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The Influence of SCADA Information Technology System Application on Improving Performance Efficiency (Field study on the Ministry of Electricity and Oil of the Kurdistan Region of Iraq)

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ABSTRACT

This paper aims to show SCADA's (Supervisory Control and Data Acquisition) influence on performance efficiency in Iraqi Kurdistan Region's Electricity and Natural Resources ministries. SCADA system is a technological tool that improves performance efficiency. Supervisory Control and Data Acquisition can be prescribed as a monitoring plan. The execution of the control strategy and the decided actions constitute a process control loop. This research studies the relationship between SCADA as an independent variable and performance efficiency as a dependent variable. Hence, to answer the research questions and test the hypotheses, the study has mainly adopted quantitative research with a questionnaire to collect primary data. 366 employees working in the ministries in different positions, as a sample, have completed this questionnaire. This study recommends additional training on SCADA for employees to guarantee its sustainable use and system integration in all work details to grant the ministries flexibility in making decisions and enhancing performance.

Keywords: SCADA, Supervisory Control, Data Acquisition, Performance Efficiency.

1. INTRODUCTION

Due to technological advancement and the spread of Knowledge-based Economies, there has been a significant role for Information Systems, mainly at the administrative level (Javier Maseda et al., 2021, p10-20). Technology development has led to the foundation of an information society operating through Knowledge Operations Management to process, capture and store information. The operators, feeders, and beneficiaries are responsible for Knowledge Operations Management (Scranton, 2021). Given their increasing importance, Information Technology systems, particularly SCADA, have been majorly integrated into the vital sectors of electricity and oil by adopting open systems that interact with the environment to realize socio-economic goals and set future visions and general orientations. Information Technology systems are the pillar of success and development (Upadhyay & Sampalli, 2020, p90). They help improve behaviors, skills, and thought patterns.

The system (SCADA) has reduced the dependency on the human element. This system provides critical information for the senior management to perform their duties to the fullest (Upadhyay and Sampalli, 2020, p80). Furthermore, This system gives access to transparent, accurate, and quick goals in receiving, storing, transferring, and updating data and information in business organizations. In addition, it can secure internal control and showing all warning cases (Nițulescu and Korodi, 2020, p78-90). From these logical outcomes, the technology used in organizations contributed to developing the means of communication between the various

administrative levels in the organization, whether horizontally or vertically. Consequently, the SCADA system is not just about having tools and devices but also ideas for solving problems and a technological tool to improve performance efficiency (Budiman, Sunariyo and Jupriyadi, 2021, p160).

1.1. Research Problem

The Iraqi Kurdistan Region's Electricity and Natural Resources ministries invest in modernizing their organizations. SCADA provides these organizations with a practical course of action to fulfill accurate goals and performance efficiency. However, control methods and tools used for each data type are diverse (Sakti, Yulianto and Adhisuwignjo, 2021, p150). Therefore, Supervisory Control and Data Acquisition are prescribed in a monitoring plan specifying, for each of the criteria taken into account, the strategy to be applied and the decision rules to be used. The execution of the control strategy and the decided actions constitute a process control loop. Despite the "local" effectiveness of the control strategies, their overall efficiency is not guaranteed due to the lack of a practical integrated planning approach. The process of executing the control strategy is a sequential process that is highly interactive with other operational processes and is often confronted with hazards from various sources: decisions of human operators, queues, and resource sharing (Xiang et al., 2021, p170). For example, the control parameter measurement procedure schematically illustrates the sources of its interactions and hazards that impact the availability and speed of acquisition of control data. Obtaining these is an essential step in the control process.

The problem is that in the absence of a dynamic and comprehensive planning approach to control different stages of the process, there is no guarantee of absolute control over the quality of the final product. The risk of being faced with a large quantity of non-compliant products remains feared as this increases costs and manufacturing times (Kermani et al., 2021, p1118-1120). Planning is dynamic that it adapts to the different industrialization phases, to the changes in the control process, or in the production process. It helps reach defect-free products and services through continuous enhancement, development, and the adoption of innovative technologies is an added value and a driving force (Syamsul Arifin et al., 2021; Muthukrishnan, 2019). Technology has become the most significant source in the success and failure of the organization and its impact on performance efficiency. SCADA includes solutions to industrial problems, especially in the field of oil extraction, refining, distribution, and in the field of electric power. That is deployed to generate, diffuse, allocate and dispense efficient data and supervise internal and external control procedures, in addition to the process of data control and production systems in factories.

1.2. Research Objectives

This research aims to present a theoretical aspect of SCADA Information Technology Systems and its relationship with performance efficiency.

The objective behind this research is to :
1. Determine the effect of SCADA on improving the ministries of Electricity and Natural Resources employee performance.
2. Gauge the SCADA Supervisory Control and Data Acquisition and their impact on performance efficiency.

1.3. Research Questions

Based on the above mentioned, the study problems can be specified in the following questions:

1. To which extent does SCADA improve the performance of the ministries of Electricity and Natural Resources?
2. What is the relation of SCADA with improving performance in the ministries in question?
3. What is the influence of SCADA on the performance of the ministries of Electricity and Natural Resources in Kurdistan?

1.4. Research Significance and Structure

The adoption of SCADA information technology in public ministries is an imperative element for improving the performance and a catalyst in achieving its efficiency (Wu et al., 2015, p7-9). The adoption and familiarization of the SCADA

system are significant due to its role in modernizing the Ministries of Electricity and Natural Resources keeping pace with development. The application of accurate knowhow and technological progress helps enhance performance and operational proficiencies of Electricity and Oil ministries. They adopt better functional procedures and measure their quantitative outcomes. Public ministries can minimize interruptions thus increasing operational expenses, facilitating optimized deliveries and complying with stricter protocols and guidelines. Consequently, these benefits amplify revenue, profit and financial objectives (Shahzad et al., 2014, p655-654).

The rest of the paper is organized as follows. The review of literature is the focus of section two. The methodology is formulated in the third section providing a description of the research, research instruments, and an explanation of the sample and sampling technique. A presentation of the descriptive and inferential analysis results is pinpointed in the fourth section, focusing on the presentation of quantitative analysis results. The conclusion and recommendations constitute the fifth section and proposes avenues of future research.

2. LITERATURE REVIEW

The importance of the SCADA information technology system has facilitated its adoption in the electricity and oil sector. Its application is an urgent need in these two vital sectors because of its positive effect on performance efficiency (Shahzad et al., 2014, p655-654). SCADA interacts with the organizational mission to achieve social and economic goals, and determine future vision. Therefore, SCADA is one of the most critical technologies that contribute to the public organizations' success and help them develop behavior, skills and thinking patterns (Kure et al., 2022). This advanced technological system maximizes return on operational expenses to achieve growth in markets within these two vital productive sectors. Managing change requires dependence on information technology and expertise (Vanderzee et al., 2015, p24).

2.1. SCADA Overview

SCADA is a "Supervisory Control and Data Acquisition System". This abbreviation denotes a category of software dedicated to industrial process control and real-time data collection in remote locations (Villar & Alcala, 2021). SCADA systems can maintain control over equipment and industrial procedures, optimize operating conditions, and regulate procedures in large industries. SCADA monitors collect and process data simultaneously and instantly. This system can guide and govern daily operations embracing factual data assembled remotely and simultaneously controlling them (Wu et al., 2015, p6).

The computer in charge of the SCADA operational system and procedures dispenses accurately realistic statistics. It contributes to data analysis and in generating significant conclusions. SCADA is essential for industrial organizations to sustain proficiency and efficiency and avoid any additional product loss. SCADA automation infrastructure should be properly designed to enable companies to restore answers to operational questions, achieve better outcomes at lower cost, increase the equipment's durability, improve its performance, and reduce maintenance costs (Vanderzee et al., 2015, p17).

The role of the SCADA system is changing from being just a convenient tool for managing a plant or production process to a vital part of the digital component of any industry. This increases the importance of today's SCADA platforms, giving them a prominent place in the numerical industrial revolution and the new business models. Generally speaking, the main barrier to digital transformation is a lack of unified network between operational technology (OT) and information technology (IT) in the integrated management systems. A company's business success in today's competitive environment depends on personnel having quick and easy access to relevant, up-to-date data for operations and decision support (Shahzad et al., 2014b).

Another challenge of digital transformation is cyber risks. However, the latest security measures within SCADA can help system developers implement a robust defense strategy against cyber-

attacks. This can happen naturally when developing apps, without any compromise on usability. Thus, the SCADA becomes the platform for creating advanced, integrated, and secure solutions that bring real added value to manufacturers (Sajid, Abbas and Saleem, 2016, p10). These trends and requirements reflect the development work that makes "SCADA MAPS 4 platform" a viable foundation for digital transformation. Built on a solid service-oriented architecture (SOA), it enables users to develop high-level visualization applications faster while offering optimized functionality to support IT/OT connectivity.

2.2. Information Technology System

Information means data that have been processed for a specific goal and usage (Bai, Kusi-Sarpong and Sarkis, 2017, p1107-1121). Information is defined as a set of meaningful data collected to become useful in administrative procedures to generate effective decisions (Martono et al., 2020, p1010). Data has been recorded, organized, and classified to be retrieved (Al-Hawamdeh and Alkshali, 2020, p40-45). A piece of good information is accurate, limited, fixed, clear, credible, objective, appropriate, repeated, measurable, and inclusive (Lohrke, Frownfelter-Lohrke and Ketchen, 2016, p12). Information is processed and saved on an information technology system. Information, data, and knowledge are interrelated in meaning (Borisova et al., 2019, p106-110).

Data are the raw material recorded in the form of symbols, figures, sentences, or expressions (Handayani et al., 2019, p10-12). Data are a sign or symbol that comes as a result of direct observation of events and facts. However, data are the raw material used to generate information. As facts and traits of specific events, they do not give enough evidence nor sufficient indicators that enable decision-makers to decide on the situation or the case at hand (Sabah, 2018, 25). Data are divided into three types (Leontyev, Chumak and Chumak, 2021). First is the Linear Data Structure: elements are arranged in tables or databases to be processed. Second, the Non-Linear Data Structure: Include people's daily texts, pictures, videos, messages, and comments on social media websites. Third, the Quasi-Linear Data Structure is a subcategory of linear data structure; however, data are not put in tables or databases. Data Sources include commercial sources, networks, and devices sources, events, tracking devices from mobile phones sources, new global positioning system, behavioral data sources, opinion data sources, consumer confidence index, public opinion index, mobility, and trends.

Information is the result of processing data through selection, analysis, explanation, or justification (Ahmed et al., 2021, p11110). Knowledge includes ideas and concepts deduced from reports. Usually, systems theory is related to general concepts and principles of advanced viable and evolvable systems. Understanding a system's nature and characteristics is the primary step to understanding information systems (Gholami et al., 2021a, p 178-190). A system is defined as a set of well-structured interrelated elements that seek to implement several goals. Another definition of a system is a group of interrelated elements that consensually interoperate to achieve some goals. Moreover, a system is defined as a group of subsystems and their systematic relationship in a specific environment to attain specific goals (Gholami et al., 2021b, p184).

A system encompasses five components including elements, relationships, work mechanisms, limits, and goals. Each system has its entity and limits that make it unique in its surrounding. System elements are interconnected and integrated. Transformational system; it transforms inputs into outputs according to specific standards (Meiryani, Lindawati and Fauziah, 2019, p2928-2922).

2.2.1. Functions of Information Technology System

Information Technology System is imperative in decision-making, the foundation of an organization and its performance efficiency. It is a technological capital and is assessed as natural resources, human resources, and time; it is the main factor in formulating managerial decisions and performance efficiency (Ayaz and Yanartaş, 2020, p20). According to Lv and Singh (2021); Li et al. (2020), the Information Technology System is advantageous in five main vectors: first, the optimization of the organization's capacity to

benefit from available information. Second, the rationalization and coordination of the organization's research and development efforts based on existing information. Third, it is a method to guarantee a broad knowledge base to solve problems. Fourth, it provides modern methods and alternatives to solve technical problems and minimize their future occurrence (Yuan et al., 2020, p1729-1759). Finally, this system is a source to improve the effectiveness of techniques in the manufacturing sector and a valuable source of performance efficiency. Moreover, it has a vital role in decision-making since it contributes to motivating and guaranteeing coordination among employees; the information Technology System has several functions (Teru, Idoku and Ndeyati, 2017, p58) as follows:

Table 1: Functions of Information Technology System (Lestiowati et al., 2021; Komalasari et al., 2018; Pashaie et al., 2020)

Function	Description	Authors
1. Decision Making	Making various decisions highly depends on the availability of quality information as it is the basis for decision making since it decreases uncertainty and therefore the likelihood of mistakes that a decision-maker might face.	(Zhu et al., 2021)
2. Management and communication	All administrative activities cannot be performed without information. Information is an internal tool of communication among all employees and it allows any organization to be in touch and adapt to its surrounding.	(Handayani, Yudianto and Afiah, 2020)
3. Coordination efficiency	Information exchange among various administrative levels or within the same administrative level at an organization is essential. It enables coordination among various activities since information interlinks organization posts.	(Richter et al., 2021)
4. Motivation and Integration	Information is a source to motivate individuals and provide them with a report about their competence in job performance. It helps them understand hierarchy, makes them feel comfortable when deviations from the performance are within the limits. Information should help integrate employees into an institution, particularly when involving them in decision making or the so-called participative management.	(Gholami et al., 2021)

2.2.2. Features and Benefits of Information Systems

Information systems have some features (Mir and Rezania, 2021, p722-732):

1. Information System Objective: The information system of any company has three main objectives: providing information to make decisions, to help achieve daily tasks, and to specify the administration responsibilities.

2. Scrutiny and monitoring: Getting correct and accurate information requires monitoring inputs, processing, and outputs to make sure that the system produces and provides information as per the set standards upon creation. These standards include a set of procedures and rules

aiming at verifying the system work, and all procedures that guarantee the relevancy of inputs, processing, and outputs (Ratna et al., 2020, p372-380).

3. System limits: System limits mean to specify what to include in and exclude from a system as well as specifying relevant data (Purnama, Wijaya and Cahyono, 2020, p107-109).

4. System Inclusiveness: it means that the whole system can attain the goal while its components cannot separately achieve it because there might be a conflict among the subsystem's objectives when a specific decision or event of a subsystem is inconsistent with all subsystems or the integrated system (Bellman et al., 2022, p39).

As for benefits, information systems are responsible for: collecting, processing, managing, storing, conveying, and monitoring data and security information (Yu, Huo and Zhang, 2021, p460-489). A business realizes various benefits when having an efficient information.

Table 2: Benefits of Information Systems

Benefits	Explanation	References
Efficiency	It refers to the extent to which business goals are realized and to performing tasks quickly at the lowest cost through downsizing and using computers instead.	(Adhikara et al., 2020)
Better services	Information systems aim at providing better services for customers.	(Tetteh et al., 2022)
Improved products	Information plays an important role in finding and developing special products at institutions.	(Zhao et al., 2019)
Identifying and seizing opportunities	Businesses exist in an accelerated environment, which requires them to adapt to change.	(Adhikara et al., 2020 ; Tetteh et al., 2022)
Linking customers to the business	It makes customers closer and more connected through improving services provided, and can satisfy them in a way that impairs competitors from appealing to them.	(Kamariotou and Kitsios, 2018)
Linking to suppliers	Information systems are used to bridge the location gap between an organization and suppliers to accelerate its operations and save time, effort, and cost.	(Tetteh et al., 2022 ; Zhao et al., 2019)
Linking subsystems together in an integrated system	This issue allows the flow of information and data among systems, which realizes coordination among these systems' activities.	(Kamariotou and Kitsios, 2018)

As for information systems features, Hardika et al. (2020, p2758) has summarized them by providing information to all levels when needed, specifying and clarifying communication channels horizontally and vertically. They serves beneficiaries constantly by answering clarifications through discussions between the beneficiary and the system. (Borshalina, 2021, p1308-1302); Kamariotou and Kitsios (2018, p55) summarize the main tasks of information systems in the ability of an organization to collect information that permits studying the market and its players. In this case, managers can adopt strategic decisions they make, respond to customers' reactions and needs, respond to market growth, know competitors' strengths (producers,

prices, market shares), spread information knowledge, and disseminate decisions making (Plaza and Pawlik, 2021).

2.3. Concept of Supervisory Control and Data Acquisition

The implementation of innovative systems such as SCADA supports establishments in governing and directing industrial processes remotely and on-site. This advance system assists public organizations to promote direct interactions with electronic apparatus and equipment located in a centric premise. SCADA allows organizations to observe their progressions, report on them on the basis of actual statistics, and documents the information for later assessment (Bellman et al., 2022, p39-41). Organizations can use Supervisory Control and Data Acquisition in four tasks. First controlling procedures on-site or remotely, second, interacting with devices using HMI software, third, collecting, monitoring, and processing data, and finally, logging events and data (Ratna et al., 2020, p372-380).

These functions allow companies to supervise, control and acquire data, therefore, having increased visibility of organizational advances. Accumulated data allows them to continuously monitor machines instant performance and visualize potential improvements. Workers can alter the operation for entire infrastructures, individual processes, or just certain machines Kamariotou and Kitsios (2018); Hardika et al., (2020); Borshalina, (2021).

2.4. Performance Efficiency Concept

Performance and efficiency are two correlated terms in the world of business. Therefore, a definition of each term is doomed obligatory. Firstly, performance is described as the investment of skills, tools, and devices to reach a high level of compliance in a precise time, accurate way, and at the lowest cost. It is the harmonization of effort, task, and implementation of skills, tools, and devices (Gholami et al., 2021b, p184). It combines work conditions since it links the business's strategic goals, departments, and units with customer satisfaction and economic contributions by increasing revenues (Olfat et al., 2016, p277-284).

Performance refers to the extent of realizing or achieving the important objectives of an organization for its stakeholders. Performance is specified according to multi-dimension standards (Ghasemaghaei, Ebrahimi and Hassanein, 2018, p110). It is a way through which organizations achieve their objectives by adopting repetitive tasks and activities. The focus on employee performance stems from the fact that an organization achieves its specific goals through the effective capabilities of its human resources (Blankert et al., 2020, p447).

Mainly efficiency of performance accomplishes the organization's objectives and guarantees the attainment of goals. The efficiency of performance must be studied, followed up, and assessed to avoid deviation (Salcedo, 2020, p98-100). This issue pushes organizations to adopt various administrative methods to develop, rationalize and improve performance. Performance is of crucial importance for any organization because it guarantees its stability. It is worth noting that employees are a fundamental strategic resource and asset that contribute to its overall performance (Sutopo et al., 2022, p2-4).

2.4.1. System Performance Efficiency

System performance means a special measurement of competent and efficient system source usage to achieve goals (Ahmed and Ibrahem, 2021, p40-42). A system performance directly increases with competence.

Efficiency means the proper use of available sources in a way that decreases costs without scarifying system outputs quality. It enables a system to reduce the costs of necessary sources to realize set objectives efficiently (Wang, Zhou and Wang, 2020, p64). As for efficiency, it reflects the extent of realizing system objectives, doing the right things, making suitable decisions, following up on decisions to realize goals, or measuring system objectives (Eriki and OSifo, 2015, p5-9). The evaluation of an information system combines several approaches: the measurement of opportunity, consistency, effectiveness, and efficiency (Rahman et al., 2020, p47-50).

System Performance Efficiency can proceed in four steps. Firstly, analyzing the internal coherence of the project, the articulation between

the three constituent levels of the scheme: the finalities, the goals, which are the means retained to concretize the intentions. Eventually, the operational objectives, which is expected results in terms of the "ability to" of the action (Wang, Zhou and Wang, 2020, p65). Secondly, measuring the effectiveness of the plan. For instance, the gap between the results obtained and the results sought. This gap can be examined from the point of view of purposes, goals, and objectives. This measurement assumes that we have indicators that define the situation (Eriki and OSifo, 2015, p5-9). Thirdly, measuring the efficiency of the performance, for example, the relationship between the quantity and quality of the results obtained and the material, human and financial resources used to obtain them. Finally, measuring the impact of the project through the effects, planned or not, perverse or not, but not explicitly sought, with the pursuit of the objectives, goals, and purposes of the scheme.

2.4.2. Performance Measurement Indicators and Improvement Methods

Performance indicators are related to two main concepts: measurement and objective. A performance indicator is defined as quantitative information that measures the efficiency and efficacy of each part of a system according to a specific goal, scheme, or standard within the organization's strategy (Sonnentag and Frese, 2012). Performance measurement indicators should be compared with a specific goal or standard. The absence of these features hardens the mobilization of employees.

Performance measurement indicators cover all operations by adopting a specific set of indicators or they become impossible to use. They should allow modification every time the main objective changed. Performance indicators do not come from one source (Ahmed and Ibrahem, 2021, p40-42). Their choice and establishment do not rely on intuition and simple traditions. Appropriate indicators should be chosen, or else what is the benefit of an indicator that provides credible information but does not match the set objectives. There are various performance indicators and the organization is free to select them according to its objectives. The performance indicators of a company provide information on the health of the company, that is to say, the quality of its operation (Eriki and OSifo, 2015, p5-9). These indicators are in the form of numerical information. They allow you to know if the company achieves its objectives (effectiveness), and to obtain the best possible results given the means implemented (efficiency). They constitute a real dashboard and are therefore also decision-making tools in terms of the management and strategic management of the company (Ratna et al., 2020, p372-380).

Table 3: The Main Performance Indicators (Kaur, Grover and Dixit, 2019; Neves, Gouveia and Proença, 2020)

Performance Indicators	Explanation
1. Financial indicators	These indicators correspond to the sum of the establishment's profits and trade volume. It can be computed globally and on organizational level. Evaluated financial indicators comprise: ROI return on investment, the margin rate, working assets or cash requirements.
2. Commercial activity indicators	These activities provide detailed knowledge of the origin of turnover by measuring the revenue generated by each product category, the customer conversion rate (number of potential customers contacted who have become customers of the company), the rate of satisfaction and degree of customer loyalty, the impact of promotional campaigns (advertising), the notoriety of the

	products or the brand on social networks, the evolution of market shares compared to competitors.
3. Human resource management indicators	HRM indicators include, among other things, the absenteeism rate, the rate of workplace accidents, production costs, and production capacity.
4. Social responsibility indicators	Socially oriented indexes provide evidence on the quality of production methods in terms of environmental impact (water or energy consumption, pollution) and employee working conditions.

2.5. The Relationship Between SCADA and Performance Efficiency of Public Organizations

SCADA systems allow public ministries to employ collected data to enhance their performance efficiency. Besides, this advanced technological system enlightens decision-makers in the selection of the right decision, improve communication to avoid idle time. This cohesive computer software combines large data from differentiated sources, and send it to related connected computers after a proficient process and a creation of comprehensive and customized reports (Ahmed and Ibrahem, 2021, p40-42). This system is beneficial in managing services/products quality. SCADA activates an alarm when sensors detect defects in a set of products. This system is beneficial in managing energy by reducing the consumption of electricity of devices. SCADA systems can significantly improve performance efficiency by saving organizations time and money (Borshalina, 2021, p1308-1302); Kamariotou and Kitsios (2018, p55).

SCADA information technology system help public ministries and organizations to increase performance efficiency by diminishing idle time. It is based on data collection and contributes to a variety of purposes, which helps in the control procedures and decision-making, and in turn, it is in the interest of the production process and performance efficiency (Rogge, Agasisti and De Witte, 2017, p266-279).

The Plant Application software solution provides performance control with a global view of the indicators. In particular, they must continue to minimize the downtime of pipelines and equipment (Rahman et al., 2020, p47-50). However, simply reducing costs is not enough, these companies face the challenge of increasing the efficiency of operations, especially upstream production, while dealing with more stringent safety and environmental regulations. SCADA improves performance efficiency by adopting Supervisory Control and Data Acquisition. Three hypotheses were formulated for the study.

2.6. Hypotheses

- **Hypothesis one (H1):** SCADA has a significant statistical influence on performance efficiency.
- **Hypothesis two (H2):** Supervisory Control has a significant statistical influence on performance efficiency.
- **Hypothesis three (H3):** Data Acquisition has a significant statistical influence on performance efficiency.

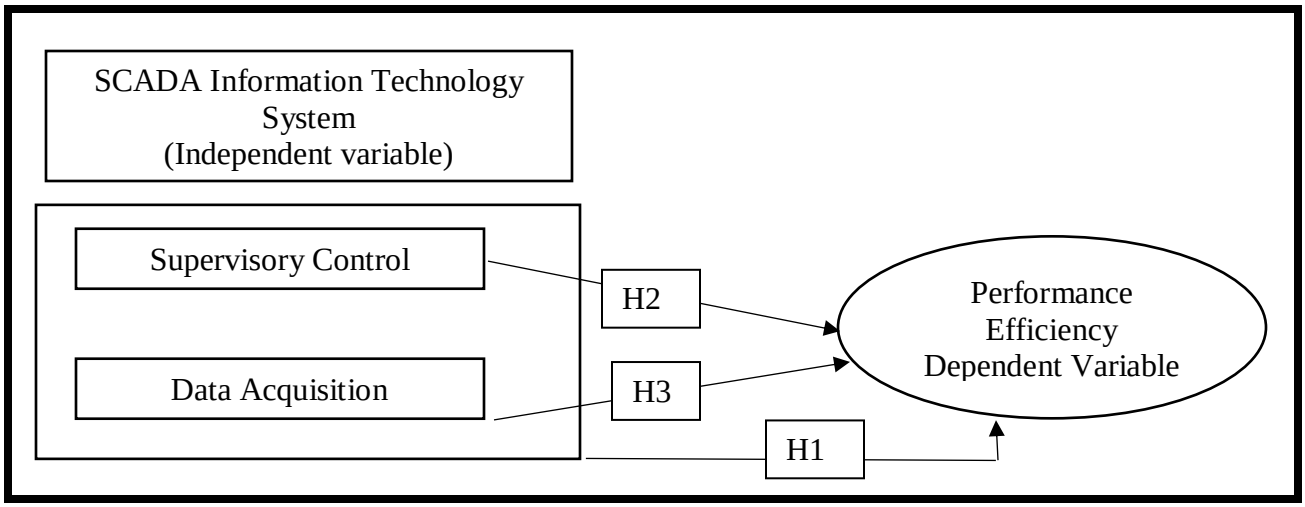

Figure 1: Conceptual Framework

3. RESEARCH METHODOLOGY

Positivism as a research philosophy is adopted in this paper. Epistemological positivism requires, in the first place, that science starts from observable and defined facts relative to an observer, since any phenomenon always consists of a determined relation between an object and a subject. In this case, this research traces SCADA and performance efficiency as observable facts in public ministries. Positivism is therefore followed to govern the influence of one independent variable titled SCADA, the latter is divided into two dimensions aggregating its name symbolized in Supervisory Control and Data Acquisition and performance efficiency as the dependent variable to discover and distinguish the relationship between those two variables. Besides, deductive reasoning is the research approach in this research. Deductive reasoning is reasoning based on hypotheses. Deductive reasoning is established based on assumptions that are considered to be true following statistical comparison before concluding.

To address the herein topic, answer the raised problem, and test hypotheses, the analytical and descriptive approach is adopted. It studies, accurately describes, and analyzes quantitatively and qualitatively the phenomenon without any change. It is suitable to report facts and understand the topic since the role of general concepts in improving performance is covered. The analytical approach is used to analyze and diagnose some issues related to the ministries of Electricity and Natural Resources in the Kurdistan Region. The descriptive statistical approach is used for the practical side. Then a questionnaire is put to collect information and data about the extent of applying Supervisory Control and Data Acquisition (SCADA) and its impact on improving performance efficiency.

3.1. Survey Sampling

The target population includes 8000 bachelor-degree-holding employees from class one to class seven in the ministries of Electricity and Natural Resources in the Kurdistan Region of Iraq. A random sample will be drawn according to the Sample Size Calculator in large communities:

$$n = \frac{z^2 p(1-p)}{d^2}$$

n= minimum sample size

Z= Standard normal distribution= 1.96

P= Estimated proportion from previous and similar studies= 0.50

D= Tolerated margin of error= 0.05

Since the community size is determined to be less than 10000, the sample size should be as follows:

$$nsz = \frac{sz}{1 + \frac{sz}{N}}$$

3.2. Methods

The research was based on diagnosing the performance efficiency in the Ministry of Electricity and Natural Resources. This paper aims at displaying SCADA's influence on improving performance efficiency in Iraqi Kurdistan Region's Electricity and Natural Resources ministries. It illustrates the relationship between the study variables by analyzing a sample of the respondents' opinions. A questionnaire has been addressed to 366 employees working in the ministries as a data collection tool for the quantitative research method. This study reflects the relationship and impact between SCADA (Supervisory Control and Data Acquisition) as an independent variable from one side and performance efficiency as a dependent variable from another side. Both variables have been studied together and formed the base of the current study, triggering three main statistical hypotheses. A set of measures and statistics was used to analyze the responses of the sample in question.

4. DATA ANALYSIS

The current topic aims to diagnose the reality of the relationship between SCADA (Supervisory Control and Data Acquisition) and performance efficiency among workers in the Ministry of Electricity and Natural Resources. The empirical study was analyzed on the examination of (366) answers assessing the statements of the questionnaire denoting variables dimensions. Mean, standard deviation, coefficient of variation, and relative importance (Cohen, 1988:14) are used and then a comparison between the calculated mean and the mean which represents categories was made to identify availability, adoption, practice, and interest. In the below table (4), the dimension of the main evaluation scale (Likert scale), can be interpreted as follows:

Table 4: Interpretation of Means Compared to Likert Gradients

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1-1.80	**1.80-2.60**	**2.60-3.40**	**3.40-4.20**	**4.20-5**
Very weak	weak	Moderate	High	**very high**

4.1. Validity Analysis

Kaiser-Mayer-Olkin (KMO) analysis was conducted to gauge the internal consistency of the paragraphs and the adequacy of the sample size to perform. The KMO analysis of the questionnaire is shown in the table (5) below:

Table 5: Validity Analysis (KMO)

Index	SCADA	Supervisory Control	Data Acquisition	Performance Efficiency
KMO	0.861	0.833	0.846	0.820
Bartlett test	6577.414	2482.206	1217.322	2039.303
degree of freedom DF	136	28	28	29
P-value	0.000	0.000	0.000	0.000
number of statements	17	8	7	8

Data in the above table shows that the KMO for the SCADA has a value of (0.861), which is greater than the value (of 0.50). The dependent variable, the performance efficiency, obtained a (KMO = 0.820) and across (8) items that represented it. While the value of Supervisory Control was (KMO =0.833), and Data Acquisition was obtained (KMO=0.846).

Reliability is among the tests necessary to build the questionnaire, as it embodies its ability to measure what it was adopted for. In addition to determining its ability and validity to measure the variables concerned with the research, it represents an important condition for determining the accuracy of the questionnaire. Accordingly, the results of the tests were the following:

4.2. Reliability Analysis

Table 6: Reliability Analysis

Index	SCADA	Supervisory Control	Data Acquisition	Performance Efficiency
Cronbach alpha	0.984	0.943	0.946	0.920
P-value	0.000	0.000	0.000	0.000
number of statements	17	8	7	8

SCADA as an independent variable was measured in two dimensions, as well as in an overall measure represented by (17) items. In total, the α of SCADA has a value of 0.984, Supervisory Control has an α of 0.943, and Data Acquisition has an α of 0.946. Thus, the axis of the independent variable is valid for measurement and gives the same results even if the questionnaire is redistributed to the same sample after a while.

4.3. Presentation, analysis of SCADA as the independent variable (SCADA)

The independent variable measured (SCADA) is evaluated on the answers of 366 adequately filled questionnaires in the Ministries. SCADA in total attained a high-level mean of (3.73) demonstrating that workers possess in the Ministry of Electricity and Natural Resources, have the possibility to reach the information technology system, and to deal with its data far from the traditional ways. The independent variable in total obtained a standard deviation of (1.022), and a relative interest of (74.6%). Those indicators are considered in a respectable and accepted range. Besides, the coefficient of relative variation (27.39%) specifies some consistency in employees understandings concerning information technology system availability and its practice in the Ministry of Electricity and Natural Resources.

The statements appearing above the sequence (1-17) in the questionnaire, obtained a mean (3.40-3.94), and a standard deviation (1.180-1.489). It indicates a divergence in the level of answers and limited consistency, a relative coefficient of difference (30.56%-43.61%). The Ministry provides a relative interest (68%-78.8%) of a secure and fast network connection to its members. The (SCADA) system offers a real-time information to its users, as a result of high level of information network security, quick retrieval of information and data when needed, in addition to the fact that the software used by the Ministry is compatible with the nature of its work. The various departments of the administration and the system adopted by the Ministry have real-time alerts when facing any problem. There are enough computers to benefit from the information technology system (SCADA), which improves the quality of decision making and adequate with the nature of the tasks required. The ministry is interested in training its members, and maintaining their education using the SCADA system.

Table 7: Presentation and Analysis of SCADA (Supervisory Control and Data Acquisition)

	Nb	Paragraphs	Mean	Standard Deviation	Relative Importance	Coefficient Of Variation	Priority
Supervisory Control	1	Sufficient and necessary computers are available to benefit from the SCADA system.	3.67	1.412	73.4	38.47	13
	2	High-tech devices are available to take advantage of the SCADA system.	3.57	1.489	71.4	41.70	16
	3	The software used contributes to maximizing the benefit of the application of the SCADA system.	3.69	1.426	73.8	38.64	14
	5	The Ministry provides a secure and fast network connection.	3.86	1.180	77.2	30.56	1
	8	The necessary databases are available to save and analyze the massive data of the system.	3.81	1.325	76.2	34.77	7
	11	SCADA is easy to operate and use.	3.74	1.369	74.8	36.60	10
	12	SCADA system provides real-time alerts in the event of any malfunction.	3.77	1.333	75.4	35.35	9
	13	The organization is keen to provide a high level of network security.	3.84	1.212	76.8	31.56	3
	14	The SCADA system contributes to improving the quality of the decision taken by the management.	3.64	1.352	72.8	37.14	12
	15	The SCADA system contributes to increasing administrative flexibility at the ministry level.	3.56	1.439	71.2	40.42	15
Data Acquisiti	4	The software used is appropriate to the nature of the ministry's work.	3.83	1.243	76.6	32.45	5

	6	SCADA system contributes to providing information in real-time.	3.87	1.212	77.4	31.31	2
	7	SCADA system contributes to providing accurate information necessary for decision-making.	3.90	1.296	78	33.23	6
	9	Databases provide quick retrieval of information and data when needed.	3.94	1.255	78.8	31.85	4
	10	Databases allow the exchange of information between the various departments of the administration.	3.76	1.328	75.2	35.31	8
	16	The management is concerned with training employees on a continuous and sustainable basis on the use of the (SCADA) system.	3.40	1.483	68	43.61	17
	17	Management is concerned with the continuous development of the system.	3.64	1.336	72.8	36.70	11
	SCADA		**3.73**	**1.022**	**74.6**	**27.39**	

4.4. Presentation, Analysis of the Dependent Variable Performance Efficiency

The research was based on diagnosing the performance efficiency in the Ministry of Electricity and Natural Resources. The dependent variable measured the performance efficiency through (8) statements and based on (366) workers in the Iraqi Ministry of Electricity and Natural Resources. Performance efficiency as a dependent variable attained (1.163) for its standard deviation, and (32.39%) for its variation coefficient. Those two indexes designate a restricted homogeneity of the readiness of practice in the Ministry of Electricity and Natural Resources. Results of Table (8), as for the statement level. The latter were classified and organized respectively.

Table 8: Presentation and analysis of performance efficiency data

Nb	Paragraphs	Mean	Standard Deviation	Relative Importance	Coefficient Of Variation	Priority
18	The employees are prepared to take responsibility	3.86	1.163	77.2	30.12	3
19	Employees do business efficiently and effectively	3.51	1.236	70.2	35.21	4

20	Employees can solve business problems	3.44	1.228	68.8	35.69	5
21	The employee is looking for the best methods and ways to get the work done	3.14	1.367	62.8	43.53	8
22	Employees can deal well with work pressures	3.57	1.289	71.4	36.10	6
23	Employees put business interests above their interests	3.81	1.048	76.2	27.50	2
24	Employees comply with labor laws and regulations	3.83	0.971	76.6	25.35	1
25	The employees make every effort to achieve the Ministry's goals	3.56	1.301	71.2	36.54	7
Performance Efficiency		**3.59**	**1.163**	**71.8**	**32.39**	

The statements appearing above the sequence (18-25) in the questionnaire, obtained a mean (3.14-3.86). The standard deviation (0.971-1.367) indicates a diversity of answers with a relative coefficient of difference (25.35-43.53%) and relative interest (62.8%-77.2%) in the ministry's ability to invest in its members' commitment to regulations and laws. They show no conflict of interest and willingness to hold responsibility, so they perform their work and tasks efficiently. In addition to their ability to solve work problems, and deal well with work pressures, they provide sufficient effort to achieve the Ministry's goals, and search for the best methods to get the work done.

4.5. Testing the Effect of SCADA on performance efficiency

H1: SCADA has a significant statistical impact on performance efficiency. To support the null/alternative hypotheses or to reject them, a simple linear regression model was implemented as follows:

Table 3: The effect of SCADA on Performance Efficiency

Independent Variable	**Performance Efficiency**						
	α	**β**	**R^2**	**A R^2**	**Sig**	**T**	**F**
SCADA	0.529 (0.000)	0.969	0.939	0.939	0.000	75.048	5632.187

Results presented in the Table (9) disclosed that the value of (F) for the model (5632.187) at the significance level (0.000). This index is higher than the planned value (3.841) at the significance level (0.05) to indicate the significance of the model, in addition to the existence of an interpretation coefficient (0.939). At the significance level (0.000), and with a corrected interpretation coefficient (0.939), the information technology system (SCADA) was able to explain (93.9%) of the changes that occur in performance efficiency, while the remaining (6.1%) is attributed to other variables that were not included. Within the tested model, it was found that there was a strong positive impact of SCADA (0.939) at the significance level (0.000), and the T value (75.048), as the Ministry of Electricity and Natural Resources was able to employ the

information technology system (SCADA) to improve performance efficiency. Consequently, the first hypothesis is supported: (SCADA has a significant statistical influence on the performance efficiency), according to the following equation:

Performance efficiency (Y) = (-0.529) + 0.969 * (SCADA)

4.6. Testing the Effect of Supervisory Control on the Performance Efficiency

H2: Supervisory Control has a significant statistical influence on performance efficiency. To verify the validity of the hypothesis or to reject it, a simple linear regression model was implemented according to the following:

Table 4: The effect of Supervisory Control on Performance Efficiency

Independent Variable	Performance Efficiency						
	α	β	R^2	A R^2	Sig	T	F
Supervisory Control	0.745 (0.000)	0.924	0.854	0.853	0.000	46.077	2123.085

Results of Table (10) demonstrated that the calculated value of (F) for the model (2123.085) at the significance level (0.000). This statistical index proved to be higher than its expected value (3.841) at the significance level (0.05) to indicate the significance of the model, in addition to the existence of an interpretation coefficient (0.854). At the significance level (0.000), and with a corrected interpretation coefficient (0.853), Supervisory Control was able to explain (85.4%) of the changes that occur in the performance efficiency, while the remaining percentage (14.6%) is attributed to other variables that were not included in the tested model. It was found that there is a strong positive effect of Supervisory Control (0.924) at the significance level (0.000), and (46.077) for the (T) value. As the Ministry of Electricity and Natural Resources was able to employ Supervisory Control in improving the performance efficiency. Therefore, the calculated indexes presented in table (10) statically support the second main hypothesis: (Supervisory Control has a significant statistical influence on the performance efficiency), according to the following equation:

Performance efficiency (Y) = (0.745) + 0.924 * (Supervisory Control)

4.7. Testing the Effect of Data Acquisition on Performance Efficiency

H3: Data Acquisition has a significant statistical influence on performance efficiency. To verify the validity of the hypothesis or to reject it, the simple linear regression model was implemented as follows:

Table 5: The Effect of Data Acquisition on The Performance Efficiency

Independent Variable	Performance Efficiency						
	α	β	R^2	A R^2	Sig	T	F
Data Acquisition	0.238 (0.000)	0.905	0.819	0.818	0.000	40.537	1643.242

Results of Table (11) showed that the calculated value of (F) for the model (1643.242) at the significance level (0.000). This statistically measured index has verified that it possesses a value (3.841) higher than the significance level (0.05) to indicate the significance of the model, in

addition to the existence of an interpretation coefficient (0.819). At the significance level (0.000), and with a corrected interpretation coefficient (0.818), Data Acquisition was able to explain (81.9%) of the changes that occur in the performance efficiency, while the remaining (18.1%) is attributed to other variables that were not included in the tested model. It was found that there is a strong positive effect of Data Acquisition (0.905) at the significance level (0.000), and with a calculated (T) value (40.537). As the Ministry of Electricity and Natural Resources was able to employ Data Acquisition in improving the performance efficiency. Subsequently, the calculated indexes presented in table (11) statically support the last hypothesis: (Data Acquisition has a significant statistical influence on the performance efficiency), according to the following equation:

Employee performance (Y) = (0.238) + 0.905 * (Data Acquisition)

4.8. Results Interpretations

As technology continues to advance, SCADA system is gaining and enhancing its functions in performance efficiency, and Supervisory Control and Data Acquisition are playing a significant key role in smart factories. The advanced technological information system SCADA is improving procedures for collecting and managing operational capabilities. These beneficial outcomes consent businesses to leverage their advantages from the unconventional data analytics. Therefore, through the collection, supervision, acquisition, and analysis of data, SCADA is transforming data into information for improving operational decisions and embracing the optimization of production, and performance efficiency. As public ministries increasingly focus on industrial expertise, SCADA information technology system play a vital function in the performance efficiency of operations. At the same time, industrial infrastructures are increasingly intertwined and SCADA systems are interrelated with operational equipment. To summarize the results, the below table shows the supported hypotheses.

Table 6: Research Hypotheses

Hypotheses		**Result**
H1	SCADA has a significant statistical impact on performance efficiency.	Supported
H2	Supervisory Control has a significant statistical impact on performance efficiency.	Supported
H3	Data Acquisition has a significant statistical impact on the performance efficiency	Supported

5. Conclusions and Recommendations

The oil and gas industry are experiencing drastic changes due to a price crash that seems regular and predictable. Therefore, novel conditions resulted in a consistent alteration in priorities. Electricity and gas ministries should focus on development and advancement initiatives. These ministries should diminish expenses, advance operational efficiencies, and leverage performance efficiency.

Public ministries are working on cost reduction and eliminating failures to achieve performance efficiency. Public ministries are trying to achieve these results. SCADA technology information system as an automation-driven technology is assessed an efficient technological tool to attain end objectives. Segregated activities congregate the need to maximize the use of equipment. Hence, for public ministries to reach performance efficiency and competitiveness, managers need to constantly discover innovative methods to work efficiently, and more economically.

The Electricity and Natural Resources ministries are highly interested in SCADA and have adopted and invested in it by providing a quick security network connection. Moreover, they are interested

in training employees continuously and sustainably.

These ministries have proceeded towards improving the productivity of their employees by raising the slogan "Your department realizes its objectives with the lowest financial costs". This issue has pushed employees to manage work and time in line with the slogan and led to the achievement of work efficiently and effectively.

It is proven that Electricity and Natural Resources ministries foster creativity properly by motivating their employees to come up with new ideas and keep abreast of scientific and knowledge developments, and by providing an atmosphere that suits the nature of creativity they look forward to. Public ministries have adopted innovation and worked on its improvement through streamlining work processes, welcoming untraditional ideas to face and overcome long-standing and urgent work problems, and tending to adopt changes and renovations to be able to adapt to the external environment and increase demand on their services.

The following two sets of guidelines are recommended for the ministries of Electricity and Natural Resources. The first guidelines aims to improve their interest in SCADA by adopting the following:

- Additional continuous training in a way that guarantees their usage of the system.
- High-tech devices are provided to optimize the benefit of the system.
- System inclusion in all work details gives flexibility to the ministries in making decisions and responding to environmental data.
- Adoption of advanced algorithms, software, and computers that enable the ministries to interact with the system and respond to developments.

The second set of guidelines aims to improve performance efficiency in the ministries by adopting the following:

- Looking for and disseminating the best practices and methods.
- Urging employees to spare no effort to realize the ministries' goals.
- Preparing continuously to deal well with work pressures.
- Giving employees jurisdictions to solve urgent work problems according to their capabilities.

Despite the deep empirical investigations in this paper, future research can focus on in-depth investigation of organizational culture. This would also allow identifying other related research problems.

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