improvement of consulting engineering services in the present era is one of the most important basic elements of successful engineering management as it is the focus of engineering work and its most important elements. It is a function inherent to the work of administrative leaders and engineers at various organizational levels. Therefore, this study sought to analyze the path of mediator role for rules and fields of professional behavior in the relationship between engineer professional performance and consulting engineering services at Ministry of Infrastructure and Urban Development in The Northern State.

1.1. Significance of the research:

1.1.1. Scientific significance:

This study contributes to bridging a research gap that was not addressed in previous studies – to the researcher's knowledge– by analyzing the course of mediator role for rules and fields of professional behavior in the relationship between engineer professional performance and consulting engineering services at Ministry of Infrastructure and Urban Development in The Northern State. This topic has not been dealt with in previous studies in its full dimensions in the way this study has dealt with. The study also contributes from a scientific point of view to providing a scientific reference on the researched variables to contribute to the existing knowledge and helping researchers to develop knowledge in this field.

1.1.2. Practical significance:

The practical significance of this study is that it provides data and information that help decision-makers in the Ministry of Infrastructure and Urban Development in The Northern State to rationalize their decisions. Moreover, it highlights the importance of using the mediator's role analysis of the rules and areas of professional behavior in the relationship between the professional performances of the engineer and engineering consulting services.

1.2. Objectives of the study:

The main objective of this study is to analyze the course of the role of the mediator of the rules and areas of professional behavior in the relationship between the professional performance of the engineer and the engineering consulting services in the Ministry of Infrastructure and

Urban Development in The Northern State. This is done by achieving the following sub-objectives:

1. To identify the quality of conformity to the study model.
2. To verify the presence of direct, indirect and total impact of the engineer's professional performance on consulting engineering services on the basis of the existence of rules and areas of professional behavior as a mediating variable.
3. To know the nature of the intermediate variable, whether it is partial or complete.

1.3. Statement of the Problem:

The problem of the study lies in the level of commitment to the rules and areas of professional conduct in the Ministry of Infrastructure and Urban Development in The Northern State, which is marred by a major defect and weakness that led to a low level of consulting engineering services. In this regard, the Ministry's goals are not achieved, and customers complain about the low level of services provided. The higher leadership of the Ministry of Infrastructure and Urban Development in The Northern State is also disturbed by the low level of consulting engineering services in the general engineering departments.

Perhaps this is due to a defect in the development of the professional performance of engineers in the ministry. The problem of the study is represented in the main question: Can the development of the professional performance of engineers improve the level of consulting engineering services in the Ministry of Infrastructure and Urban Development in The Northern State in practicing the mediation of the rules and areas of professional behavior? This central question includes several sub-questions, as follows:

1. To what extent are indicators of conformity quality available for the study model?
2. What is the direct, indirect and total impact of the engineer's professional performance on the consulting engineering services based on the existence of rules and areas of professional behavior as a mediating variable? Is the intermediate variable partial or complete?

1.4. Methodology of the research:

This study follows the descriptive analytical approach. The researchers also used the historical method. The study relies on primary sources represented by the respondents and experts, and the questionnaire and personal interview are used as data collection tools respectively, in addition to secondary sources: books, scientific research, studies, reports, magazines and newspapers, seminars and conferences related to the subject of the study.

1.5. The limits of the study:

Time: During the period from 2008-2022.
Venue: Ministry of Infrastructure and Urban Development in the Northern State.
Study population: Engineers in the aforementioned ministry.

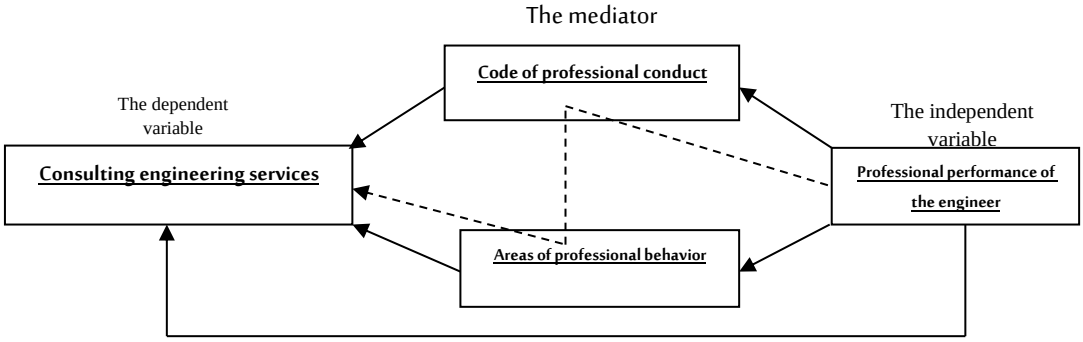
1.6. Study variables: The study consists of three variables:

- The independent variable: It is the professional performance of the engineer.
- The mediator: It is the rules and areas of professional behavior.
- The dependent variable: It is the consulting engineering services.

1.7. The proposed model for the study:

To achieve the specific objectives of the study in determining the effect of the independent variable on the dependent variable in the presence of the mediator using the path analysis technique, the researcher designed and developed a special model for this study based on previous literature. Figure (1) shows the form of the model for the path of these variables

Figure 1. the study model (the path of the variables



Source: Prepared by the researcher based on Dongola (2022).

1.8. Hypotheses:

This study is based on the following main hypothesis:

- The rules and areas of professional behavior mediate the relationship between the professional performance of the engineer and the consulting engineering services in the Ministry of Infrastructure and Urban Development in the Northern State.

1.9. Study terminology:

Following what was stated in Suleiman and Nour Al-Daeem (2021), the Sudanese Engineering Council Law (1998), the Engineering Profession Practice Regulations (2000), and Abdul Rahim (2015), it is possible to adopt a definition of terms (the mediating role, the professional performance of the engineer, rules and fields of professional behavior, consulting engineering services) as follows:

Suleiman and Nour Al-Daeem (2021, p. 64) defined the mediating role as one of the operations that take place between two things in order to reach an appropriate feature addition to the commercial or non-commercial process. The mediator plays an essential role represented in providing the appropriate environment to connect or supplement what may be lacking in one of the parties to the mediation.

The mediating role is one of the most effective and reliable methods in obtaining suitable solutions that satisfy all parties in the internal and external business environment. Abdul Rahim (2015) mentioned that the engineering profession is one of the ancient professions that has been practiced throughout the ages and is inherited from generation to generation. Moreover, engineers are the ones who build the future with their knowledge and professional skills, and their work is what shapes the future of nations, urban development, happiness and prosperity, or misery. According to the Engineering Council Law (1998, p. 2), engineering fields mean areas of work and training in all disciplines of engineering sciences and engineering technology approved by the Sudanese Engineering Council.

Engineer means every person who holds a university qualification or its equivalent (Bachelor of Honors) or postgraduate degree in engineering sciences or engineering technology in accordance with the foundations approved by the Council. According to Regulations on Practicing the Engineering Profession (2000, pp. 6-12), consulting engineering services are the services provided by engineering agencies in the public or private sectors and consulting offices in the engineering fields and their branches. These services include engineering works (civil, mechanical, architectural, electrical, chemical, agricultural, surveying, mining and oil, textile, urban planning, and the environment) and in that it has the right to carry out studies and engineering supervision or manage project implementation.

According to Abdul-Rahim (2015, p. 28) the term engineering ethics refers to the field of applied ethics and a system of ethical principles that apply to the practice of engineering. This field deals with the obligations of the engineer towards society, towards his clients and his profession. In terms of being a scientific discipline, it is closely related to many topics such as the philosophy of science, the philosophy of engineering, and the ethics of technology.

2. Theoretical background:

2.1. Previous Studies:

Abd al-Hamid and Abu Saleh (2022) examined the modifying role of engineering ethics for the relationship between the strategy of building a quality management system in accordance with the requirements of ISO 9001: 2015 and the added value of the Ministry of Infrastructure and

Urban Development in the Northern State. They followed the descriptive analytical and historical approaches. Besides, the (SPSS) program was used to treat the study data statistically. The results showed a high level of rules and areas of professional conduct and obligations of the engineer and the quality of engineering services. Engineering ethics also modifies the relationship between strategy and added value. The study recommended the need to educate the leadership and engineers of the importance of applying the strategy and professional ethics to be reflected in the added value achieved in the ministry.

Abdel-Hamid and Hussein (2022) conducted a study analyzing the relationship between operations strategy and rules of professional conduct and its impact on competition challenges in the Ministry of Infrastructure and Urban Development in the Northern State of Sudan. The researchers followed the analytical, descriptive and historical approaches. They also used the (SPSS) program to analyze the study data statistically. The results showed a high level of rules of professional conduct, and a statistically significant effect of rules of professional conduct on facing competition challenges in the ministry. They recommended that the ministry develop an appropriate strategy to manage and consolidate the concepts of operations strategy, rules of professional conduct and competitive challenges, and highlight their importance, programs and applications through training programs and panel discussions.

Abdel Hamid (2022) studied the combined effect of the rules of protection of the profession and the pillars of professional ethics on the quality of the service provided. The researcher followed the analytical, descriptive and historical approaches. Furthermore, the (SPSS) program was used to statistically process the data of the study questionnaire. The results showed a high level of rules for protecting the profession and quality of service, thus proving the existence of a common effect. The researcher recommended strengthening the potentials of the profession protection rules and the pillars of professional ethics and addressing the shortcomings that surround them.

Abu Al-Kass (2015) studied the role of professional ethics in job performance. The researcher followed the analytical, descriptive and historical approaches. Moreover, the (SPSS) program to statistically process the data of the study questionnaire. The results showed a high degree of commitment to professional ethics and the level of job performance, and the existence of a relationship between professional ethics and job performance. The researcher recommended the formation of a specialized supervisory body to monitor the employees' commitment to professional ethics.

2.2. Theoretical framework of the study:

The study variables according to the Sudanese Engineering Council Law (1998) and the Engineering Profession Practice Regulations (2000) are as follows:

- Engineer's professional performance:

Article (9) of the Regulations for the Practice of the Engineering Profession (2000) clarifies the obligations of the engineer (the professional performance of the engineer) so that the engineer employed by the engineering bodies is committed to cooperating with his colleagues in a spirit of collegiality while providing the duty of respect and compliance with his superiors, giving care and guidance to his subordinates, preserving their dignity and giving them the opportunity to benefit from their knowledge, developing their technical information and expanding their expertise, verifying the project documents that are organized by the engineering bodies, with the signature of the engineers responsible for the studies, each in his field of competence. Editions made to these documents are also indicated by the signature of the engineer responsible for these amendments, thus considering the studies he performs in the engineering body as the property of the department to which the body belongs, and subjecting his work when allowing him to practice consulting engineering work to the provisions of engineering offices.

- Consulting engineering services:

The Engineering Profession Practice Regulations (2000) devoted Chapter Four to consulting engineering services. Article (12) clarifies that studies include programming, feasibility studies, planning, analysis, design, defining contractual terms and technical specifications, preparing technical reports, bills of quantities and cost estimates, participating in studying and evaluating offers, and providing consultations during implementation stages. Furthermore, article (13) clarifies that supervision extends to advisory supervision. This is limited to providing consultations and responding to inquiries submitted by the service applicant. The technical supervision of the implementation includes an assignment from the employer according to the project's plans and documents. It also includes providing consultations and clarifications, visiting the project periodically, issuing instructions, making observations about implementation, providing clarifications to the resident supervisory body, verifying and following up in accordance with the terms of the contract, avoiding errors during all stages of project implementation, approving payments to the contractor, approving final payments after completion of implementation, inspecting and handing over the project, and full supervision. And it requires the presence of a technical staff residing in the project to follow up the implementation,

take measurements, and hold the contractor accountable, in addition to general supervision.

On the other hand, Article (14) indicated the tasks of the Project Implementation Department, represented in ensuring that implementation conforms to the plans and project documents, accurately applying the plans, conditions and specifications, issuing instructions, clarifications and notes and ensuring that they are implemented at the required level, handing over the completed works and taking the necessary measures for the safety of citizens and workers during implementation.

- Code of professional conduct:

Article (26) of the Sudanese Engineering Council Law (1998) clarifies the rules of professional conduct as follows: (1) In addition to any other rules established by the Council under the regulations issued under this law, the registered person must abide by the following rules:

(a) In the event that he (the engineer) is entrusted with any work, he shall do it to the fullest extent and make every effort to ensure the safety of the work and its conformity with the requirements of his client and the fulfillment of all his obligations in this regard.
(b) Professional honesty and non-interference in work that does not fall within the engineer's field of specialization or in the field of specialization of those he delegates, and taking into account the interest of the employer and the public interest in all of this.
(c) Refrain from performing any work for a third party if it is directly related to his job in the state or any institution that authorizes him to decide on work or authorize it.
(d) If he intends to perform work that requires dealing with any institution or organization of which he is a director or a member of its board of directors and has a material interest in it, he shall notify the business owner in writing of his relationship with that institution or organization and obtain his approval in a written form to accept dealing despite that relationship.
(e) Not to benefit financially from any secret entrusted to him during his work, and not to reveal that secret to anyone in any way, whether with or without consideration, unless he obtains permission from the owner of the secret allowing him to do so.
(f) Respecting colleagues in the profession, establishing a relationship with them on mutual trust, and not denouncing their professional ability.
(g) Not taking any legal actions against any registered person for any work of the profession except after referring the matter to the Secretary General.
(h) To observe accuracy and humility in announcing his work.

(2) The engineer shall not be liable if the contractor does not comply with the drawings and specifications he has drawn up.

- Areas of professional conduct:

The Regulations for Practicing the Engineering Profession (2000) devoted Chapter Five to the rules and ethics of practicing the profession – areas of professional conduct. Articles (15-19) clarify the following: In addition to the rules of professional conduct stipulated in Chapter Six of the law, the engineer is bound by professional rules and ethics in his relationship with the public, the employer, contractor and fellow engineers. 16: The engineer's relationship with the public is as follows: The engineer may not do work that is contrary to the principles of the profession, nor accept the practice of his profession in any way that contravenes the laws and regulations in force, and he must refrain from doing any work he is not convinced of its safety and technical correctness, or if its implementation leads to public harm, and he must do his job sincerely and with a good level of performance.

The engineer's decisions must be independent, fair and unbiased between the contracting parties and governed by scientific and technical considerations. He must benefit from all specialized expertise with the aim of advancing the level of the profession and the safety of society. His announcement of his engineering activity must not offend others or harm the prestige of the profession. An engineer who works in the field of consulting, design, auditing and supervision of implementation may not have any association or relationship with contracting work, except for projects contracted to turnkey. It is not permissible for an engineer who works in consulting, design, auditing and supervision works to directly manage trading business in materials related to his profession.

3. Investigating the study variables in the context of the Ministry of Infrastructure and Urban Development in the Northern State:

Musa (2022) mentioned that the Ministry of Infrastructure and Urban Development is a public institution that exercises the functions, powers, tasks, works and activities stipulated in State Decree No. (11) of 2018 related to the establishment of ministries and defining their tasks and competencies. Imam (2022) adds that the ministry has a very important role in the community of the northern state, due to the services it provides in several different engineering fields. Therefore, there is a need for strong human energies of engineers with a set of ethics concerned with this sensitive task. This in turn increases its performance to help it provide its engineering services with fairness and sustainable development. Abdel Fattah (2022) indicated that no engineer is appointed to an engineering job unless he is registered with the Sudanese Engineering Council. The registration certificate is one of the employment documents and is placed in the engineer's service file at the Service Affairs Department. The engineer is not promoted from the ninth

to the eighth grade (probationary period / competency barrier) if he does not bring evidence of his registration with an engineering number in the Sudanese Engineering Council within the category of graduate engineer. However, the rest of the promotions in planning the career path of the engineer are not linked to the rest of the Engineering Council grades, especially the specialist engineer and the consulting engineer.

4. Field study procedures:

4.1. Study population and sample:

The study population includes engineers headed by the Ministry of Infrastructure and Urban Development; (57) engineers. This number includes all administrators and engineers from the various presidential engineering departments. Due to the nature of the research population, the intentional sample was relied upon. To determine the sample size, the study used the Stephen Thompson equation (Cochran, 2007), based on the availability of the original community size of (57) individuals in the ministry in question.

$$\frac{N \times p \times (1 - p)}{[[(N - 1) \times (d^2 \div z^2)] + p \times (1 - p)]}$$

Since: (n) = sample size, (N) = population size, the percentage of availability of the neutral characteristic (p) = (0.50), the error percentage (d) = (0.05), (z) the standard score corresponding to the significance level (0.95). = (1.96).

By calculating the sample size, it was found, according to the previous equation, that it is equal to (50) individuals. 52 questionnaire copies were distributed, and 51 questionnaires were retrieved. The number of valid questionnaire copies that were used in the statistical analysis was 50, which is the required minimum. The sample was proportionally distributed.

Furthermore, sample items were deliberately chosen in the general engineering departments headed by the ministry in question. The inspection unit consisted of engineers holding a bachelor's degree in engineering at all administrative levels. The following is the distribution of the sample items among the public administrations, as shown in Table No. (1).

Table (1): Frequency distribution of the total distributed, retrieved and valid questionnaires for the study sample

General	Distributed	Retrieved	Valid questionnaire	Percentage

management of	questionnaire copies	questionnaire copies	copies	
Works and buildings	21	21	20	40%
Energy and mining	14	14	14	28%
Roads and bridges	11	10	10	20%
Urban planning	3	3	3	6%
Space	3	3	3	6%
Total	52	51	50	100.0%

Source: Prepared by the researchers from field study data (Dongola, 2022).

4.2. Study tool:

A questionnaire was developed for data collection, and it consisted of two parts. The first part dealt with the personal data of the respondents, while the second part dealt with the objective data. It included 32 phrases divided into four axes of the study. The first axis dealt with professional performance, the second axis dealt with rules of professional conduct, the third axis dealt with areas of professional behavior, while the fourth axis dealt with consulting engineering services.

The statistical package for social sciences (SPSS) program was used in addition to the use of the (Amos) program supported by the (SPSS) program to process the study data statistically. This is done through a number of statistical methods, including Cronbach's alpha coefficient, Skewness test, frequencies and proportions, percentiles, arithmetic means and standard deviations, one-sample t-test, correlation coefficient, path analysis.

To test the extent of the internal validity and self-validity of the questionnaire items, the coherence of the questionnaire was evaluated by calculating the value of (α) alpha to calculate the internal reliability coefficient and the square root to calculate the self-truth coefficient. Despite that there are no standard rules regarding appropriate values (Alpha), the value of ($\alpha \geq 0.60$) is reasonable, from an applied point of view, in research related to the humanities (Suleiman, 2006). The following table shows the reliability and validity coefficient for the four variables of the field study.

Table (2): internal validity coefficient and subjective validity of the questionnaire variables (Cronbach alpha) for the field study sample

Variable	Axis	Items	Internal validity coefficient	Subjective validity coefficient
Independent	The engineer's professional performance	12	0.965	0.982

Mediator	Code of professional conduct	4	0.901	0.949
	Areas of professional conduct	4	0.970	0.985
Dependent	Consulting engineering services	12	0.948	0.974
Total		32	0.973	0.986

Source: Prepared by researchers from field study data (Dongola, 2022).

It is clear from Table (2) that the internal validity and subjective validity coefficients indicate that the tool in general has a very high reliability and validity coefficient. The total internal stability coefficient of the questionnaire was (0.973) and the total subjective validity coefficient was (0.986), and it lies in the range between zero and one. This indicates the possibility of the validity of the results that can be produced by the questionnaire as a result of its application, according to what was reported by Al-Fadni (2008).

Face Validity: The researcher verified the face validity by presenting the list in its initial form to seven arbitrators specialized in the field of engineering work, business administration, economics and accounting. For the purpose of the study, and to ensure the comprehensiveness of the information covering the objectives and subject of the study, some observations have been taken into account, and appropriate adjustments have been made.

Structural validity: After the researcher made sure of the face validity of the study tool, he applied it to a sample. It included (5) items. This step aimed to identify the degree of internal consistency between the statements of the questionnaire list, using the normal distribution test for the questionnaire data, in order to find out whether the data follows a normal distribution or not. This is shown in Table (3).

Table (3): Skewness test to test the normal distribution of the axes of the questionnaire for the experimental sample

Variable	**Axis**	**Items**	**Skewness**	**Error**	**Statistical decision**
Independent	The engineer's professional performance	12	-0.304	+0.337	Follows a normal distribution
Mediator	Code of professional conduct	4	-0.071	+0.337	
	Areas of professional conduct	4	+0.150	+0.337	
Dependent	Consulting engineering services	12	+0.623	+0.337	

Total	32	+0.258	+0.337	

Source: Prepared by researchers from field study data (Dongola, 2022).

It is clear from Table (3) that the skewness coefficient is confined to the range (±3) and its standard error value is (+0.337), meaning that the data follows a normal distribution. Besides, the axes of the questionnaire follow the normal distribution. The torsion coefficient is confined to the range (±3), which is the level adopted in the statistical processing of this study. This indicates a good correlation between the variables of the study, which confirms that these variables have the ability to explain the effect among them.

5. Results:

5.1. Characteristics of the study sample:

The following table shows the characteristics of the study sample in terms of (gender, age, academic qualification in engineering, scientific specialization in engineering, category of registration in the Sudanese Engineering Council, job title, job grade, years of experience in the ministry, training courses, public administration, etc.

Table 4: Characteristics of the study sample

Variable		**Frequency**	**Percentage**	**Variable**		**Frequency**	**Percentage**
Gender	Male	29	58%	Job	Ninth	4	8%
	Female	21	42%		Eighth	10	20%
Age group	20-35	20	40%		Seventh	20	40%
	35-50	28	56%		Fifth	3	6%
	50-65	2	4%		Fourth	11	22%
Qualification	BA	46	92%		Sector	2	4%
	Master degree	4	8%	Job title	Engineer	6	12%
Registration category	Graduated engineer	47	94%		Senior engineer	15	30%
	Specialist engineer	3	6%		Chief engineer	2	4%
Major in engineering	Civil	12	24%		Ass. Director of the Department	7	14%
	Electricity	12	24%		Director of the Department	9	18%
	Mechanics	10	20%		Sub-department manager	5	10%
	Space	3	6%		Former general manager	2	4%

	Architect	3	6%		Other	4	8%
	Chemical	4	8%	Courses	Internal	12	24%
	Oil	4	8%		Internal and external	35	70%
	Mining	2	4%		Nothing	3	6%
Work experience in the ministry	Less than 10	27	54%	General management	Works and buildings	20	40%
	10 – 15	19	38%		Energy and mining	14	28%
	15 – 20	2	4%		Roads and bridges	10	20%
	More than 20	2	4%		Planning	3	6%
Total		50	100%		Space		6%

Source: Prepared by researchers from field study data (Dongola, 2022).

5.2. Descriptive analysis of the study variables:

The researchers used the arithmetic means and standard deviations, the importance of the text, and its order, as in the following tables. Table 5 shows the level of importance of the professional performance of the engineer, as the arithmetic means for this variable ranged between (4.18-4.54), and the general arithmetic mean was (4.39). It is noted that the higher arithmetic mean for the statement (the engineer cooperates with his colleagues in a spirit of collegiality while providing a duty of respect and compliance to his superiors and supervisors) with an arithmetic mean of (4.54), which is higher than the general arithmetic mean, and a standard deviation of (0.542).The minimum arithmetic mean for the expression (the engineer of the ministry considers the studies he performs in the organizational unit to be owned by the ministry) has an arithmetic mean of (4.18), which is lower than the general arithmetic mean and a standard deviation of (0.873). In general, it is clear that the level of importance of professional performance in the general engineering departments headed by the Ministry from the point of view of the study sample (managers and engineers) was high.

Table (5): Descriptive analysis of the professional performance of the engineer in the Ministry

No.	The professional performance of the engineer in the ministry	Arithmetic means	Standard deviation	Sig. level	Rank

1	The engineer takes the utmost safety and health of the general public in the performance of his engineering professional duties	4.40	0.729	High	6
2	The engineer performs his engineering work in the field of his specialization and does not transgress to others in which he is not specialized	4.22	0.910	High	11
3	The engineer values testimonials, reports, statements, and general professional data with utmost honesty and objectivity	4.36	0.693	High	9
4	The engineer shall act in engineering matters with every employee or client with sincerity and impartiality, without regard to personal or other conflicts of interest	4.34	0.717	High	10
5	The engineer builds his professional reputation on his deserved achievements based on his competence and acquired experience without entering into unfair and competition with others.	4.54	0.579	High	2
6	The engineer promotes the basic values and principles of engineering ethics and their consolidation in society.	4.36	0.631	High	7
7	The engineer is keen to continue developing his professional skills throughout the period of his professionalism in the engineering profession, and he works to provide opportunities for receiving and transferring them to his subordinates among the engineers.	4.40	0.571	High	5
8	The engineer cooperates with his colleagues in the spirit of collegiality while providing a duty of respect and compliance with his superiors.	4.54	0.542	High	1
9	The manager cares and guides his subordinates, preserves their dignity, and makes a space for them to benefit from their work in the ministry, develop their technical information, and expand their expertise.	4.48	0.544	High	4
10	The manager verifies the project documents organized by the Ministry with the signature of the engineers responsible for the studies, each in his field of specialization.	4.50	0.614	High	3
11	Amendments to these documents are indicated by the signature of the engineer responsible for these amendments.	4.18	0.873	High	12
12	The engineer is subject to his work when he is allowed to practice consulting engineering work to the provisions of the engineering offices contained in the law and regulations of the Sudanese Engineering Council	4.36	0.631	High	7
Arithmetic mean and standard deviation of the variable		4.39	0.574		

Source: Prepared by the researcher from the field study data (Dongola, 2022).

Table (6): Descriptive analysis of the rules of professional conduct in the ministry

م	Codes of professional conduct in the ministry.	Arithmetic mean	Standard deviation	Degree of commitment	Rank
13	The Ministry's engineer is characterized by honesty, integrity and professional honesty	4.30	0.544	High	2
14	The Ministry's engineer is characterized by sincerity, justice and transparency	4.18	0.629	High	4
15	The Ministry's engineer is respected by colleagues in the profession	4.34	0.658	High	1
16	The Ministry's engineer shall not accept commissions (bribes) in exchange for conducting work related to the Ministry	4.20	0.857	High	3
Arithmetic mean and standard deviation		4.26	0.599		

Source: Prepared by researchers from field study data (Dongola, 2022).

Table (6) shows the degree of adherence to the rules of professional conduct, as the arithmetic means for this variable ranged between (4.18-4.34), and the general arithmetic mean was (4.26). It is noted that the higher arithmetic mean for the phrase (the engineer of the ministry is distinguished by the respect of colleagues in the profession) has an arithmetic mean of (4.34), which is higher than the general arithmetic mean, and a standard deviation of (0.658). Moreover, the minimum arithmetic mean for the phrase (the engineer of the ministry is characterized by sincerity, fairness and transparency) has an arithmetic mean of (4.18), which is lower than the general arithmetic mean and a standard deviation of (0.629). In general, it is clear that the degree of adherence to the rules of professional conduct in the general engineering departments headed by the Ministry, from the point of view of the study sample, was high.

Table (7): Descriptive analysis of areas of professional conduct in the ministry

No.	Areas of professional conduct in the ministry	Arithmetic mean	Standard deviation	Sig. level	Rank
17	The Ministry's engineer abides by professional codes and ethics in his relationship with the public	4.32	0.551	High	1
18	The Ministry's engineer abides by professional codes and	4.20	0.606	High	4

	ethics in his relationship with the employer				
19	The Ministry's engineer abides by professional codes and ethics in his relationship with the contractor	4.26	0.527	High	2
20	The Ministry's engineer abides by professional codes and ethics in his relationship with his fellow engineer	4.26	0.565	High	3
Arithmetic mean and standard deviation		4.26	0.539		

Source: Prepared by the researchers from field study data (Dongola, 2022).

Table 7 shows the degree of commitment to the areas of professional conduct, as the arithmetic means for this variable ranged between (4.20-4.32), and the general arithmetic mean was (4.26). It is noted that the highest arithmetic mean for the an individual (the engineer of the ministry is committed to professional code and ethics in his relationship with the public) has an arithmetic mean of (4.32), which is higher than the general arithmetic mean, and a standard deviation of (0.551). Besides, the minimum arithmetic mean for the statement (the engineer of the ministry is committed to professional code and ethics in his relationship with the employer) has an arithmetic mean of (4.20), which is lower than the general arithmetic mean and a standard deviation of (0.606). In general, it is clear that the degree of commitment to the areas of professional conduct in the general engineering departments headed by the Ministry, from the point of view of the study sample, was high.

Table 8 shows the level of importance of consulting engineering services, as the arithmetic means for this variable ranged between (4.00-4.34), and the general arithmetic mean was (4.15). It is noted that the higher arithmetic mean for the phrase (studies prepared in our office include participation in studying and evaluating proposals and providing consultations during implementation stages) with an arithmetic mean of (4.34), which is higher than the general arithmetic mean, and a standard deviation of (0.626). Furthermore, the minimum arithmetic mean for the expression (full supervision in our office requires the presence of a technical staff residing in the project to follow up on implementation, take measurements and hold the contractor accountable) with an arithmetic mean of (4.00), which is lower than the general arithmetic mean and a standard deviation of (0.904).

Thus, it is clear that the level of importance of consulting engineering services in the general engineering departments headed by the Ministry from the point of view of the study sample was high.

Table 8: Descriptive analysis of consulting engineering services (studies, supervision, and implementation management) in the Ministry

م	Consulting engineering services: studies, supervision and implementation management in (the ministry represented by the organizational unit (the office)):	Arithmetic mean	Standard deviatio	Sig. level	Rank

			n		
21	The studies prepared in our office include programming, feasibility studies, planning, analysis, design, contractual terms and technical specifications	4.14	0.670	High	7
22	The studies prepared in our office include the preparation of technical reports, bills of quantities and cost estimates	4.26	0.600	High	3
23	The studies that are prepared in our office include participating in the study and evaluation of offers and providing consultations during the implementation stages	4.34	0.626	High	1
24	Consulting supervision in our office is limited to providing consultations and responding to inquiries submitted by the service applicant	4.10	0.763	High	8
25	The general supervision in our office includes the technical supervision of the implementation commissioned by the employer according to the project plans and documents	4.30	0.505	High	2
26	The general supervision in our office includes providing consultations and clarifications, visiting the project periodically, issuing instructions and making observations about implementation	4.16	0.650	High	6
27	The general supervision includes providing clarifications to the resident supervising body, ensuring and following up in accordance with the terms of the contract, and avoiding errors during all stages of implementation	4.06	0.712	High	9
28	The general supervision in our office includes approving the contractor's disbursements and approving the final disbursement after completion of implementation and project inspection and delivery	4.00	0.833	High	11
29	Full supervision in our office requires the presence of a technical staff residing in the project to follow up on implementation, take measurements, and hold the contractor accountable, in addition to general supervision	4.00	0.904	High	12
30	Implementation management in our office includes ensuring that the implementation conforms to the plans of the project documents and the accuracy of applying the plans, conditions and specifications	4.16	0.584	High	4
31	Implementation management in our office includes issuing instructions and clarifications and ensuring that they are implemented at the required level	4.16	0.584	High	4
32	Implementation management in our office includes the delivery of finished works and taking the necessary measures for the safety of citizens and workers during implementation	4.00	0.808	High	10
Arithmetic mean and standard deviation		4.15	0.542		

Source: Prepared by researchers from field study data (Dongola, 2022).

The results of Table 9 indicate that the arithmetic mean of the professional performance of the engineer, the areas of professional conduct, the rules of professional conduct, and consulting engineering services, has increased, reaching (4.39, 4.26, 4.26, 4.15) and a standard deviation of (0.574, 0.539, 0.599, 0.542) respectively. This means the interest of the engineering general departments in the ministry to develop the professional performance of engineers and to adhere to the fields and rules of professional conduct. The ministry is also keen to improve consulting engineering services.

Table 9: General descriptive analysis of the study variables

No.	Variable	Dimension	Arithmetic mean	Standard deviation	t-value	Sig. of T	Sig. level	Rank
1	Independent	Professional performance of the engineer	4.39	0.574	17.149	0.000	High	1
2	Mediator	Code of professional conduct	4.26	0.599	14.823	0.000	High	3
		Areas of professional conduct	4.26	0.539	16.524	0.000	High	2
3	Dependent	Studies service	4.25	0.508	17.367	0.000	High	3
		Supervision service	4.10	0.622	12.549	0.000	High	1
		Implementation management service	4.11	0.611	12.798	0.000	High	2
		Consulting engineering services	4.15	0.542	15.036	0.000	High	4

Source: Prepared by researchers from field study data (Dongola, 2022).

The following is the correlation matrix between the variables of the study, as shown in Table (10).

Table 10: Correlation Matrix between the independent, mediator and dependent variables

Variable	Professional performance of the engineer	Code of professional conduct	Areas of professional conduct	Consulting engineering services
Professional	1	0.464**	0.558**	0.619**

performance of the engineer				
Code of professional conduct	0.464**	1	0.842**	0.794**
Areas of professional conduct	0.558**	0.842**	1	0.875**
Consulting engineering services	0.619**	0.794**	0.875**	1

Source: Prepared by researchers from field study data (Dongola, 2022).

The data of Table (10) indicate that there is a correlation between the variables of the study, and the correlation was statistically significant for all variables at a significant level (0.01).

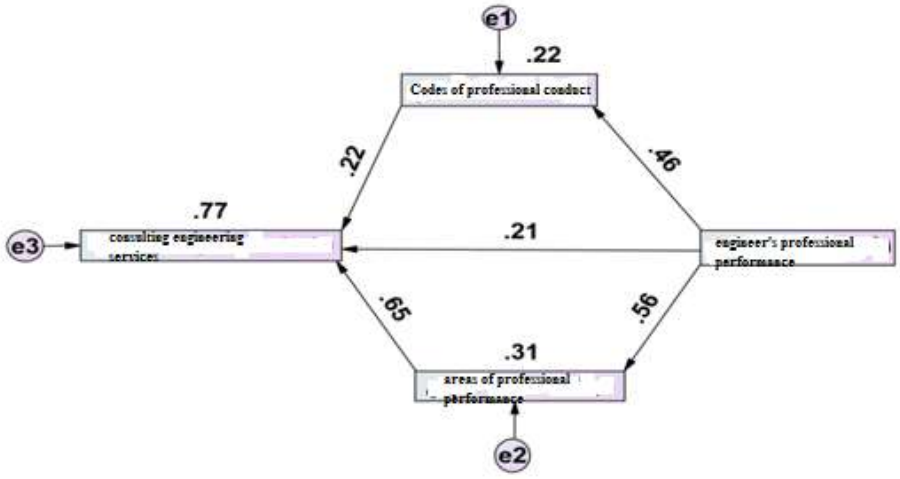
5.3. Testing the main hypothesis of the study:

The code and areas of professional conduct mediate the relationship between the professional performance of the engineer and the consulting engineering services in the Ministry of Infrastructure and Urban Development in the Northern State. Before examining this hypothesis, it is worth getting acquainted with the mediating variable model used by many researchers in the field of business administration and statistics.

Mediating variable model:

The main hypothesis test:

Figure (2) shows the result of testing the main hypothesis. Path analysis was followed using the statistical program (Amos Ver.22) supported by the program (SPSS Ver.26), in order to verify the quality of conformity to the study model. It was also used to verify the existence of the direct, indirect and total effect of the role of the mediator in the relationship between the independent and the dependent variables, and to ascertain the nature of the intermediate variable, whether it is partial or complete.



Source: Prepared by researchers from field study data (Dongola, 2022).
Figure (2): The structural model of the study

Table (11) presents the results of the conformity indicators for this model.

Table (11): Indicators of conformity quality to the study model

Indicators	**χ^2/df**	**RMR**	**GFI**	**NFI**	**IFI**	**CFI**	**RMSEA**
Recorded values	48.47	0.07	0.76	0.69	0.70	0.69	0.98
Acceptance condition	Less than 5	Near to 0	Near to 1				0.05 - 0.08

Source: Prepared by researchers from field study data (Dongola, 2022).

It is clear from Table (11) that the indicated conformity quality indicators reflect an appropriate condition, as most of the indicators had good values. This confirms the validity of the assumption that the structural model is appropriate to the study data, i.e. that the study model has the quality of conformity.

Table 12 below summarizes the direct effect, the indirect effect, and the total effect among the study variables.

Table 12: The direct, indirect, and total impact on the study model

Total	Indirect impact	Direct impact	Sig. level	t-value	Standard error	Rating	Path
0.46	0.00	0.46	0.00	3.67	0.13	0.48	Professional performance of the engineer - codes of professional conduct
0.56	0.00	0.56	0.00	4.71	0.11	0.52	Professional performance of the engineer - areas of professional conduct
0.67	0.46	0.21	0.02	2.28	0.08	0.18	Professional performance - consulting engineering services
0.22	0.00	0.22	0.01	2.80	0.07	0.18	Code of professional conduct - consultation services
0.65	0.00	0.65	0.00	7.80	0.08	0.60	Areas of professional conduct - consultation services

Source: Prepared by researchers from field study data (Dongola, 2022).

Table (13): Sobel test results

Path	Z	Sig. level
Professional performance of the engineer - codes of professional conduct - consulting engineering services	3.601	0.000
Professional performance of the engineer - areas of professional conduct - engineering consulting services	4.139	0.000
The professional performance of the engineer - codes and fields together - consulting engineering services	7.740	0.000

Source: Prepared by the researchers from the results of the Sobel Test Calculator (Dongola, 2022).

Figure (2), Table (12), and Table (13) evidently present results represented in the presence of a direct, positive, significant effect of the engineer's professional performance on the rules of professional conduct, with a value of (0.46), and the existence of a direct, positive, significant effect of the engineer's professional performance on the axes of professional conduct whose value was (0.56). There was also a significant direct positive effect of the professional performance of the engineer on consulting engineering services, with a value of (0.21).

Furthermore, there was a direct, positive, significant impact of the codes of professional conduct on consulting engineering services with a value of (0.22), and the existence of a significant positive effect of the fields of professional conduct on consulting engineering services with a value of (0.65). Besides, there was an indirect (mediator) positive, significant effect of the rules and areas of professional conduct on the relationship between the professional performance of the engineer and the consulting engineering services; (0.46), and there was an overall effect (direct and indirect) positive and significant of the codes and areas of professional conduct in the relationship between the professional performance of the engineer and the consulting engineering services, with a value of (0.67).

6. Discussion:

First: The results of the path analysis showed that there is a significant positive impact of the engineer's professional performance on the codes of professional behavior according to the opinions of the sample members. This can be explained by the engineer's keenness to continue developing his professional skills throughout his professionalism in the engineering profession and his work to provide opportunities to receive and transfer them to his subordinates, engineers, which increases the degree of his commitment to the codes of professional conduct. This is reflected in the rule of good ethics in engineering work such as honesty, integrity, honesty, justice and sincerity. This is consistent with the findings of Abd al-Salam (2015) and Siam and Abu Hamid (2006).

Second: The results of the path analysis showed that there is a significant positive effect of the engineer's professional performance on the areas of professional conduct according to the opinions of the sample

members. This reveals the importance of the effective role of the engineer building his professional reputation on his deserved achievements based on his competence and acquired experience without entering into unfair and honest competition with others, which leads to raising the degree of commitment to professional codes and ethics in the engineer's relationship with the public, the employer, the contractor and his fellow engineers and enhances prestige of the engineering profession locally and globally. This result is consistent with Abu Al-Kass (2015).

Third: The results of the path analysis showed that there is a significant positive effect of the engineer's professional performance on the consulting engineering services, according to the opinions of the sample members. This result reflects the commitment of the engineer in his professional conduct to the methods that support and enhance the status, honesty and dignity of the engineering profession locally and globally, which is reflected in the provision of consulting engineering services of high quality that satisfies the stakeholders. This is consistent with Abdul Hamid (2022).

Fourth: The results of the path analysis showed that there is a significant positive impact of the codes of professional conduct on consulting engineering services, according to the opinions of the sample members. This indicates that the engineer's commitment to the good ethics of practicing the engineering profession facilitates the process of improving consulting engineering services in engineering institutions. This is consistent with the result of Abdel-Hamid and Hussein (2022) and (Gabriele, et.al., 2014).

Fifth: The results of the path analysis showed that there is a significant positive impact of the fields of professional behavior on the consulting engineering services, according to the opinions of the sample members. This indicates the fact that the engineer's commitment to the areas of professional conduct helps engineering institutions to improve the services of studies, supervision and implementation management, which leads to improving the status and reputation of the engineering profession, its practitioners and those dealing with it. This result is distinguished by testing the relationship of professional conduct fields to consulting engineering services, unlike previous studies, which did not address this in testing their hypotheses.

Sixth: The results of the path analysis showed that the codes and fields of professional behavior play a partial mediating role in the relationship between the professional performance of the engineer and the engineering consultancy services in the engineering general departments headed by the Ministry in practice. This means that the commitment of the Ministry's engineers to the code and areas of professional conduct increases the impact of the professional performance of the Ministry's engineers on improving the engineering consultancy services provided. This result is consistent with Abdel Hamid and Abu Saleh (2022), which

showed a high level of codes and areas of professional conduct, engineer obligations, and the quality of engineering services.

7. Recommendations:

1. There is a need to educate managers and engineers in public and private engineering institutions of the importance of developing the professional performance of the engineer to be reflected in the commitment to the rules and areas of professional conduct and the improvement of engineering consulting services.
2. The ministry's senior leadership should emphasize the importance and role of the codes of professional conduct as one of the strategies that can be adopted by the ministry in the field of strengthening the ethics of practicing the profession in order to transform it into a ministry characterized by the quality of the consulting engineering services provided.
3. The Training Department of the Ministry shall hold seminars, lectures and workshops on the ethics of practicing the engineering profession based on the Sudanese Engineering Council Law of 1998, the Engineering Profession Practice Regulations of 2000, and the Engineering Work Practice Monitoring Regulations of 2004.
4. The general engineering departments of the Ministry should adopt many concepts that reflect the ethics of the engineering profession, which is reflected as a conduct in identifying the degrees of organizational loyalty, attachment and job implication of its engineers, by spreading the concepts of transparency, justice, integrity and right and linking it to duty towards the implementation of the tasks of the engineering job.
5. The engineer appointed at the Ministry must abide by the professional rules and ethics in his relationship with the public, the employer, the contractor, his fellow engineers and employees, which will enhance the values of civil service, raise the level of quality, develop performance, serve citizens and increase their satisfaction with the Ministry and its engineering consultancy services provided.
6. The general engineering departments headed by the Ministry should continue to improve the consulting engineering services (studies, supervision, implementation management) due to their importance in controlling resources and making them at the minimum level, which will reflect on the efficiency of construction and maintenance operations and reduce the problems, losses and costs related to that.

8. Suggestions for future studies:

Based on the research limitations, the proposed future studies can be referred to:

1. Future research can address this study using other fields of application and compare the results with the current study, which constitutes an addition to the research literature in this field.
2. The current study focused on the mediating role of the codes and fields of professional conduct (engineering) in the relationship between professional performance and consulting services. The mediating role of professional ethics in the relationship between other variables that have not been addressed can be investigated.

Acknowledgment:
" The authors extend their appreciation to the Deanship of Scientific Research at King Khalid University for funding this work through Small group Research Project under grant number **(RGP1215/44)**

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