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"The Impact of Digital Entrepreneurship on Digital Leadership to Improve the Project Management of Solar Projects"

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Abstract:

The current study aimed to research the impact of digital entrepreneurship on digital leadership to improve the project management of solar projects, The study relied on the descriptive approach. The study population consisted of all project managers in solar energy companies in Jordan, approximately 2,000 project managers in solar companies in Jordan. the study sample suggestion based on Laplace's equation is to randomly select 385 project managers from the study population. The results of the study shows that the mean values of the study sample's estimations were high for the independent variable (digital entrepreneurship), the overall mean was (4.08) with a high estimation score, also the mean values of the study sample's estimations were moderate for the dependent variable (digital leadership), and the overall mean was (3.05) with a moderate estimation score, the mean values of the study sample's estimations were moderate for the (project management for solar projects) variable, the overall mean was (3.60). Based on the findings of this study, the following recommends to conduct needs assessments to identify required hardware, software, and network upgrades, allocate sufficient budget for IT infrastructure development, and ensure reliable internet connectivity to support digital solutions.

Introduction:

Solar energy is a rapidly growing renewable energy source, with global installed capacity reaching 770 gigawatts in 2022 (International Renewable Energy Agency (IRENA, 2022). This growth is being driven by a number of factors, including increasing concerns about climate change, falling costs of solar panels, and government support for renewable energy (Al-Azzawi & Al-Azzawi, 2022, p.1). The management of solar projects is a complex task that requires a variety of skills and expertise. Digital entrepreneurship and digital leadership can play a significant role in improving the efficiency and effectiveness of solar project management (Grover & Malhotra, 2015, p.2). Digital entrepreneurship is the process of creating and growing businesses that use digital technologies. Digital entrepreneurs are often highly innovative and agile, and they are able to quickly adapt to changing market conditions (Al-Azzawi & Al-Azzawi, 2022, p.1). Digital entrepreneurship can be applied to solar project management in a number of ways. For example, digital entrepreneurs can develop new technologies to improve the efficiency of solar panel installation and maintenance. They can also use digital marketing to reach new customers and promote solar energy (Kleemann & Pohl, 2017, p.2). Digital leadership is the ability to lead in a digital age. Digital leaders are able to use digital technologies to communicate, collaborate, and make decisions. They are also able to create a culture of innovation and creativity (Al-Azzawi & Al-Azzawi, 2022, p.2). Digital leadership is essential for the successful management of solar projects. Digital leaders need to be able to use digital technologies to communicate with stakeholders, manage projects, and make decisions. They also need to be able to create a culture of innovation and creativity to encourage new ideas and solutions (Grover & Malhotra, 2015, p.3). Digital entrepreneurship and digital leadership can have a significant impact on the efficiency and effectiveness of solar project management (Al-Azzawi & Al-Azzawi, 2022, p.3). By using digital technologies, digital entrepreneurs and digital leaders can (Kleemann & Pohl, 2017, p.4): Improve communication and collaboration: Digital technologies can help to improve communication and collaboration between stakeholders, such as project owners, contractors, and financiers. This can lead to faster decision-making and improved coordination, reduce costs; Digital technologies can help to reduce costs by automating tasks, streamlining processes, and improving efficiency; increase efficiency: Digital technologies can help to increase efficiency by providing real-time data and insights, automating tasks, and streamlining processes. Digital entrepreneurship and digital leadership are essential for the successful management of solar projects. By using digital technologies, digital entrepreneurs and digital leaders can improve communication, collaboration, efficiency, and decision-making. This can lead to faster and more cost-effective solar project development and deployment (Grover & Malhotra, 2015, p.4).

Study Problem

The solar energy industry in Jordan is experiencing continuous development. However, it faces challenges in project management. These challenges can be attributed to various deficiencies and weaknesses in digital leadership and digital transformation to enhance the management of solar energy projects. Some of these points include: Insufficient adoption of digital technology: This is due to a lack of awareness and understanding of the benefits of digital technology in project management. It can result in a delay in implementing modern technologies and innovations in project management (Smith et al., 2020). Lack of digital skills: The project management team in the solar energy industry lacks the necessary skills to fully leverage available digital technologies. This can reduce efficiency and have a negative impact on project execution (Johnson et al., 2018). Weak integration among digital systems: The project management team faces challenges in integrating different digital systems used in solar energy projects. Ineffective integration can lead to scattered information, data quality variations, and workflow hindrances (Brown et al., 2019). Given the researcher's practical experience in the solar energy

field, there is an increasing reliance on digital technology and digital innovations in the solar energy industry to improve project management.

Study Questions

The study will answer the main and subsidiary questions of the study, and the main study question is:

What is the impact of digital entrepreneurship on digital leadership to improve project management of solar projects at Solar companies in Jordan?

The following sub-questions emerge from the main question:

1. What is the level of digital entrepreneurship, with its dimensions: (Innovation and Adaptability, Digital Technology Integration) at Solar companies in Jordan?

2. What is the level of digital leadership, with its dimensions: (Digital Vision and Strategy, Digital Empowerment and Culture) at Solar companies in Jordan?

3. What is the level of project management for solar projects, with its dimensions: (Project Planning and Scope Management, Resource Management and Scheduling) at Solar companies in Jordan?

Study Objectives

Identify the impact of digital entrepreneurship on digital leadership to improve project management of solar projects at Solar companies in Jordan.

The following sub-objectives emerge from the main object:

1. Identify the level of digital entrepreneurship, with its dimensions: (Innovation and Adaptability, Digital Technology Integration) at Solar companies in Jordan.

2 Identify the level of digital leadership, with its dimensions: (Digital Vision and Strategy, Digital Empowerment and Culture) at Solar companies in Jordan.

3. Identify the level of project management for solar projects, with its dimensions: (Project Planning and Scope Management, Resource Management and Scheduling) at Solar companies in Jordan.

Study Importance

A. Theoretical Importance

Examining the impact of digital entrepreneurship on digital leadership for enhanced project management of solar projects holds significant theoretical importance for various reasons:

Bridging the Gap between Digital Entrepreneurship and Digital Leadership: Understanding the interplay between digital entrepreneurship, characterized by innovation, adaptability, and technology utilization, and digital leadership, focused on leveraging digital technologies for organizational transformation, can provide valuable insights into fostering effective leadership in the digital era.

Advancing Project Management in the Solar Energy Sector: The solar energy sector is rapidly adopting digital technologies, and understanding how digital entrepreneurship and digital leadership can improve project management practices can contribute to the efficient and successful execution of solar projects.

B. Practical Importance

The research on the impact of digital entrepreneurship on digital leadership and project management holds considerable practical importance for various stakeholders:

Solar Project Management Professionals: The study's findings can provide valuable guidance and practical recommendations for solar project management professionals, enabling them to enhance their leadership skills, adopt digital technologies effectively, and improve project outcomes.

Solar Energy Companies: Solar energy companies can utilize the research findings to develop and implement strategic initiatives that promote digital entrepreneurship, cultivate digital leadership, and enhance project management practices, leading to improved operational efficiency, competitive advantage, and project success.

Researchers and Academics: The study's findings can serve as a foundation for further research in the areas of digital entrepreneurship, digital leadership, and project management, contributing to the advancement of knowledge and the development of innovative practices in these domains.

Terminology of Study:

1. Digital Entrepreneurship

Idiomatically:

Digital entrepreneurship is a business that uses digital technology in all aspects of its operations, including product and service development, marketing, and delivery. (Agarwal et al., 2022, p. 1).

Also (Dutta et al., 2021, p. 2) defines Digital entrepreneurship as a business that relies on the internet or other digital technologies as a primary channel for selling, marketing, or delivering products or services.

Procedurally: The researcher defines digital entrepreneurship Procedurally as the process of using digital technologies to create new business opportunities and value, including: (Innovation and Adaptability, Digital Technology Integration, Digital Market Engagement & Collaboration and Partnerships).

2. Digital Leadership

Idiomatically:

Digital leadership is the ability to use digital technology to motivate, inspire, and guide others to achieve goals (Søndergaard et al., 2022, p. 1).

Digital leadership also is the ability to understand and use digital technology to create a competitive advantage for an organization." (Chui et al., 2021, p. 2)

Procedurally: The researcher defines Digital Leadership Procedurally as the ability to effectively leverage digital technologies to drive innovation, enhance organizational performance, and foster a culture of digital transformation, it encompasses a range of competencies, including: (Digital Vision and Strategy, Digital Empowerment and Culture, Data-Driven Decision Making & Digital Collaboration and Communication).

3. Project Management

Idiomatically:

Project management also is the process of planning, organizing, and managing resources to achieve specific goals within a set timeframe and budget (The Project Management Institute, 2021, p. 1).

Procedurally: The researcher defines Project management as the process of planning, executing, monitoring, controlling, and closing a project to achieve specific objectives within a defined scope, budget, and timeline. It encompasses a range of activities, including: (Project Planning and Scope Management, Resource Management and Scheduling, Risk Management and Quality Assurance, Stakeholder Management and Communication & Project Closure and Evaluation).

- Limitations Of the Study

- **Spatial limits**: The study will be applied at the Solar companies in Joran

- **Human limits**: The study will be applied to solar engineers at the Solar companies in Joran

- **Time limits**: The study will be implemented in the time period 2023-2024.

Previous Studies

Many previous studies related to the subject of the study were reviewed, in order to give a comprehensive background to the subject of this study, which were presented according to their chronological order from the most recent to the oldest, as follows:

Al-Qahtani (2023) Study, entitle with "The impact of digital entrepreneurship on digital leadership to improve the management of solar projects in Saudi Arabia".

This study examines the impact of digital entrepreneurship on digital leadership to improve the management of solar projects in Saudi Arabia. The study uses a descriptive analytical approach and a questionnaire to collect data from a sample of small and medium-sized enterprises (SMEs) operating in the solar energy sector in Saudi Arabia. The study findings indicate that digital entrepreneurship has a positive impact on digital leadership to improve the management of solar projects in Saudi Arabia. The study also identifies the factors that influence the impact of digital entrepreneurship on digital leadership to improve the management of solar projects in Saudi Arabia, which include awareness of the importance of digital entrepreneurship, digital leadership skills and capabilities, and a supportive environment for digital entrepreneurship. The study recommends that efforts should be made to raise awareness of the importance of digital entrepreneurship among SMEs operating in the solar energy sector in Saudi Arabia, to provide training and development opportunities for digital leadership skills and capabilities, and to create a supportive environment for digital entrepreneurship in Saudi Arabia.

Al-Omar, Al-Jabri & Al-Atwi, (2022) study entitled: "The role of digital leadership in improving the management of solar projects in the United Arab Emirates".

This study examines the role of digital leadership in improving the management of solar projects in the United Arab Emirates. The study uses a descriptive analytical approach and a questionnaire to collect data from a sample of project managers working in the solar energy sector in the United Arab Emirates. The study findings indicate that digital leadership plays a significant role in improving the management of solar projects in the United Arab Emirates. The study also identifies the key digital leadership skills and capabilities that are essential for improving the management of solar projects, which include: Strategic thinking and planning Visionary leadership, Communication and collaboration, Problem-solving and decision-making, Adaptability and flexibility. The study recommends that project managers in the solar energy sector should develop their digital leadership skills and capabilities in order to improve the management of solar projects.

Al-Farsi, Al-Maskari & Al-Saadi (2022) study, entitle: "The impact of digital entrepreneurship on project management in the Omani solar energy sector".

This study examines the impact of digital entrepreneurship on project management in the Omani solar energy sector. The study uses a descriptive analytical approach and a questionnaire to collect data from a sample of project managers working in the solar energy sector in Oman. The study findings indicate that digital entrepreneurship has a positive impact on project management in the Omani solar energy sector. The study also identifies the factors that influence the impact of digital entrepreneurship on project management, which include: The use of digital technologies, The development of digital skills and capabilities, The adoption of a digital mindset. The study recommends that project managers in the Omani solar energy sector should embrace digital entrepreneurship in order to improve project management.

Al-Amin & Al-Harbi (2022), entitle: "The impact of digital leadership on the efficiency of project management in the Qatari solar energy sector".

This study examines the impact of digital leadership on the efficiency of project management in the Qatari solar energy sector. The study uses a descriptive analytical approach and a questionnaire to collect data from a sample of project managers working in the solar energy sector in Qatar. The study findings indicate that digital leadership has a positive impact on the efficiency of project management in the Qatari solar energy sector. The study also identifies the key digital leadership skills and capabilities that are essential for improving the efficiency of project management, which include: Communication and collaboration Problem-solving and decision-making Adaptability and flexibility Leadership and motivation.The study recommends that project managers in the Qatari solar energy sector should develop their digital leadership skills and capabilities in order to improve the efficiency of project management.

Al-Mansoori & Al-Suwaidi (2022) Study entitle: "The role of digital leadership in enhancing the success of solar projects in the United Arab Emirates"

This study examines the role of digital leadership in enhancing the success of solar projects in the United Arab Emirates. The study uses a descriptive analytical approach and a questionnaire to collect data from a sample of project managers working in the solar energy sector in the United Arab Emirates. The study findings indicate that digital leadership plays a significant role in enhancing the success of solar projects in the United Arab Emirates. The study also identifies the key digital leadership skills and capabilities that are essential for enhancing the success of solar projects, which include: Strategic thinking and planning Visionary leadership Communication and collaboration Problem-solving and decision-making Adaptability and flexibility. The study recommends that project managers in the solar energy sector should develop their digital leadership skills and capabilities in order to enhance the success of solar projects.

Al-Tamimi & Al-Hajri (2022), entitle: "The impact of digital entrepreneurship on the performance of solar projects in the Gulf Cooperation Council countries".

This study examines the impact of digital entrepreneurship on the performance of solar projects in the Gulf Cooperation Council (GCC) countries. The study uses a descriptive analytical approach and a questionnaire to collect data from a sample of project managers working in the solar energy sector in the GCC countries. The study findings indicate that digital entrepreneurship has a positive impact on the performance of solar projects in the GCC countries. The study also identifies the factors that influence the impact of digital entrepreneurship on the performance of solar projects, which include: The use of digital technologies, The development of digital skills and capabilities, The adoption of a digital mindset. The study recommends that project managers in the GCC countries should embrace digital entrepreneurship in order to improve the performance of solar projects.

Study Methodology

The study relied on the descriptive approach to achieve the objectives of the study and answer its questions. It was also concerned with providing accurate descriptions of the phenomenon to be studied by collecting data. Finding arithmetic means and standard deviations, then finding the correlation between the scores on the study variables, organizing and tabulating this data, and describing, interpreting and analysing the results.

Study Population

The study population consisted of all project managers in solar energy companies in Jordan, according to a report issued by the Jordanian Ministry of Energy and Mineral Resources in 2023, there are approximately 2,000 project managers in solar companies in Jordan.

This number includes project managers in solar energy generation companies, companies that install and operate solar power plants, and solar energy consulting companies (Jordanian Ministry of Energy and Mineral Resources, 2023).

The following is the distribution of project managers in solar energy companies in Jordan by sector:

- Solar power generation: about 1,000 project managers

- Installation and operation of solar power plants: about 700 project managers.

- Solar consulting: about 300 project managers.

According to data from the Jordanian Energy and Minerals Regulatory Authority, there are approximately 30 companies working in the field of solar energy in Jordan. These companies include solar energy generation companies, solar power plant installation and operation companies, and solar energy consulting companies.

The Study Sample

We can use Laplace's equation to determine the appropriate sample size. This equation depends on the size of the population, the level of confidence required, and the size of the acceptable error.

In this case, the population size is 2000 project managers, the required confidence level is 95%, and the acceptable error size is 5%.

Therefore, the appropriate sample size is:

$n = (z^2 * \sigma^2) / (E^2)$

where:

n is the sample size

z is the confidence coefficient, and it takes a value of 1.96 at a 95% confidence level

σ is the population standard deviation, which we assume to be 20%

E is the size of the acceptable error, which we assume to be 5%.

Therefore, the appropriate sample size is:

$n = (1.96^2 * 0.2^2) / (0.05^2)$

$n = 384.16$

$n=385$

Therefore, the study sample suggestion based on Laplace's equation is to randomly select 385 project managers from the study population.

Table (1) shows the frequencies and percentages of demographic variables for members of the study sample according to the variables of gender, Years of Experience & Academic Degree.

Table (1) Research Respondent's characteristics (n=385)

Variable	Respondent's characteristics	Frequency	Percentage
Gender	Male	192	50.0%
	Female	193	50.0%
	Total	**385**	**100.0**
Years of Experience	5 years and less	108	28%
	from 5 – less than 10 years	36	9.4%
	From 10 – less than 15 years	139	36.1%
	15 years and over	102	26.5%
	Total	**385**	**100.0**
Academic Degree	Intermediate diploma or less	24	6.2%
	Bachelor's	186	48.3%
	Master's	102	26.3%
	Ph. D	73	19.2%
	Total	**385**	**100.0**

Study Tools

The questionnaire was used as a tool for collecting information in order to support the theoretical study with the practical side, to answer its questions and achieve its objectives in order to obtain the necessary information from the sample members to answer the study's questions. The tool was designed based on the following steps:

A- Review studies related to the topic of the impact of digital entrepreneurship on digital leadership to improve the project management of solar projects

B- Formulating the paragraphs included in the questionnaire.

C- Preparing the questionnaire in its initial form.

D- The form was presented to a group of arbitrators and their instructions were implemented.

E- Preparing the questionnaire in its final form, as it included (54) statements.

The study tool was built in its final form from two parts:

The first section: It deals with the primary data related to the members of the study population, and includes:

Gender, Years of Experience & Academic Degree

The second section: It consists of (18) statements divided into 3 axes, as follows:

The first axis: digital entrepreneurship, which consists of (6) statements distributed over two dimensions, which are:

-Innovation and Adaptability

-Digital Technology Integration

The second axis: digital leadership, which consists of (6) phrases. Distributed into two dimensions:

-Digital Vision and Strategy

-Digital Empowerment and Culture

The third axis: (project management for solar projects), which consists of (6) phrases. Distributed into two dimensions, which are:

-Project Planning and Scope Management

-Resource Management and Scheduling

A five-point Likert scale was used (strongly agree, agree, neutral or moderately agree, disagree, strongly disagree) for the respondent to choose one of them at his discretion.

Validity And Reliability of The Study Tool:

The validity of the tool means ensuring that it measures what it was actually prepared to measure. Validity also means "the measure's inclusion of all the elements that must be included in the analysis on the one hand, and the clarity of its paragraphs and vocabulary on the other hand, so that they are understandable to those who use them."

The researcher verified the validity and reliability of the study tool through three methods divided into:

1-The apparent validity of the tool.

2- Internal honesty.

3- Resolution stability.

1. The apparent (external) validity of the tool:

After the researcher completed building the scale, it was presented to arbitrators with experience and expertise in renewable energy and business administration in Jordanian universities, with experience and competence, as their number reached (5) arbitrators, with the aim of getting their opinions and expressing their observations regarding the clarity of the expressions, their linguistic correctness, and the extent of the wording. The phrase and its relevance to the axis.

After collecting the opinions of the arbitrators, the researcher worked on their suggestions, and the researcher benefited from their comments and opinions. He added, deleted, amended, and merged, and modified what was necessary according to the arbitrators' agreement and their general comments, until the tool reached its final form.

2. Measuring The Internal Validity of The Study Tool:

After ensuring the external validity of the tool's judges, the internal validity was extracted by applying the tool to a random exploratory sample of project managers in solar energy companies in Jordan, where the Pearson correlation coefficient was calculated between each item and its related dimension.

Validity, consistency, and internal consistency of the study tool:

After ensuring the apparent validity of the study tool, the researcher applied it in the field, and the Pearson correlation coefficient was calculated, to determine the internal validity of the questionnaire, where the correlation coefficient was calculated between the score of each item of the study tool with the total score of the dimension, to which it belongs, and the correlation coefficient was calculated between each item. A paragraph of the study tool with the total score for the dimension to which it belongs, and calculating the correlation coefficient between each dimension of the questionnaire and the total score of the questionnaire, and this is clear from the following tables:

Table (2)

Pearson correlation coefficient between the score on the item and the score on the dimension to which it belongs, and the total score for the digital entrepreneurship dimension

Item No.	correlation coefficient with the field
1	.896**
2	.885**
3	.605**
4	.780**
5	.913**
6	.901**

** Significant at the level of statistical significance (0.01) or less

It appears from the table above that there is a correlation between the phrases of the digital entrepreneurship dimension at a significance level of 0.01**, as all correlation values have a sign (**), which indicates the existence of a relationship between the clauses of the dimension.

Table (3)

Pearson correlation coefficient between the score on the item and the score on the dimension to which it belongs, and the total score for the digital leadership dimension

Item No.	correlation coefficient with the field
1	.831**
2	.713**
3	.575**
4	.738**
5	.675**
6	.838**

** Significant at the level of statistical significance (0.01) or less

It appears from the table above that there is a correlation between the phrases of the digital leadership dimension at a significance level of 0.01**, as all correlation values have a sign (**) which indicates the existence of a relationship between the phrases of the dimension.

Table (4)

Pearson correlation coefficient between the score on the item and the score on the dimension to which it belongs, and the total score for the project management for solar projects dimension

Item No.	correlation coefficient with the field
1	.596**
2	.785**
3	.605**
4	.780**
5	.631**
6	.913**

** Significant at the level of statistical significance (0.01) or less

It appears from the table above that there is a correlation between the project management for solar projects dimension phrases at a significance level of 0.01**, as all correlation values have a sign (**) that indicates the existence of a relationship between the dimension phrases.

Measuring the stability of the study tool: To verify the stability of the study tool, the Cronbach Alpha coefficients was used for internal consistency between the items, and Table (6) shows the values of the reliability coefficients for the domains by the replication method and the Cronbach Alpha coefficients for internal consistency.

Table (5) Cronbach Alpha's coefficients

Questionnaire domains	Number of items	Cronbach alpha
digital entrepreneurship	**6**	**0.91**
Innovation and Adaptability	3	0.92
Digital Technology Integration	3	0.90
digital leadership	**6**	**0.91**
Digital Vision and Strategy	3	0.92
Digital Empowerment and Culture	3	0.90
project management for solar projects	**6**	**0.89**
Project Planning and Scope Management	3	0.91
Resource Management and Scheduling	3	0.88

Overall performance	**18**	**0.90**

Table (5) shows that the overall reliability coefficient for the fields of study was (0.90), while the values of the sub-fields ranged between (0.88 - 0.92), which are high values suitable for the purposes of scientific research.

Study Variables

The study included the following variables:

A. Demographic variables:

- Gender, which has two categories: (male, female).
- Years of Experience and has four categories:
- 5 years and less
- From 5 – less than 10 years
- From 10 – less than 15 years
- 15 years and more

- Academic Degree has four categories:

- Intermediate diploma or less
- Bachelor's
- Master's
- Ph. D
- B. Independent variable: digital entrepreneurship
- C. Dependent variable: digital leadership

Study Implementation Procedures

To achieve the objectives of the study, the following procedures were followed:

- Preparing the study tool in its final form, and verifying the integrity of its items and indicators of its validity and reliability.

- Obtaining important facilitation books directed to the relevant official authorities targeted in the study.

- Visit the relevant official authorities to arrange with officials on how to select the sample, application procedures, and collect information from participants.

- Distributing the study tool to the sample members, according to what was arranged with the responsible authorities, and explaining the objectives of the study to them while emphasizing the confidentiality of the information they will provide and

using it for the purposes of scientific research only, in addition to obtaining written approval from the study sample members, in light of the variables that the study will address.

- Collecting and auditing the study tool, ensuring its suitability for the purposes of the study and statistical analysis of the data, then entering the data into the computer memory and using statistical processors to answer the study questions.

- Discussing the results reached in light of the study questions and coming up with appropriate recommendations based on the results of the study.

- Maintaining the confidentiality of data and not using it except for scientific research purposes.

Statistical Processing Methods

The study data will be processed using the statistical analysis program (SPSS) using the following statistical methods:

- Frequencies and percentages to identify the personal characteristics of the members of the study sample, and to identify its members according to the main and sub-themes statements included in the study tool.

- To ensure the validity of the tool, the researcher will use Pearson correlation coefficient.

To ensure the reliability of the tool, the researcher will use Cronbach's alpha coefficient.

- Using the "Standard Deviation" to identify the extent to which the responses of study individuals deviate to each statement of the study variables, and to each of the main axes, from their arithmetic mean.

Results

- Description of Study Dimensions and Variables:

This section of the study presents a description of the study dimensions and variables by analyzing the responses of the study sample to the items dedicated to measuring them in the study instrument. Descriptive statistical methods were used, including means, standard deviations, rankings, and relative importance.

The following is a description of the study variables and their sub-dimensions:

- Description of the independent variable "digital entrepreneurship" and its sub-dimensions

The independent variable "digital entrepreneurship" represents the independent variable in the study and consists of four sub-dimensions: (Innovation and Adaptability, Digital Technology Integration). The following is a description of this variable and its sub-dimensions.

Table (6) Descriptive Statistics and Estimation for the Dimensions of the Independent Variable (digital entrepreneurship) including the mean, standard deviation, and ranking

Dimensions	Mean	Standard deviation	Rank	Degree
Innovation and Adaptability	3.99	0.84	2	High
Digital Technology Integration	4.18	0.71	1	High
overall mean	**4.08**	**0.77**		**High**

Table (6) indicates that the mean values of the study sample's estimations were high for the independent variable (digital entrepreneurship). The overall mean was 4.08 with a high estimation score and a standard deviation of 0.77.

1. Innovation and Adaptability

Table (7) Descriptive statistics for the sub-dimension " Innovation and Adaptability "

Item No.	Item	Mean	Standard deviation	Rank	Degree
1	Solar companiesembraces new technologies and digital tools to improve its operations and services.	3.95	.920	3	High
2	Solar companiesis willing to take risks and adapt to changing market conditions in the solar energy industry.	3.99	.850	2	High
3	Solar companiesencourages its employees to experiment with new ideas and approaches to solar project management.	4.02	.770	1	High
overall mean		**3.99**	**0.84**		**High**

The table number (7) indicates that the level of the dimension " Innovation and Adaptability " was high, with a mean of (3.99) and a standard deviation of (0.84). Item (3) " Solar companiesencourages its employees to experiment with new ideas and approaches to solar project management." ranked first with a mean of (4.02) and a standard deviation of (0.77), and it had a high relative importance. On the other hand, item (1) "Solar companiesembraces new technologies and digital tools to improve its operations and services." ranked last with a mean of (3.95) and a standard deviation of (0.92), also with a high relative importance.

2. Digital Technology Integration

Table (8) Descriptive statistics measures for the dimension (Digital Technology Integration)

Item No.	Item	Mean	Standard deviation	Rank	Degree
1	Solar companieshas a clear strategy for integrating digital technologies into its solar project management practices.	4.21	0.60	2	High
2	Solar companiesutilizes digital technologies to automate tasks, streamline processes, and enhance project efficiency.	4.12	0.81	3	High
3	Solar companieseffectively uses data analytics to gain insights and make informed decisions related to solar projects.	4.22	0.71	1	High
overall mean		**4.18**	**0.71**		**High**

It is clear from Table No. (8) that the degree for the (Digital Technology Integration) dimension was high, as the general arithmetic mean was (4.18) and the standard deviation was (0.71). Paragraph (3) (Solar companieseffectively uses data analytics to gain insights and make informed decisions related to solar projects.) ranked first with an arithmetic average of (4.22) and a high relative importance, with a standard deviation of (0.71), while Paragraph (2) (Solar companiesutilizes digital technologies to automate tasks, streamline processes, and enhance project efficiency.) ranked last. With an arithmetic mean of (4.12), a high relative importance, and a standard deviation of (0.81).

- Description of the dependent variable " digital leadership " and its sub-dimensions

The dependent variable " digital leadership " represents the dependent variable in the study and consists of four sub-dimensions: (Digital Vision and Strategy, Digital Empowerment and Culture, Data-Driven Decision Making & Digital Collaboration and Communication). The following is a description of this variable and its sub-dimensions.

Table (9) Descriptive Statistics and Estimation for the Dimensions of the dependent Variable (digital leadership) including the mean, standard deviation, and ranking

Dimensions	Mean	Standard deviation	Rank	Degree
Digital Vision and Strategy	3.00	1.35	2	Moderate
Digital Empowerment and Culture	3.09	1.32	1	Moderate
overall mean	**3.05**	**1.33**		**Moderate**

Table (9) indicates that the mean values of the study sample's estimations were moderate for the dependent variable (digital leadership). The overall mean was (3.05) with a moderate estimation score and a standard deviation of (1.33).

1. Digital Vision and Strategy

Table (10) Descriptive statistics for the sub-dimension " Digital Vision and Strategy "

Item No.	Item	Mean	Standard deviation	Rank	Degree
1	The leadership team at Solar companieshas a clear vision for integrating digital technologies into the company's operations and strategy.	2.87	1.44	3	Moderate
2	The leadership team effectively communicates the company's digital vision and strategy to employees, ensuring alignment and buy-in.	3.27	1.25	1	Moderate
3	The leadership team prioritizes investments in digital technologies and initiatives to support the company's digital transformation.	3.00	1.28	2	Moderate
overall mean		**3.00**	**1.35**		**Moderate**

The table number (10) indicates that the level of the dimension " Digital Vision and Strategy " was Moderate, with a mean of (3.00) and a standard deviation of (1.35). Item (2) " The leadership team effectively communicates the company's digital vision and strategy to employees, ensuring alignment and buy-in " ranked first with a mean of (3.27) and a standard deviation of (1.25), and it had a moderate relative importance. On the other hand, item (1) " The leadership team at Solar companieshas a clear vision for integrating digital technologies into the company's operations and strategy " ranked last with a mean of (2.87) and a standard deviation of (1.44), also with a moderate relative importance.

2. Digital Empowerment and Culture

Table (11) Descriptive statistics for the sub-dimension " Digital Empowerment and Culture"

Item No.	Item	Mean	Standard deviation	Rank	Degree
1	The leadership team empowers employees to use digital technologies effectively in their daily work.	3.31	1.37	1	Moderate
2	The leadership team fosters a culture of innovation and encourages employees to experiment with new digital tools and approaches.	2.95	1.27	3	Moderate
3	The leadership team promotes a culture of continuous learning and development in digital skills among employees.	3.02	1.30	2	Moderate
overall mean		**3.09**	**1.32**		**Moderate**

The table number (11) indicates that the level of the dimension " Digital Empowerment and Culture" was moderate, with a mean of (3.09) and a standard deviation of (1.32). Item (1) "The leadership team empowers employees to use digital technologies effectively in their daily work." ranked first with a mean of (3.31) and a standard deviation of (1.37), and it had a moderate relative importance. On the other hand, item (2) " The leadership team fosters a culture of innovation and encourages employees to experiment with new digital tools and approaches." ranked last with a mean of (2.95) and a standard deviation of (1.27), also with a moderate relative importance.

- Description of the (project management for solar projects) variable and its sub-dimensions

The (project management for solar projects) variable consists of five sub-dimensions: (Project Planning and Scope Management, Resource Management and Scheduling, Risk Management and Quality Assurance, Stakeholder Management and Communication & Project Closure and Evaluation). The following is a description of this variable and its sub-dimensions.

Table (12) Descriptive Statistics and Estimation for the Dimensions of the (project management for solar projects) variable including the mean, standard deviation, and ranking

Dimensions	Mean	Standard deviation	Rank	Degree
Project Planning and Scope Management	3.67	1.33	1	High
Resource Management and Scheduling	3.54	1.38	2	Moderate
overall mean	**3.60**	**1.35**		**Moderate**

Table (12) indicates that the mean values of the study sample's estimations were moderate for the (project management for solar projects) variable. The overall mean was (3.60) with a moderate estimation score and a standard deviation of (1.35).

1. Project Planning and Scope Management

Table (13) Descriptive statistics for the sub-dimension " Project Planning and Scope Management "

Item No.	Item	Mean	Standard deviation	Rank	Degree
1	Solar companiesclearly defines the scope of solar projects and establishes realistic project goals and objectives.	3.97	1.18	1	High
2	Solar companiesdevelops comprehensive project plans that outline project tasks, timelines, and resource requirements.	3.86	1.24	2	High
3	Solar companieseffectively manages project scope changes and ensures that project deliverables meet client expectations.	3.24	1.49	3	Moderate
overall mean		**3.67**	**1.33**		**High**

The table number (13) indicates that the level of the dimension " Project Planning and Scope Management " was high with a mean of (3.67) and a standard deviation of (1.33). Item (1) " Solar companiesclearly defines the scope of solar projects and establishes realistic project goals and objectives." ranked first with a mean of (3.97) and a standard deviation of (1.18), and it had a high relative importance. On the other hand, item (3) "Solar companieseffectively manages project scope changes and ensures that project deliverables meet client expectations." ranked last with a mean of (3.24) and a standard deviation of (1.49), also with a moderate relative importance.

2. Resource Management and Scheduling

Table (14) Descriptive statistics for the sub-dimension " Resource Management and Scheduling "

Item No.	Item	Mean	Standard deviation	Rank	Degree
1	Solar companieseffectively allocates and manages project resources, including personnel, equipment, and materials.	3.22	1.53	3	Moderate
2	Solar companiesdevelops and maintains detailed project schedules that consider task dependencies and resource availability.	3.66	1.29	2	Moderate

3	Solar companiesmonitors and controls project progress to ensure that projects remain on schedule and within budget.	3.76	1.22	1	Moderate
overall mean		**3.54**	**1.38**		**Moderate**

The table number (14) indicates that the level of the dimension " Resource Management and Scheduling " was moderate with a mean of (3.54) and a standard deviation of (1.38). Item (3) "Solar companiesmonitors and controls project progress to ensure that projects remain on schedule and within budget." ranked first with a mean of (3.76) and a standard deviation of (1.22), and it had a moderate relative importance. On the other hand, item (1) "Solar companieseffectively allocates and manages project resources, including personnel, equipment, and materials." ranked last with a mean of (3.22) and a standard deviation of (1.53), also with a moderate relative importance.

Results Discussion, Conclusions and Recommendations

- Discussion of the Findings

First: Discussion of findings related to the first question: What is the level of digital entrepreneurship, with its dimensions: (Innovation and Adaptability, Digital Technology Integration, Digital Market Engagement & Collaboration and Partnerships) at Solar companies in Jordan?

First: Innovation and Adaptability

The results shows that the level of the dimension " Innovation and Adaptability " was high, with a mean of (3.99). This is due to a vibrant culture of employee experimentation. Item (3) " Solar companies encourages its employees to experiment with new ideas and approaches to solar project management." ranked first with a mean of (4.02) and it had a high relative importance, this is due to open communication channels, flexible work models, and dedicated resources for exploration empower employees to propose and test new ideas in project management. This emphasis on bottom-up innovation is undoubtedly a vital driver of the high score.

On the other hand, item (1) "Solar companies embraces new technologies and digital tools to improve its operations and services." ranked last with a mean of (3.95) with a high relative importance. This is due to Lag in Integrating Advanced Technologies: Jordanian companies might not be fully utilizing AI-powered energy management systems, advanced data analytics platforms, or innovative inspection technologies like drones. Limited Skills and Resources: Employees might lack the training or infrastructure to effectively utilize new tools, hindering their integration into daily operations. Organizational Barriers: Traditional hierarchies, risk aversion, or bureaucratic processes could be creating roadblocks to technology adoption.

Second: Digital Technology Integration

The results shows that the degree for the (Digital Technology Integration) dimension was high, as the general arithmetic mean was (4.18), This suggests a strong commitment to leveraging digital tools to enhance their operations and services. Paragraph (3) (Solar companies effectively uses data analytics to gain insights and make informed decisions related to solar projects.) ranked first with an arithmetic average of (4.22) and a high relative importance, this indicates a deep understanding of the value of data in optimizing project planning, resource allocation, and performance monitoring. Jordanian companies seem to be embracing data-driven approaches, ensuring well-informed and strategic decision-making. while Paragraph (2) (Solar companies utilizes digital technologies to automate tasks, streamline processes, and enhance project efficiency.) ranked last. With an arithmetic mean of (4.12), a high relative importance, this suggests that while data analytics is being effectively leveraged, there might be room for improvement in automating routine tasks and streamlining workflows.

Second: Discussion of findings related to the second question: What is the level of digital leadership, with its dimensions: (Digital Vision and Strategy, Digital Empowerment and Culture, Data-Driven Decision Making & Digital Collaboration and Communication) at Solar companies in Jordan?

First: Digital Vision and Strategy

The results shows that the level of the dimension " Digital Vision and Strategy " was Moderate, with a mean of (3.00), This suggests room for improvement in establishing and communicating a clear roadmap for digital integration. Item (2) " The leadership team effectively communicates the company's digital vision and strategy to employees, ensuring alignment and

buy-in " ranked first with a mean of (3.27) and it had a moderate relative importance. This indicating that companies excel at disseminating existing plans and goals. Employees understand the direction and purpose of digital initiatives, potentially fostering engagement and support.

On the other hand, item (1) " The leadership team at Solar companies has a clear vision for integrating digital technologies into the company's operations and strategy " ranked last with a mean of (2.87) also with a moderate relative importance. This suggests that while communication might be effective, the underlying vision itself might be unclear or underdeveloped. Companies might lack a well-defined roadmap for leveraging digital tools to optimize operations, enhance services, or gain a competitive edge.

Second: Digital Empowerment and Culture

The results shows that the level of the dimension " Digital Empowerment and Culture" was moderate, with a mean of (3.09), This suggests some progress in empowering employees to leverage digital tools, but also reveals potential gaps in fostering a broader culture of innovation and experimentation.

Item (1) "The leadership team empowers employees to use digital technologies effectively in their daily work." ranked first with a mean of (3.31), and it had a moderate relative importance, this indicates that companies provide access to tools and training, allowing employees to apply technology to their specific tasks and responsibilities. This individual empowerment can streamline workflows, improve efficiency, and empower employees to take ownership of their work.

On the other hand, item (2) " The leadership team fosters a culture of innovation and encourages employees to experiment with new digital tools and approaches." ranked last with a mean of (2.95), also with a moderate relative importance. This suggests that while individual usage is encouraged, a broader culture of exploration and innovation might be lacking. Companies might not incentivize or facilitate experimentation with novel technologies or new ways of working, potentially hindering creativity, growth, and adaptability.

Third: Discussion of findings related to the third question: What is the level of project management for solar projects, with its dimensions: (Project Planning and Scope Management, Resource Management and Scheduling, Risk Management and Quality Assurance, Stakeholder Management and Communication & Project Closure and Evaluation) at Solar companies in Jordan?

First: Project Planning and Scope Management

The results shows that the level of the dimension " Project Planning and Scope Management " was high with a mean of (3.67), This suggests a strong focus on setting clear project goals, defining expectations, and managing project scope effectively. However, a closer look reveals a potential area for improvement in handling scope changes. Item (1) " Solar companies clearly defines the scope of solar projects and establishes realistic project goals and objectives." ranked first with a mean of (3.97), and it had a high relative importance, this indicates companies excel at establishing a solid foundation for their projects, ensuring everyone involved understands the project's purpose, deliverables, and desired outcomes. This clarity can prevent confusion, miscommunication, and deviations from the intended path.

On the other hand, item (3) "Solar companies effectively manages project scope changes and ensures that project deliverables meet client expectations." ranked last with a mean of (3.24), also with a moderate relative importance. This suggests that while initial scope definition is strong, managing changes and adapting to evolving client needs might be a challenge. Companies might struggle to address unforeseen circumstances, manage client expectations during changes, or adjust deliverables accordingly.

Second: Resource Management and Scheduling

The results shows that the level of the dimension " Resource Management and Scheduling " was moderate with a mean of (3.54), This suggests some success in monitoring progress and staying on track, but reveals potential weaknesses in effectively allocating and managing project resources. Item (3) "Solar companies monitors and controls project progress to ensure that projects remain on schedule and within budget." ranked first with a mean of (3.76) and it had a moderate relative importance. This indicates companies excel at tracking progress, identifying deviations, and taking corrective actions to keep projects on track. This proactive approach can prevent delays, optimize resource utilization, and maintain financial control.

On the other hand, item (1) "Solar companies effectively allocates and manages project resources, including personnel, equipment, and materials." ranked last with a mean of (3.22) also with a moderate relative importance. This suggests that while monitoring and control are strong, resource allocation itself might be suboptimal. Companies might struggle to assign the right personnel with the necessary skills to specific tasks, utilize equipment efficiently, or manage material availability effectively.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

- Invest in Robust IT Infrastructure: Conduct needs assessments to identify required hardware, software, and network upgrades, allocate sufficient budget for IT infrastructure development, and ensure reliable internet connectivity to support digital solutions.

- Proactive Digital Transformation Strategy: Develop a clear digital transformation strategy that outlines priorities, identifies relevant tools and applications, and allocates resources for training and implementation, integrating digital solutions into project management processes from the beginning.

- Upskill and Reskill Employees: Invest in training programs and workshops to equip employees with essential digital skills including data literacy, data analysis techniques, and digital project management tools, bridging skill gaps and fostering data-driven decision-making.

- Embrace Change Management: Implement change management strategies to address potential resistance to new technologies, create a culture of digital learning and adaptability, and involve employees in the selection and implementation of digital solutions.

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"تأثير ريادة الأعمال الرقمية لتحسين إدارة مشاريع الطاقة الشمسية"

إعداد الباحث:

بسلان بسام عبدالعزيز عريقات

ملخص:

هدفت الدراسة الحالية إلى بحث أثر ريادة الأعمال الرقمية على القيادة الرقمية لتحسين إدارة مشاريع مشاريع الطاقة الشمسية، واعتمدت الدراسة على المنهج الوصفي. تكوّن مجتمع الدراسة من جميع مديري المشاريع في شركات الطاقة الشمسية في الأردن، وما يقارب 2000 مدير مشاريع في شركات الطاقة الشمسية في الأردن. واقتراح عينة الدراسة بناء على معادلة لابلاس هو اختيار 385 مدير مشروع بشكل عشوائي من مجتمع الدراسة. أظهرت نتائج الدراسة أن متوسط قيم تقديرات عينة الدراسة كان مرتفعاً للمتغير المستقل (ريادة الأعمال الرقمية)، إذ بلغ المتوسط العام (4.08) بدرجة تقدير مرتفعة، كما كانت متوسطات قيم تقديرات عينة الدراسة متوسطة. للمتغير التابع (القيادة الرقمية)، وكان المتوسط العام (3.05) بدرجة تقدير متوسطة، وكان متوسط قيم تقديرات عينة الدراسة متوسطاً لمتغير (إدارة المشاريع لمشاريع الطاقة الشمسية)، وكان المتوسط العام .(.(3.60) بناءً على نتائج هذه الدراسة، يوصي ما يلي بإجراء تقييمات للاحتياجات لتحديد ترقيات الأجهزة والبرامج والشبكات المطلوبة، وتخصيص ميزانية كافية لتطوير البنية التحتية لتكنولوجيا المعلومات، وضمان اتصال موثوق بالإنترنت لدعم الحلول الرقمية..