Analyzing the Effect of Business Intelligence and Analytics on Organization Performance from Dynamic Capabilities Perspective in Yemeni Private

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Abstract:

In developing countries, the role of business intelligence and analytics (BI&A) in enhancing organizational performance remains underexplored, particularly in the higher education sector. Therefore, this study aimed to analyze the effects of BI&A on organizational performance through dynamic capabilities and innovation in Yemeni private universities. This study proposed a conceptual model comprising three independent variables (IT infrastructure, BI&A staff experience, and top management support), two mediating variables (dynamic capabilities and innovation), and one dependent variable (organizational performance). Data were collected through a questionnaire that included 269 academic and administrative employees in five private universities (University of Science and Technology, Queen Arwa University, Al-Nasser University, Al-Razi University, and Al-Rasheed University). Data were analyzed using regression analysis, correlation analysis, and factor analysis. The results revealed that BI&A staff experience and top management support significantly influence organizational performance indirectly through dynamic capabilities and innovation. However, IT infrastructure showed no significant effect on performance. The findings suggest university leaders should strengthen BI&A-related capabilities to improve organizational performance through innovation and dynamic capabilities.

Keywords: business intelligence and analytics, organizational performance, dynamic capabilities, innovation.

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تحليل تأثير ذكاء وتحليلات الأعمال على أداء المنظمة من منظور القدرات الديناميكية في الجامعات الأهلية اليمنية

الملخص:

في البلدان النامية، لا يزال دور ذكاء وتحليلات الأعمال (BI&A) في تحسين الأداء التنظيمي غير مستكشف بشكل كاف، وخاصة في قطاع التعليم العالي. لذلك، هدفت هذه الدراسة إلى تحليل تأثير ذكاء وتحليلات الأعمال على الأداء التنظيمي من خلال القدرات الديناميكية والابتكار في الجامعات الأهلية اليمنية. اقترحت هذه الدراسة نموذجًا مفاهيميًا يتكون من ثلاث متغيرات مستقلة (البنية التحتية لتكنولوجيا المعلومات، وخبرة موظفي ذكاء وتحليلات الأعمال، ودعم الإدارة العليا)، ومتغيرين وسيطين (القدرات الديناميكية والابتكار)، ومتغير تابع واحد (الأداء التنظيمي). تم جمع البيانات من خلال استبيان شمل 269 موظفًا أكاديميًا وإداريًا في خمس جامعات أهلية (جامعة العلوم والتكنولوجيا، وجامعة الملكة أروى، وجامعة الناصر، وجامعة الرازي، وجامعة الرشيد). تم تحليل البيانات باستخدام تحليل الانحدار، وتحليل الارتباط، وتحليل العوامل. كشفت النتائج أن خبرة موظفي ذكاء وتحليلات الأعمال ودعم الإدارة العليا يؤثران بشكل كبير على الأداء التنظيمي بشكل غير مباشر من خلال القدرات الديناميكية والابتكار. مع ذلك، لم تظهر البنية التحتية لتكنولوجيا المعلومات أي تأثير يُذكر على الأداء التنظيمي. تشير النتائج إلى ضرورة قيام قادة الجامعات بتعزيز القدرات المتعلقة بذكاء وتحليلات الأعمال لتحسين أداء المنظمة من خلال الابتكار والقدرات الديناميكية.

الكلمات المفتاحية : ذكاء وتحليلات الأعمال، الأداء التنظيمي، القدرات الديناميكية، الابتكار.

1. Introduction

Universities seek to enhance their administrative and academic performance to achieve societal goals, ultimately contributing to social welfare and progress. The progress of many universities worldwide is due to the increasing focus on leveraging business intelligence and analytics (BI&A), which supports their continuous development [1]. Leading universities use BI&A technologies to maintain competitiveness in an evolving and dynamic environment [2]. In fact, since 2009, BI&A has represented the largest single expenditure among IT investments by organizations [3]. Given the dynamic and competitive business environment, organizations must make informed decisions to ensure improved performance and long-term sustainability. BI&A enables the analysis of massive sets of organizational data to generate strategic insights, thereby enhancing decision-making and organizational performance [4].

BI&A has been widely studied in the literature as a tool to enhance decision-making processes and improve organizational performance [3]. However, studies examining their impact on performance in higher education institutions are still very few. Therefore, this research aims to explore the extent of the use of these systems in Yemeni higher education institutions and to study their impact on organizational performance through business intelligence (BI) factors that believe affect organizational performance.

Dynamic capabilities and innovation have been studied as a mediator between the independent variables and the dependent variable according to Teece et al.'s study which demonstrated that "strong dynamic capabilities enhance the success of innovation activities, and innovation fits naturally within the dynamic capabilities framework" [2].

2. Literature Review

The literature on the impact of BI&A on organizational performance has expanded significantly, providing valuable insights for current research. This review summarizes several key studies in this area:

The study by Chatterjee et al. [5] investigated how organizations can improve their business value by improving their performance and acquiring business analytics capabilities. They developed a conceptual model. They tested this data statistically using a survey of 306 respondents from various service sectors and organizations in India. They used structural equation modeling.

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The key variables they studied were Acquisition of Business Analytics Capabilities, Business Process Performance, and Business Decision. Their findings revealed that acquiring business analytics capabilities enhances organizational performance and thus improves the business value of the organization. The findings also indicated that acquiring business analytics capabilities impacts the performance of business processes and business decisions which significantly impacts performance and ultimately impacts business value.

Also, Ahakhatreh and Al-Hawary [6] aimed to measure the impact of BI capabilities on the competitive performance of Islamic banks in Jordan. The study community included 240 managers. This study dealt with the variable of BI as an advanced and renewable variable, which enables organizations to manage a large amount of data and transform it into important information for organizations. The study concluded that there is a statistically important effect on BI capabilities (BI structure, BI technology, and BI culture). The study showed that BI highly predicts internal and external environmental variables, which improves the quality of management work, quality, and flexibility in decision-making.

Furthermore, Yang et al. [7] study looks at the impact of BI, innovation, and organizational learning, on innovative organizations' financial efficiency. The study sample consisted of 196 employees. The compilation tool is the questionnaire. The research results showed that BI and innovation have a critical impact on company performance, Organizations that support innovation achieve a highly competitive advantage.

Chen and Lin [8] developed the sense-transform-drive (STD) conceptual model using dynamic capabilities theory and organizational evolution theory to explain BI capabilities. They chose a sample of 231 people. The most important variables studied were sensing capability, transforming capability, and driving capability. Used structural equation modeling and factor analysis. Results revealed strong effects between the structural components of the conceptual model and dynamic AI capabilities that can enhance firm performance.

Furthermore, Pundziene et al. [9] investigated the impact of dynamic capabilities on open innovation and the effect of open innovation as a mediating between dynamic capabilities and competitive performance. They selected a sample of 465 organizations in Lithuania. The most important variables

studied are environmental scanning, opportunity selection, organizational learning, innovation commercialization, and employee engagement. The results revealed that open innovation partially mediates between dynamic capabilities and the competitive performance of organizations. They also reported the importance of investing in customer engagement and innovation to maintain excellence in innovation management and thus increase the competitive performance of the organization.

Moreover, Mikalef et al. [10] adopted a resource-based perspective to examine the indirect relationship between a company's ability to analyze big data and its competitive performance. They suggested that BDACs enable organizations to generate insight that can help enhance their dynamic capabilities, which in turn positively affects technological capabilities and marketing. The study analyzed data from a survey of 202 IT managers from Norwegian organizations. Results indicated that strong big data analytics capabilities will help organizations achieve a competitive advantage; this effect is mediated by dynamic capabilities.

Also, Božič and Dimovski [11] examined the relationship between the use of BI&A, innovative capability, and organizational performance, employing a dynamic capabilities theory. Their study included a sample of 97 medium and large enterprises in Slovenia. The important variables they investigated were the utilization of BI&A and absorptive capacity. Results indicate that the effective use of BI is positively associated with achieving a successful balance between exploratory and exploitative innovation activities, which in turn enhances organizational performance. Additionally, suggests that BI can serve as a crucial resource for improving competitive advantage by bolstering exploratory innovation capabilities.

Moreover, Torres et al. [3] conducted their study from the perspective of dynamic capabilities. They illustrated how BI&A empowers organizations to identify and respond to opportunities and threats through enhanced decision-making. The sample consisted of 137 business professionals. The most important variables studied are BI&A management capability, BI&A technical infrastructure quality, and BI&A personnel expertise. Results confirmed a positive relationship between BI&A and performance, mediated by business process change capabilities, and the study showed that BI&A management capability positively affects BI&A sensor capabilities directly and indirectly through its impact on BI&A's technical infrastructure. While employee

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experience with BI&A does not important influence sensing capabilities, the relationship between employee experience and BI&A sensing becomes important when BI&A management capabilities are excluded from the model.

In addition, Wamba et al. [12] studied the effects of big data analytics capability on firm performance (FPER) as well as the mediating effects of process-oriented dynamic capabilities (PODC) in the BDAC-FPER relationship. They conducted an online survey, gathering data from 297 Chinese IT managers and business analysts. The variables studied are BDA management capabilities, BDA infrastructure flexibility, and BDA personnel expertise. The findings revealed that BDAC influences firm performance both directly and indirectly. Additionally, the results highlighted the important role of PODC brokers in fostering innovative ideas and enhancing firm performance.

3. Research Model and Hypotheses

The study model consists of three independent variables, one dependent variable, and two mediating variables. These variables were selected based on previous literature. The independent variables are the IT Infrastructure, BI&A staff experience, and top management support. The mediator variables are dynamic capabilities and innovation. The dependent variable is organization performance. Organizational performance is an organization's capacity to achieve its long-term goals at the lowest possible cost while attaining efficiency [13] and is an important variable in many studies that aim to evaluate the success of an organization. Below is a review of the research hypotheses:

• IT infrastructure

The IT infrastructure is the ability of an organization's IT platform to communicate information across different functions and to develop and leverage the business [14]. Organizations with a robust and better-equipped IT infrastructure can execute their business initiatives effectively [15]. Previous studies have identified a positive relationship between IT capacity and an organization's performance. Chen et al. [16] found that IT efficiency positively affects organizational success. IT infrastructure impacts organizational performance by enhancing sensing capabilities, enabling the organization to identify opportunities and threats, and supporting the flexibility needed to adapt to a dynamic business environment. Accordingly, the study assumes the following hypothesis:

H1: IT infrastructure has a positive impact on dynamic capabilities (sensing, orchestrating, value capturing, and transforming the organization).

- **BI&A staff expertise**

BI&A staff expertise refers to the professional knowledge and skills of BI&A employees [3]. Much literature has addressed this variable as a critical factor for organizations' success and achieving better performance. Highly skilled BI&A employees are expected to generate accurate, insightful, and actionable information compared to less experienced employees. Effective sensing is influenced by the ability of managers to assimilate data, as opportunities and threats may go unnoticed or misinterpreted. Therefore, the ability of BI&A users to accurately interpret the outputs is essential to identifying potential opportunities and threats [3]. Ahakhatreh and Al-Hawary [6] concluded that employees with strong knowledge and technical skills are more efficient in identifying and evaluating new external knowledge, thus increasing the level of knowledge in the company. Wamba et al. [12] showed that infrastructure and employee capabilities have a positive impact on organizational performance. Accordingly, the study assumes the following hypothesis:

H2: The BI&A staff experience has a positive impact on dynamic capabilities.

- **Top Management Support**

Top Management Support describes the level of direction, strength, and resources provided by top managers within the company during and after the procurement of information technology [17]. It is an important factor in using BI&A, and it is very difficult to adopt and implement any technology without their support. Paradza and Daramola [18] stated that the most important factors mentioned for deriving BV from BI are skilled human capital, data quality, intelligence infrastructure, alignment of BI with organizational objectives, use/data culture, and support for top management. Administrative support is important for system quality and adequate information supply [19]. Accordingly, the study assumes the following hypothesis:

H3: Top management support has a positive impact on dynamic capabilities.

- **Dynamic capabilities and Innovation**

Organizations rely on their dynamic capabilities to execute their market orientation. Dynamic capabilities (sensing, seizing, and transforming) allow organizations to change and adapt in response to changing market demands. Teece et al. [2] provide the most comprehensive model of

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dynamic capabilities by dividing the seizure into two sets of capabilities: orchestrating and capturing value, leading to four dynamic capabilities: sensing, orchestrating, capturing value, and transforming the organization. Organizations need to know when there are new opportunities to enhance or replace elements that make up their business model [20].

Over time, the view on how dynamic capabilities and competitive advantage are related evolved. The first researchers assumed a direct and fundamental relationship. Sharma et al. [4] showed that the organization would gain a long-term competitive advantage if it had dynamic capabilities. Recently, research has shown that there is often an indirect relationship between organizational performance and dynamic capabilities. For instance, Schilke and Huang [1] found that organizational mechanisms should mediate the connection between dynamic capabilities and performance. Similarly, Torres et al. [3] noted that functional performance serves as a mediator in this relationship. Wamba et al. [12] stated that organizations can only expect to increase performance when BI&A is used to create complementarities with dynamic capabilities such as supporting innovation capabilities. Accordingly, the study assumes the following hypothesis:

H4. Dynamic capabilities have a direct impact on innovation.

Many studies indicate a positive relationship between innovation and organizational performance. For example, Teece et al. [2] argue that "strong dynamic capabilities enable innovation processes and thus ensure the competitive performance of the organization." It can be understood as the ability to recognize new market opportunities, generate creative ideas, and implement solutions that meet market demands by utilizing existing capabilities and resources [9]. Specifically, innovation may involve qualitative changes to existing products, the introduction of entirely new products, innovation processes within industries, the exploration of new markets, or the establishment of new sources of raw materials [21]. Innovations typically enhance existing products, fulfill customer needs, and can lead to important changes in new offerings [11]. Accordingly, the study assumes the following hypothesis:

H5: Innovation has a direct effect on organizational performance.

In addition to the previous five hypotheses, this research assumes three hypotheses to test and verify serial mediation within the proposed study model, which is as follows:

H6: Dynamic capabilities and innovation mediates serially the relationship between Top management support and organizational performance.

H7: Dynamic capabilities and innovation mediate serially the relationship between IT Infrastructure and organizational performance.

H8: Dynamic capabilities and innovation mediate serially the relationship between BI&A staff experience and organizational performance.

Figure 1 illustrates the research model and hypotheses.

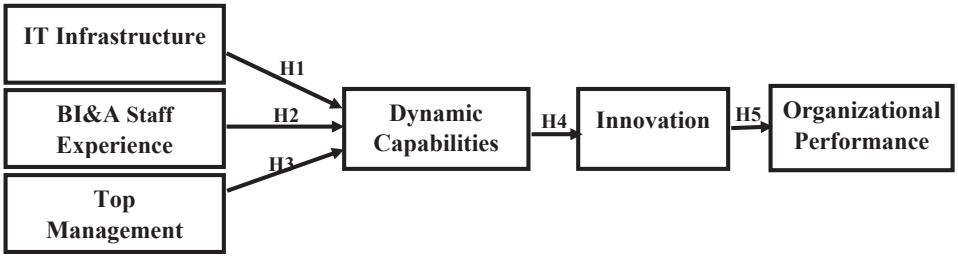

Figure 1: Research model and hypotheses

4. Methodology

This study adopted the quantitative method due to its ability to accurately measure variables and analyze causal relationships between them in an objective and systematic manner.

This method was chosen because it allows for the collection of numerical data that can be statistically analyzed, contributing to precise and generalizable results. It also facilitates data comparison and hypothesis testing in a scientific and reliable way. To achieve the study's objectives, the survey strategy was employed as the framework for data collection.

The questionnaires were carefully designed to cover all variables under investigation, based on relevant previous studies, and were pre-tested to ensure clarity and accuracy.

This approach enabled the collection of a large amount of organized data, which facilitated statistical analysis and the derivation of precise conclusions supporting the research objectives.

The questionnaires were distributed to a random sample of faculty members and administrative staff across five private universities. The sample included senior leadership (university presidents and vice presidents), middle leaders (deans of colleges and their deputies), and executive leadership (directors of

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departments, heads of academic and administrative departments, research assistants, and specialists). Workers in auxiliary functions (such as reception, secretarial, service, and maintenance) were excluded.

The study population consisted of 949 individuals, and according to Morgan's table, the required sample size to represent the population was 274 participants.

Paper questionnaires were distributed to participants through field visits to the universities, and the distribution and collection process continued over a two-month period.

To increase the likelihood of achieving the required sample size, more questionnaires than the required number were distributed.

The number of questionnaires distributed to the University of Science and Technology staff was 195, with 178 returned (1 incomplete). Queen Arwa University: 30 distributed, 20 returned (1 unusable). Al-Nasser University: 30 distributed, 26 returned (1 unusable). Al-Razi University: 30 distributed, 26 returned (1 unusable). Al-Rasheed University: 30 distributed, 23 usable questionnaires returned. After removing invalid and missing questionnaires, the final number of valid responses for data analysis was 269.

5. Data Analysis and Results

In this study, demographic analysis, reliability, correlation analysis, descriptive statistics, regression analysis and factor analysis were utilized. The following sections explain this.

5.1. Demographic Analysis

Table 1 presents the demographic characteristics of the 165 respondents. Males comprised 55.8% of the sample, while females accounted for 44.2%. The largest age group was 31–40 years, representing 47.8% of participants. In terms of educational attainment, the majority held a bachelor's degree (45.3%). Regarding professional experience, 34.1% of respondents reported 6–10 years of service. Concerning job designation, most participants were staff members (administrative specialists), accounting for 65.9% of the sample. These results demonstrate the normal distribution of workers at the universities in question. The sample from which the data were collected is therefore representative of the study community.

Table 1: Demographic profile of respondents

Characteristic	Category	Frequency	Percent (%)
Gender	Male	154	55.8
	Female	122	44.2
Age (years)	20–30	63	22.8
	31–40	132	47.8
	41–50	66	23.9
	51 or above	15	5.4
Education	Diploma	4	1.4
	Bachelor	125	45.3
	Master	100	36.2
	PhD	47	17.0
Experience (years)	5 or less	42	15.2
	6–10	94	34.1
	11–15	83	30.1
	15 or above	57	20.7
Position	University President / Deputy	2	0.7
	Dean / Deputy Dean	15	5.4
	Administrative Specialist	182	65.9
	Secretary General	6	2.2
	Academic Department Head	23	8.3
	Department Director / Head	48	17.4

Table 2 presents the BI tools used by employees in Yemeni private universities. Spreadsheets were the most commonly used tool, reported by 80.9% of respondents, followed by ERP systems (65.6%) and balanced scorecards (47.3%). Other tools, such as dashboards (11.1%), data warehouses (13.4%), performance management software (14.9%), and reporting and query software (29.0%), were used less frequently, while data mining (8.0%) and artificial intelligence systems (0.4%) were rarely employed. These results indicate a strong reliance on traditional and widely accessible BI tools within the universities under study.

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Table 2: BI tools used in Yemeni private universities

BI tools	Responses		Percent of Cases (%)
	N	Percent (%)	
Spreadsheet	212	26.0	80.9
Balanced scorecard	124	15.2	47.3
Dashboard	29	3.6	11.1
ERP	172	21.1	65.6
SPSS	103	12.6	39.3
Data warehouse	35	4.3	13.4
Data mining	21	2.6	8.0
reporting and query software	76	9.3	29.0
performance management software	39	4.8	14.9
Artificial intelligence systems	1	0.1	0.4
Others	4	0.5	1.5
Total	**816**	**100.0**	**311.5**

Considering the above results and based on the Gartner maturity model, commonly used to assess the level of BI development, it can be concluded that the use of BI in Yemeni private universities is still in its early stages. Most of the BI tools used in universities are spreadsheets, balanced scorecards, ERP, and SPSS. The following Figure 2 illustrates the Gartner maturity model.

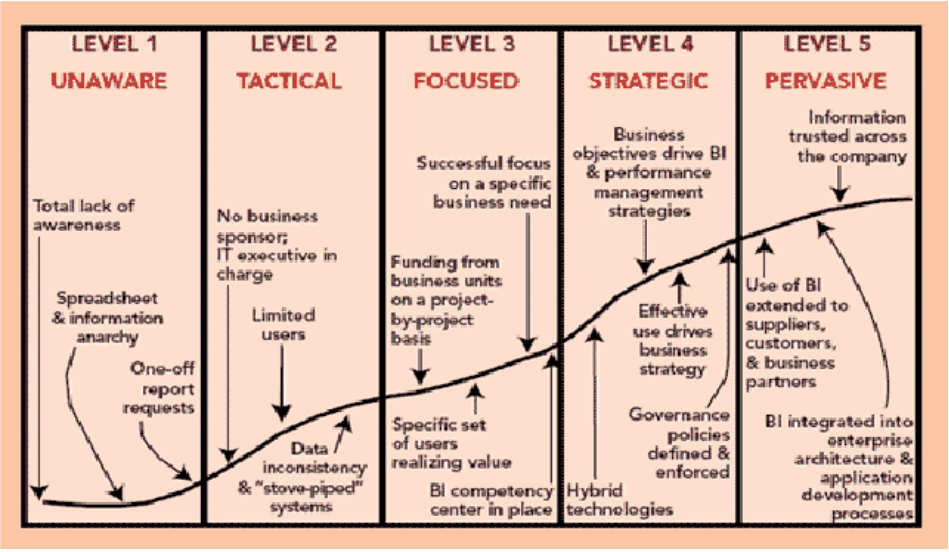

Figure 2: Gartner's Maturity Model

5.2. Reliability Assessment

Reliability is the consistency of the variable or set of variables with what it aims to measure [23]. To assess the reliability of the study variables, a reliability test was conducted. The most commonly used reliability index, the Alpha-Cronbach coefficient (α), displays the average correlation between elements that form a measure to ensure the stability and reliability of variables. Reliability analysis results are shown in Table 3.

Table 3: Reliability analysis

Construct	Cronbach's Alpha	No. of Items
Organizational Performance	.873	9
IT infrastructure	.900	6
BI&A staff experience	.894	7
Top management support	.937	5
Dynamic Capabilities	.913	6
Innovation	.891	6

All the study variables show high levels of internal consistency ($\alpha > 0.85$), implying that the respective items within each scale reliably measure their intended constructs.

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5.3. Correlation Analysis

The analysis in Table 4 reveals that there are no significant associations between the independent variables themselves. Overall, these results provide preliminary evidence that the independent variables are positively related to organizational performance.

Table 4: Correlation Matrix

	BI Staff Experience	Dynamic Capabilities	IT Infrastructure	Innovation	Organizational Performance	Top Management Support
BI Staff Experience	1					
Dynamic Capabilities	0.671	1				
IT Infrastructure	0.665	0.572	1			
Innovation	0.727	0.766	0.687	1		
Organizational Performance	0.648	0.61	0.693	0.71	1	
Top Management Support	0.763	0.743	0.681	0.776	0.653	1

5.4. Factor Analysis

Factor analysis is a statistical technique used to determine relationships within a wide range of variables. This analysis helps reduce the complexity of data and this is done by collecting related variables in smaller groups of "factors" based on their shared variation [23].

5.4.1. Factor Analysis on Independent Variables

Independent variables in this research are IT infrastructure, BI&A staff experience, and top management support. These variables consist of several items to measure them. The four items in the IT infrastructure are evolution and modernity, data integration, rapid meeting of needs, and compatibility; The four items in the BI&A staff experience are adequate understanding of the University's policies and plans, technical skills and knowledge, relational knowledge and training; and the top management support items are adequate support for business intelligence projects, commitment to large projects and risk tolerance. Each of these dimensions was composed of several constructs, and the factor analysis was used to examine whether the construction elements were compatible with their construction.

Table 5 shows the Kaiser-Meyer-Olkin (KMO) and Bartlett test values for all items that represent the independent variables.

Table 5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.934
Bartlett's Test of Sphericity	**Approx. Chi-Square**	3527.960
	Df	136
	Sig.	.000

The exploratory factor analysis (EFA) was conducted on the provided data, yielding valuable insights into the underlying structure of the variables. The data demonstrated high suitability for factor analysis, supported by a KMO value of.934, indicating excellent sampling adequacy. Additionally, Bartlett's Test of Sphericity was highly important ($p < .000$). Table 6 presents the results of factor analysis for independent variables. The EFA revealed a three-factor structure that collectively explained 70.494% of the variance in the data. Factor 1, contributing to 54.874% of the variance, was characterized by strong loadings on ITINF1-6 variables, suggesting a construct related to Information Technology Infrastructure. Factor 2, explaining 9.265% of the variance, exhibited strong loadings on IBSEX1-6 variables, indicating a construct associated with BI staff experience. Item 7 was excluded from this dimension because it cross loaded with other variables. Factor 3, representing 6.355% of the variance, displayed strong loadings on TMS1-5 variables, suggesting a construct linked to Top Management Support.

Table 6: Rotated Component Matrix[a]

	Component		
	1	**2**	**3**
ITINF1	.716		
ITINF2	.849		
ITINF3	.775		
ITINF4	.628		
ITINF5	.744		
ITINF6	.680		
IBSEX1			.601
IBSEX2			.590
IBSEX3			.736

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Table 6: Continued

	Component		
	1	2	3
IBSEX4			.754
IBSEX5			.762
IBSEX6			.773
TMS1		.762	
TMS2		.767	
TMS3		.819	
TMS4		.784	
TMS5		.758	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

5.4.2. Factor Analysis on Mediating Variables

- **Dynamic Capabilities**

Dynamic capabilities consist of several structures or variables: sensing (Environment Survey, Opportunity Selection), seizing (orchestrating and value capture), and organizational transformation. These variables were composed of several items. Table 7 shows the KMO and Bartlett test values for dynamic capabilities.

Table 7: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.875
Bartlett's Test of Sphericity	**Approx. Chi-Square**	1120.160
	Df	15
	Sig.	.000

The analysis of dynamic capabilities variables reveals robust findings through various statistical measures. The KMO measure of sampling adequacy yields a commendable value of 0.875, indicating that the sample size is deemed "good" for factor analysis. Furthermore, Bartlett's Test of Sphericity, with an approximate chi-square value of 1120.160 and 15 degrees of freedom, is important ($p < 0.05$). This significance underscores the presence of sufficient

correlations among the dynamic capability's variables, validating the appropriateness of proceeding with factor analysis. Table 8 shows the Total Variance Explained.

Table 8: Total Variance Explained

Extraction Sums of Squared Loadings		
Total	**% of Variance**	**Cumulative %**
3.828	63.793	63.793

As shown in Table 8, Examining the communalities, all variables exhibit communalities above 0.5, suggesting that a substantial proportion of variance in each variable is accounted for by the extracted factors. Moving to the Total Variance Explained, only one factor is extracted, elucidating 63.793% of the variance in the dynamic capability's variables.

This factor, represented by loadings for all six dynamic capabilities variables (DC1, DC2, DC3, DC4, DC5, DC6), unveils a common underlying construct of dynamic capabilities. The high cumulative percentage emphasizes that this factor important captures the shared variance among the variables, reinforcing the notion that these dynamic capabilities variables collectively measure a unified and fundamental aspect of dynamic capabilities.

- **Innovation**

Innovation consists of several structures or variables: a clear vision of the future direction of the university, research and development, participation in the marketing of new services, and competition in the delivery of new services. These variables were composed of several items. Table 9 shows KMO and Bartlett's test values for innovation.

Table 9: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.892
Bartlett's Test of Sphericity	**Approx. Chi-Square**	877.332
	Df	15
	Sig.	.000

The EFA conducted on the provided data indicates that the dataset is suitable for such an analysis, supported by a KMO value of.892, which is considered good. Additionally, Bartlett's Test of Sphericity is highly important ($p < .000$),

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rejecting the null hypothesis and affirming the presence of sufficient correlations among the variables. Table 10 shows the Total Variance Explained.

Table 10: Total Variance Explained

Extraction Sums of Squared Loadings		
Total	**% Of Variance**	**Cumulative %**
3.499	58.32	58.317

The EFA resulted in the extraction of a single factor, which explains a substantial portion of the variance, accounting for 58.32%. This factor is strongly loaded by all six INNO variables (INNO1-6), suggesting a comprehensive and overarching construct related to overall innovation.

The interpretation of this single factor implies that the data captures various aspects of innovation that are highly correlated and challenging to differentiate statistically. The findings suggest a unifying theme across the INNO variables, indicating that they collectively contribute to a broader and cohesive concept of innovation. This insight can be valuable for researchers and practitioners seeking to understand and measure innovation within the context of the analyzed dataset.

5.4.3. Factor Analysis on Dependent Variable

Organizational performance consists of several structures or variables: new services provided, optimal use of resources, diversity of scientific programs and disciplines, high-quality services, free services to the community, market share, customer retention, and return on investment. These variables were composed of several items. Table 11 shows KMO and Bartlett's test values for organizational performance.

Table 11: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.872
Bartlett's Test of Sphericity	**Approx. Chi-Square**	918.707
	Df	28
	Sig.	.000

The statistical analysis of the data involves key measures and tests to assess the appropriateness of conducting factor analysis. The KMO Measure of Sampling Adequacy yields a value of 0.872, which is deemed "good." This suggests that the sample size is sufficient for factor analysis. Additionally,

Bartlett's Test of Sphericity is important ($p < 0.05$). with an approximate chi-square value of 918.707 and 28 degrees of freedom. This significance indicates that there are important correlations among the variables, supporting the decision to proceed with factor analysis. Table 12 shows the Total Variance Explained.

Table 12: Total Variance Explained

Extraction Sums of Squared Loadings		
Total	**% Of Variance**	**Cumulative %**
3.688	46.097	46.097

Moving to the results of the factor analysis, the Total Variance Explained indicates that only one factor was extracted, explaining 46.097% of the variance in the data, as shown in Table 12. The factor, represented by variables OP1, OP2, OP3, OP4, OP5, OP6, OP7, and OP9, has substantial loadings. The interpretation suggests that there is a single underlying factor influencing these variables. Researchers should carefully consider the context and meaning of these variables in their specific research domain to understand the conceptual representation of this identified factor, which accounts for an important portion of the observed variance (46.097%). Item OP8 was excluded because it did not share variance with other items.

5.5. Descriptive Statistics

Descriptive statistics such as standard deviation and the mean and were examined for all study measures. All elements were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

- Organizational Performance: The overall mean score for organizational performance was 3.807, with an SD of 0.624. This indicates a positive perception of organizational performance at the university among the respondents.
- IT infrastructure: The overall mean score for IT infrastructure was 3.676, with an SD of 0.782.
- BI Staff Experience: The overall mean score of BI Staff Experience was 3.594 with an SD of 0.699. This indicates a positive perception of the BI Staff Experience at the university among the respondents.

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- Top Management Support: The overall mean score of Top management support was 3.361 with an SD of 0.909. This indicates a positive perception of the Top management support at the university among the respondents.
- Dynamic Capabilities: The overall mean score of dynamic capabilities was 3.635, with an SD of 0.794. This indicates a positive perception of the dynamic capabilities at the university among the respondents.
- Innovation: The overall mean score for innovation was 3.562 with an SD of 0.830. This indicates a positive perception of the innovation at the university among the respondents.

Table 13 shows descriptive statistics for study variables.

Table 13: Descriptive statistics for study variables

Variable	N	Mean	SD	Percent
Organizational Performance	276	3.807	0.624	76.1%
IT Infrastructure	276	3.676	0.782	73.5%
BI Staff Experience	276	3.594	0.699	71.9%
Top Management Support	276	3.361	0.909	67.2%
Dynamic Capabilities	276	3.635	0.794	72.7%
Innovation	276	3.562	0.830	71.2%

5.6. Regression Analysis

Table 14 shows that BI staff Experience, IT infrastructure, and Top management support accounts for 57.2% of the variance in the dynamic capabilities (Adj R^2=0.572). Adding to that, dynamic capabilities account for 58.3% of the variance in the Innovation (R^2=0.583). finally, Innovation explains 49% of the variance in the organizational performance R^2=0.490). The high R-squared values across all stages imply a cascade effect. In other words, improvements in BI staff experience, IT infrastructure, and Top management support lead to better Dynamic Capabilities, which then translates to enhanced Inno and influences Organizational Performance. Overall, these results suggest strong explanatory and predicative power in explaining the relationship between the study variables. In summary, the information suggests that the regression models fit the data well, the predictors have varying levels of importance, and the serial mediation process is supported.

Table 14: Model Summary

Variable	R^2	Adj R^2
Dynamic capabilities	0.577	0.572
Innovation	0.583	
Organizational performance	0.490	

5.7. Hypothesis Testing

Given Table 15, the relationship between IT Infrastructure and the of Dynamic Capabilities is not statistically important (B = 0.061, t = 0.932, p = 0.352). Therefore, this hypothesis is not supported. there is an important positive relationship (B = 0.252, t = 2.988, p = 0.003) between BI staff experience and the of Dynamic Capabilities. Thus, this hypothesis is supported. In addition, there is an important positive relationship (B = 0.461, t = 5.694, p = 0.000) between Top Management Support and the of Dynamic Capabilities. this hypothesis is supported. Furthermore, there is an important positive relationship (B = 0.804, t = 20.750, p = 0.000) between Dynamic Capabilities and the level of Innovation. this hypothesis is supported. Moreover, there is an important positive relationship (B = 0.526, t = 13.662, p = 0.000) between Innovation and Organizational Performance. this hypothesis is supported.

Table 15: Hypotheses testing

Path	B	SE	T	p
IT Infrastructure → Dynamic Capabilities	0.061	0.065	0.932	0.353
BI Staff Experience → Dynamic Capabilities	0.252	0.084	2.988	0.003
Top Management Support → Dynamic Capabilities	0.461	0.081	5.694	0.000
Dynamic Capabilities → Innovation	0.804	0.039	20.750	0.000
Innovation → Organizational Performance	0.526	0.039	13.662	0.000

H6: Dynamic capabilities and innovation mediates serially the relationship between Top management support and organizational performance..

The findings in Table 16 showed that there is an important positive relationship (B = 0.195, t = 5.401, p = 0.000) between Top management support and organizational performance through the mediation of dynamic

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capabilities and innovation. therefore, this hypothesis is supported. this positive relationship suggests that strong top management support leads to the development of dynamic capabilities in the organization.

H7: Dynamic capabilities and innovation mediates serially the relationship between IT infrastructure and organizational performance.

The findings in Table 16 showed that the relationship between its infrastructure and organizational performance through the through the mediation of dynamic capabilities and innovation is not statistically important (B = 0.026, t = 0.920, p = 0.358). Therefore, this hypothesis is not supported. While IT infrastructure is valuable assets for achieving better performance, the impact on organizational performance may be indirect and through other mechanisms that are not captured by the study model.

H8: Dynamic capabilities and innovation mediates serially the relationship between BI&A staff experience and organizational performance.

The findings in Table 16 showed that there is an important positive relationship (B = 0.106, t = 2.808, p = 0.005) between BI staff experience and organizational performance through the mediation of dynamic capabilities and innovation. Therefore, this hypothesis is supported. This finding aligns with Human Capital Theory. Experienced BI staff possesses the knowledge and skills necessary to analyze data, identify opportunities, and develop novel solutions, contributing to dynamic capabilities and innovation. This, in turn, leads to improved organizational performance.

Table 16: Serial mediation hypotheses testing

Path	B	SE	T	p
Top Management Support → Dynamic Capabilities → Innovation Organizational Performance	0.195	0.036	5.401	0.000
IT Infrastructure → Dynamic Capabilities → Innovation → Organizational Performance	0.026	0.028	0.920	0.358
BI Staff Experience → Dynamic Capabilities → Innovation → Organizational Performance	0.106	0.038	2.808	0.005

Table 17 summarized the hypothesis testing results.

Table 17: Summary of the hypothesis testing result

Hypotheses	Statement	Result
H1	IT infrastructure has a positive impact on dynamic capabilities (sensing, orchestrating, value capturing, and transforming the organization).	Not supported
H2	The BI&A staff experience has a positive impact on dynamic capabilities.	Supported
H3	Top management support has a positive impact on dynamic capabilities.	Supported
H4	Dynamic capabilities have a direct impact on innovation.	Supported
H5	Innovation has a direct effect on organizational performance.	Supported
H6	Dynamic capabilities and innovation mediate serially the relationship between top management support and organizational performance.	Supported
H7	Dynamic capabilities and innovation mediate serially the relationship between IT Infrastructure and organizational performance.	Not supported
H8	Dynamic capabilities and innovation mediates serially the relationship between BI&A staff experience and organizational performance.	Supported

The following Figure 3 shows the Structural Model.

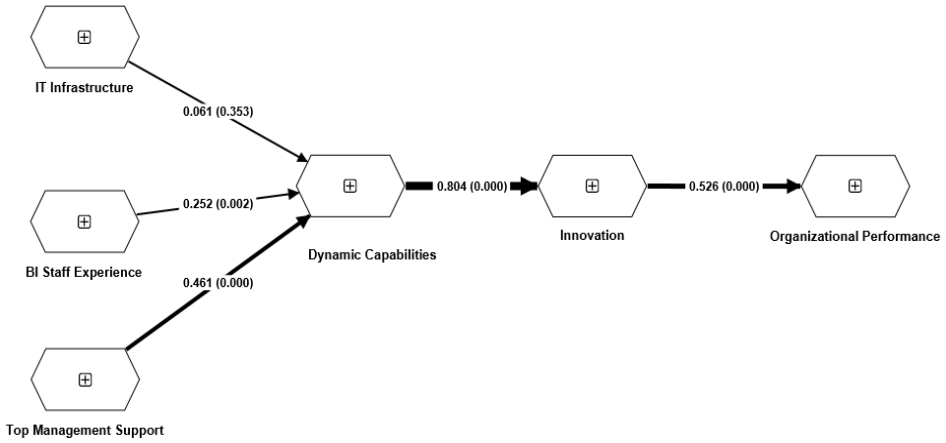

Figure 3: Structural Model

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6. Discussion

IT infrastructure was introduced as a key factor that impacts organizational performance through dynamic capabilities and innovation. as a study [3, 9] confirmed that IT infrastructure is an important factor that impacts organizational performance. However, the result of analyzing this variable in this study did not agree with previous studies. This study attributed this to several reasons, including the lack of a specialized IT infrastructure, which often consists of data storage, management, and analysis tools, or that the systems used are not flexible enough to meet changing business needs, as well as the inability of the system to integrate data from different data sources, or that the impact on organizational performance may be indirect and mediated by other mechanisms not mentioned in the study model.

As for BI&A staff experience, it was found to have a positive impact on dynamic capabilities, which in turn affects organizational performance. The results of this study are consistent with the study [9], which confirmed that BI&A staff experience has a positive impact on organizational performance through dynamic capabilities.

This study also found that top management support is an important factor that affects organizational performance through dynamic capabilities and innovation. This result is consistent with the study of [3, 9] which confirmed that top management support affects organizational performance because it is responsible for the adoption and use of business intelligence.

Finally, this study also found that dynamic capabilities affect organizational performance through innovation. This is consistent with the study of [3] who proved that dynamic capabilities do not directly affect organizational performance as the relationship is mediated by organizational or environmental factors. It is also consistent with the study of [9] who considered innovation as an intermediary factor between dynamic capabilities and organizational performance. This proves that when universities evaluate competitors' services, analyze internal and external opportunities and threats, and identify shortcomings in their operations, they promote innovation. This helps them identify and respond to technological trends, and identify emerging opportunities and market requirements. This makes it easier for them to quickly adapt their operations to competitive changes and helps

them maintain their competitive advantage. That is; by developing dynamic capabilities, organizations can support innovation to maintain competitive advantage in dynamic environments.

7. Recommendations

The study's findings indicated that dynamic capabilities and innovation, as well as BI factors such as BI&A staff experience and top management support, importantly affect organizational performance in Yemeni private universities. Based on these findings, this study presents a set of recommendations for stakeholders in these universities:

- This study recommended that Yemeni private universities focus more on BI because it represents a strategic investment for organizations. It sought to achieve a competitive advantage by providing financial resources and administrative support to develop strategies based on BI systems and the use of the latest technologies.
- Enterprises must consider BI&A as a firm and critical asset for competitive success and not merely a technical asset.
- Strengthen dynamic capacities by continuously surveying external and internal working environments, boldly selecting new opportunities, and constantly renewing their organizational design.
- Investing in R&D and innovation projects so that enterprises can enhance their competitive performance.
- Interest in training workers in BI&A systems and increasing their knowledge and expertise.
- Although the results of this study have demonstrated that IT infrastructure does not affect organizational performance, it is recommended to pay attention to its development and keep abreast of everything new, using technologies such as data warehouses, data mining, dashboards, and performance management software, as IT infrastructure can extract value from its BI&A systems.

8. Conclusions

This study aimed to examine the impact of BI&A on organizational performance from the perspective of dynamic capabilities and innovation in Yemeni private universities.

The study proposed a model with three independent variables: IT infrastructure, BI&A staff experience, and top management support. The mediating variables are dynamic capabilities and innovation, and the dependent variable is organizational performance.

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Data were collected through field-distributed questionnaires for five Yemeni private universities: the University of Science and Technology, Queen Arwa University, Al-Nasser University, Al-Razi University, and Al-Rasheed University.

Data was analyzed using several types of analysis, such as demographic analysis, reliability assessment, correlation analysis, regression analysis, and factor analysis.

The study showed the model's serial relationship and that all variables had a positive impact on organizational performance, except IT infrastructure. The results also showed that dynamic capacities and innovation have a mediating effect on independent variables and the dependent variable.

These results offer valuable theoretical contributions by enhancing the understanding of how BI&A can be integrated with dynamic capabilities and innovation to improve institutional outcomes.

Practically, the study offers actionable insights for higher education leaders, particularly in private universities, highlighting the importance of investing in Business Intelligence and Analytics (BI&A), cultivating a culture of innovation, and securing strong managerial support.

Based on the findings, it is recommended that Yemeni private universities prioritize the development of human capital in BI&A, strengthen dynamic capabilities, and promote top-level commitment to innovation-driven strategies. Future research could explore these relationships in different educational contexts, adopt longitudinal designs, or incorporate qualitative approaches to gain deeper insights into the mechanisms underlying BI&A effectiveness.

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