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The role of intelligent process automation in raising production efficiency: A field study in the Tasluja cement factory

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Abstract

Intelligent process automation is one of the fundamental developments in the field of modern industry, as it contributes significantly to enhancing production efficiency. In light of this, the current study aims to demonstrate the role of intelligent process automation in enhancing production efficiency through a field study in the Tasluja cement factory in the city of Sulaymaniyah. To achieve this goal and address the problem of the study and benefit from its importance, a questionnaire form was designed and distributed to the workers. After collecting and analyzing the data using the program (SPSS. 28), the study reached a number of conclusions, the most important of which was that there is a significant impact of the automation of intelligent processes on productive efficiency and in a way that enhances this. Competitiveness provides opportunities to improve profitability, and on the basis of the conclusions, several proposals were presented, the most important of which was the necessity of developing and improving intelligent automation systems to benefit from their vital role in raising the level of efficiency and achieving production goals.

1. Introduction

Intelligent process automation is considered one of the leading technological innovations that have brought about a radical transformation in the areas of productivity and service, because it carries out tasks and operations in an autonomous manner, without the constant need for human intervention, which contributes to improving production processes and providing services more accurately and quickly, in addition to the role of automation. Intelligent operations to meet increasing market demands, improve efficiency and increase the competitive position of the organization.

From this standpoint, this study aims to examine the role of intelligent process automation and understand its impact on production efficiency. From this goal, we will discover many of the benefits that result from adopting this technology, as well as identifying the most important challenges that may arise in the context of its application, and thus we will learn about the transformation that The world today is witnessing a new concept of productivity, where human work effectively converges with technology to achieve innovative work models based on intelligence and continuous improvement. Accordingly, the current study consists of four aspects: study methodology, theoretical aspect, field aspect, conclusions and proposals.

2. Methodology

2.1. problem of the study: The Tasluja cement factory suffers from low production efficiency for several reasons, the most important of which are: 1- Old technology: Updating equipment and technology may be expensive and requires large investments, 2- Lack of infrastructure: whether it is digital transformation infrastructure or transportation and logistics infrastructure, 3 Lack of technical skills: Which affects the ability to operate and maintain equipment efficiently. Confronting this problem is done by relying on intelligent process automation because it helps enhance production efficiency through the following: 1- Reducing human error, as process automation reduces the risk of human errors, 2- Increasing productivity through process automation, which leads to improving production processes. 3- Reducing costs: Automated processes can reduce the overall costs of production by improving resource consumption and reducing waste. 4- Automation makes production more flexible and quickly adjustable to meet Changes in demand. To address this problem statistically and scientifically, the following questions are raised: 1- Is there automation of intelligent processes in the factory sample of the study? 2- How does factory management enhance the production efficiency of all its activities? 3- How does intelligent process automation contribute to enhancing production efficiency in the factory?

2.2. Objective of the study: In light of the problem of the study, its main objective must be determined, which stipulates (revealing the role of intelligent process automation in enhancing production efficiency through a field study in the Tasluja cement factory in Sulaymaniyah Governorate). From this objective, we determine the following objectives:

1- Identify the most important problems facing the application of intelligent process automation requirements in the factory sample of the study, which are (lack of infrastructure, lack of skills, high costs).

2- Addressing these problems based on the theoretical and practical sides of the study in a way that achieves the goal of the study, which is to enhance the production efficiency of the factory.

2.3. Importance of the study: The study achieves a number of benefits for laboratory management. The study sample is:

1- Helping the factory management to study how the implementation of intelligent process automation affects production speed and high quality, as well as measuring the impact of automation on waste and defective products.

2- Learn how to use process automation as a tool for continuous improvement by supporting innovation efforts in the production process.

3- Determine the impact of automation on employment and work skills, as well as its role in assessing the need to retrain workers and develop their skills.

4- Identify the impact of intelligent automation on costs and revenues in order to achieve a strong competitive position for factory management in the market.

2.4. Study hypotheses: The study is based on two hypotheses: The first: There is a statistically significant correlation between the automation of intelligent processes and productive efficiency. The second: There is a significant, statistically significant impact of the automation of intelligent processes on productive efficiency.

2.5. Study methodology and statistical methods: The study adopted the descriptive analytical approach, and also relied on many statistical methods, frequencies, arithmetic mean, standard deviation, response ratio, coefficient of variation, B test, F test, R test, and R2.

3. Theoretical aspect

Intelligent process automation is gaining the attention of countries around the world in general and industrial organizations in particular, as intelligent process automation plays an important role in quickly completing work, with high accuracy, and at the lowest possible cost and effort. It enables the organization to quickly reach the market and the customer at a speed that exceeds the speed of competitors, in addition to its role in Reducing the burden on workers to a minimum, and therefore intelligent process automation differs from early decision support systems and knowledge-based systems in three aspects: (Coombsa, et. al, 2020, 2): First: The old systems were not able to learn and improve their methods. Its results were automated and relied on human programmers to make adjustments. Second: Old systems served as assistants or advisors to human professionals who provided recommendations or advice, but they required a human agent to implement the decision. Third: Automation systems are designed to assist managers in making repetitive decisions and complex, unorganized problems. From this standpoint, this research addresses the following paragraphs:

3.1. Concept of intelligent process automation: The International Standards Association defines intelligent process automation as a pre-configured program that combines business rules, experience-based logic, and decision criteria to initiate and implement many interconnected human and automated processes in a dynamic context (Martínez, et. Al, 2022, 4 (Kam, et. Al, 2021, 6) indicates that it is a synergy of technologies to enable business organizations to accomplish their work with better practical efficiency, operational efficiency, and adapting to changes in the business environment, and (Bauml and Meibner, 2021, 100) explains that it is a way of running operations. Automatically according to certain rules, which can save resources such as time, money, and labor, and reduce vulnerability to errors and their repetition. (Coombsa, et. al, 2020, 2) believes that it is a wide range of technologies that can match or exceed human capabilities by automating the equipment that controls Computers such as machine learning and mobile robots.

3.2. Benefits of using intelligent process automation: Intelligent process automation achieves a number of advantages for the organizations that apply it, and these benefits include (Ghobakhloo, et. al, 2023, 2):

1- Simulate human intelligence by interacting with humans in real time and learning independently.

2- Adapt to new working conditions by making independent decisions and predicting potential outcomes.

3- Improving companies' competitiveness and providing added value.

4- It helps companies identify disruptions and changes throughout the business environment and proactively prepare the necessary strategic responses.

5- Improving the productivity of human resources and reducing costs.

6- Improvements in response time, customer services, and product quality improve customer satisfaction.

7- Promotes adherence to regulatory requirements and policies.

3.3. Dimensions of intelligent process automation: The effective application of intelligent process automation depends on two important dimensions:

1- **Robotic process technology**: Robotic process automation is a very intelligent and innovative solution for implementing the transformation process from traditional work to digital work in production processes and improving human work within organizations. This technology has recently been introduced into human resources, finance, accounting, supply chain management and information technology systems. This is due to the increasing pressure to improve service and operational efficiencies, as they are a substitute for human labor Martínez, et. Al, 2022, 3)), Robotic process technology is defined as processes that create value for stakeholders because they provide labor-saving solutions, and also replace processes that require labor-intensive or manual tasks with automation processes that perform the tasks entrusted to them without human intervention (Kam, et Al, 2021, 6), and (Bras, et. Al, 2023, 4) see it as a pre-configured program that is used to automate a set of processes, tasks, activities or services, with graphical user interfaces designed to interact with any type of system. Almost as a human user does, ensuring increased efficiency of operations, lower implementation costs, and achieving a very quick return on investments, and explains (Mamede, et. al, 2023, 2) It is an emerging method of automating processes using software that the industry calls robots, as these robots perform Repetitive, low-complexity tasks that were previously performed by humans, to provide the

organization with improved digitization, and one of the most important market leaders for robotic process automation (Mamede, et. al, 2023, 3):

A- UiPath - The market leader and the fastest growing RPA vendor, its success has depended on attracting partners and experienced end users, which has allowed it to become a tool of differentiation from other vendors.

B- Automation Anywhere - a leading company in the field of automation and has an important market share in the field of robotic operations and the goal of its core operations are shared services such as quoting for cash, human resources management, payment, automation of back office operations and a little front-end support.

C- Blue Prism - This company was the first vendor to see RPA as a separate tool from BPM. Business at this company grew from 124 to 448 customers in 2017, and its revenues exceeded $70 million.

2- **Artificial Intelligence:** (Al-Obaidi, 2015, 44) defines it as understanding the nature of human intelligence by creating programs on the computer to imitate the actions or actions carried out by humans in an intelligent or automated way, or it is a combination of technologies that enable systems to perform tasks. Judgment and decision making is simply the ability of a computer to collect and extract information and apply logic to the data to make a decision (Alnases, et. al, 2023, 2), or it is a set of comprehensive computer-assisted systems that can solve problems and make decisions (Li, 2023 , 2), and (Guliyev, 2023, 1) indicates that it is a new digital front that will have a profound impact on the world, changing the way we live and work through its ability to collect data from digital or physical sources, interpret the data, learn from it, and use that data to solve queries. Customers and complex problems, and the most important artificial intelligence tools are the following:

A- Machine learning: The application of machine learning is widely used in cognitive analytics and is the most common artificial intelligence technique. Machine learning applies probabilistic frameworks to extract possible models from data collected digitally and the best possible model is chosen for the application. Therefore, machine learning is used to make Predictions, and is also used in developing many algorithms, as these algorithms work with input data, which is mainly applied in data mining to be able to find relationships between inputs and outputs, and this will help the organization to work in an unknown environment, as multiple studies have shown that one The most difficult parts of machine learning is choosing the appropriate model or algorithm because of the many options (Elodie, 2020, 27). Active machine learning consists of two branches with two different purposes: active learning and optimization. Active learning aims to explore and model a process with a minimum number of “experiments” to ensure accurate predictions. Over the entire design space, improvement depends on repeatedly selecting new experimental data to find an experiment that improves the goal (Ureel, et. al, 2023, 2).

B- Natural language processing: It is a computer-assisted analytical technique that aims to automatically analyze and understand human language. It allows scientists to easily extract useful ideas found in text data sets while avoiding cumbersome computational work, in addition to its role in machine translation, pattern matching, sentiment analysis, and recognition. On speech (Kang, et. al, 2020, 1), the generation of natural language depends on six steps: (Mah, et. al, 2022, 7):

1- Content analysis: Here information is filtered to determine what should be included in the content produced at the end of the process. This process includes identifying the main topic in the source text or document and establishing relationships between them.

2- Understanding data: This stage includes interpreting information and patterns in a specific and organized context, and machine learning is widely used in this stage.

3- Document Structure: This stage included a documented plan. This stage helps create a narrative structure based on the type of information being interpreted.

4- Grouping Sentences: This section helps combine related sentences or parts of sentences in ways that accurately summarize information about the topic.

5- Grammatical structuring: It helps in programming applications that produce the grammatical structure of a sentence, provides the general correctness or meaning of the text and then uses this information to rewrite the sentence in a grammatically correct way.

6- Language representation: It is the final results created based on the structure or format template used by the programmer, and based on the need or necessity of the language structure and the purpose of the text, and the author or editor can choose any format.

C- Computer vision: It is a multidisciplinary scientific field concerned with the automatic extraction of useful information from image data in order to understand or represent the basic physical world, whether qualitatively or quantitatively (Spencer, et. al, 2019, 200) and is shown to be a field of intelligence. Artificial intelligence that trains computers to interpret and understand the visual world, using digital images from cameras and videos and applying "deep learning" technology so that machines can identify and classify objects or data with greater accuracy than ever before (Malan and Kuperholz, 2020, 5).

3.4. Challenges of intelligent process automation: Despite the benefits achieved by intelligent process automation, it faces a number of challenges, the most important of which are (Kam, et. Al, 2021, 10):

1- Integration issues with legacy systems: System integration must be in place to ensure workflow, and re-engineering legacy systems is essential to ensure low latency, usability, consistency, and quality of activity logs, event triggers, and data in business processes.

2- Cultural readiness and refining workforce skills: Digital business using intelligent software will lead to a significant change in operational processes. Wise management must encourage its employees to use digital work by providing adequate education, time and training, and employees must view this as a supportive and cooperative role and their role. This is for supervision only.

3- Problem-driven and expert-dependent issues: Business activities that are unpredictable, process-complex, and adaptable to change require constant situational awareness and awareness of context in near-time decisions. According to the decision logic of AI engines, the re-engineering phase may require domain experts. And internal teams and consulting to design the appropriate solution to the problem.

4. Productive efficiency: Business organizations today are working to improve the efficiency and effectiveness of productivity in terms of quality and quantity, in order to achieve a larger market share than competitors and achieve a financial return that enables them to expand the production process in the future. Accordingly, we will talk about productive efficiency according to the following paragraphs:

4.1. The concept of productive efficiency: It is defined as the extent of an organization's ability to make full use of the material and human means available to it in order to obtain the highest return and the lowest possible cost. It is a function used to compare the value of the material and moral results that are achieved from the production process, and the value of the tools that are achieved. They are used in production, whether these tools are human or natural (Khamis, 2018, 269), and (Al-Janabi and Salem, 2022, 110) indicate that they outperform the organization in achieving its goals by ensuring rationality and rationality in transforming the organization's resources (human and material) into goods and services that meet The customer's need, and (Al-Ramadan et al., 2022, 411) sees it as the organization's optimal use of its resources in a way that enables it to provide a large production quantity of products and services at the lowest cost and in the fastest possible time and achieves a high level of production efficiency. (Wahab, 2021, 11) explains it as an expression About the correspondence and compatibility between actual productivity and its standard productivity.

4.2. Benefits of productive efficiency: Productive efficiency brings many benefits to organizations that pay attention to its details, the most important of which are (Khamis, 2018, 269):

1- Using the organization's material and human resources in an optimal manner.

2- Reducing costs by eliminating all forms of waste, which will be reflected in a lower selling price.

3- Efficiency will lead to a decrease in the selling prices of products in the market, and thus the amount of sales will increase and profits will increase with it.

4.3. Factors affecting the improvement of the productive process: There are two important factors that affect achieving optimal productive efficiency:

1- Technical and technological factors: These factors are based on the quantity and quality of materials and the level of processing by the supplier, as well as the level of processing by the customer, as well as the raw materials used in the work and job design, in addition to the necessity of providing administrative factors such as planning, organization and control, which inevitably affects productivity. The stronger the administrative factors are available, the more this will lead to increased productivity and vice versa (Wahab, 2021, 12). The technical factors consist of two factors: technical efficiency, which reflects the material efficiency of converting inputs into outputs, and allocation efficiency, which reflects the optimal allocation of input factors. Allocation efficiency is characterized by avoiding waste by producing the largest possible amount of outputs and using fewer inputs. An organization that works with its best practices will be considered 100 percent technically effective, and therefore the technical

factors include (materials, equipment, information, funds, workers , and others) (Khan and Murova, 2015, 173).

2- Humanitarian factors: These factors revolve around the organization's ability to raise employees' desire to work to enhance productivity, by providing training and development programs, and paying attention to the quality of work life, as well as giving them wages, incentives, and other economic factors of a humanitarian nature (Al-Janabi and Salem, 2022). 110), as workers constitute the force that is relied upon in developing the production process, as talented workers provide technical estimates of problems in the organization that would reduce the efforts expended in performing engineering and administrative work, as well as achieving targeted rates of improving production performance, and this helps in Reaching productivity capable of achieving the organization's economic and competitive goals (Muhammad and Abdullah, 2021, 242), and among the most important humanitarian factors (Al-Ramadan et al., 2022, 411):

   A- Ability to work, including skills and learning.

   B- The desire to work and its impact on production

   C- Individual needs and material and social conditions.

4.4. The theoretical relationship between the automation of intelligent processes and productive efficiency: There is a close relationship between the automation of intelligent processes and productive efficiency, as the use of technology and automation in industrial and service processes is considered an essential part of companies' strategies to enhance productivity, as automation contributes to improving efficiency in several ways, including (McKinsey Global Institute, 2017):

1- Increased speed and accuracy: Automation can perform tasks at a higher speed and accuracy compared to manual work, which reduces the time spent in production and reduces human errors.

2- Reducing labor costs: By replacing human labor with machines and robots in some tasks, labor costs can be reduced and resource distribution improved.

3- Increase productivity: Automation can achieve greater productivity by running operations for long periods without interruption, which leads to increased overall production.

4- Improving product quality: Thanks to the precision of automation, product quality can be improved and deficiencies or defects can be reduced.

5. Practical aspect

5.1. The factory the study sample: The factory was established in 1982 and was operated in 1985. In 2005, the factory was invested in agreement with the Egyptian Orascom Cement Company. In 2008, the Egyptian company's share was sold to the French company Lafarge, the leader in this field, with a production capacity of 6,400 thousand tons per day. The factory was built 26 kilometers northwest of the city of Sulaymaniyah by the German company Pulsius. It also produces three types of cement (Taslujah Building), (Taslujah Resistant), and (Taslujah Portland).

5.2. Describing and diagnosing the results of intelligent process automation: The results of Table (1) indicate that the study sample company members agreed in their answers on intelligent process automation and its dimensions in general, as the internal consistency rate for intelligent processes reached 79.5%, and this is an indicator that indicates the validity and stability of the data collection tool. In addition, the value of the arithmetic mean is 3.202, which is an acceptable value because it is higher than the hypothetical mean estimated at 3, while the standard deviation is 1.078, which is a somewhat acceptable value, which indicates that there are many values deviated from the arithmetic mean, while the response rate for the total items was obtained. The automation of processes is at 64% and the coefficient of variation is 33.6%. Based on the answers of the working individuals, it turns out that the company currently has automation processes at a rate of 64%, and is trying to make its production and service processes fully automated in the near future.

5.3. Describing and diagnosing the results of productive efficiency: The results presented in Table (1) show that most of the individuals in the company agreed on the increase in productive efficiency in their company, as the internal consistency constituted 92.2%, which indicates the stability of the questionnaire items, and the response rate was very close to consistency. The internal ratio represents 92.6%. The arithmetic mean reached 4.623 and the standard deviation reached 0.922%. As for the coefficient of variation, it reached 1.9%. Accordingly, the company's production efficiency may exceed 92%, and this is a positive indicator of the good use of resources and the degree of achieving goals.

Table 1. Results of employees' answers to the dimensions of the study variables in the study sample company

Intelligent process automation results						
Dimensions	Paragraphs	Statistical methods				
		Internal consistency	Arithmetic mean	standard deviation	Response rate	Coefficient of variation
Robotic operations	X1 – X10	0.801	3.25	1.072	0.65	0.329
artificial intelligence	X11 – X20	0.789	3.155	1.085	0.631	0.343
average		**0.795**	**3.2025**	**1.0785**	**0.6405**	**0.336**
Productivity efficiency results						
Dimensions	Paragraphs	Internal consistency	Arithmetic mean	standard deviation	Response rate	Coefficient of variation
Technical and technical factors	X21 – X25	0.912	4.66	0.0912	0.932	0.019
Human factors	X26 – X30	0.932	4.605	0.0932	0.921	0.020
Average		**0.922**	**4.6325**	**0.0922**	**0.9265**	**0.0195**

5.4. The correlation and impact relationship between the two variables of the study (in general): The results of Table (2) show that there is a strong correlation relationship at a significance level of 0.05 between the automation of intelligent processes and productive efficiency, which is estimated at 78.9%, while the percentage of the impact relationship for the automation of intelligent processes in productive efficiency was Its value is 62.3%, meaning that the more automation of intelligent processes increases, the more this is reflected positively on production efficiency. To confirm the validity of the impact relationship model, the F value came to prove this, as it reached 32.55, which is significant because it is greater than its tabular value of 2.353. In light of these results, we will accept My study hypothesis.

5.5. The gradual correlation and impact relationship between the two variables of the study: The results of Table (2) show that there is a significant correlation between the automation of robotic processes and productive efficiency at a rate of (61.4%), and there is also a significant correlation between artificial intelligence and productive efficiency at a rate of (50%). Robotic operations alone affect production efficiency by 37.7%, while artificial intelligence alone affects production efficiency by 24.9%, and therefore the total effect has reached 62.3%. When we add 1 correct to the result of robotic operations, this will affect production efficiency by 37.7%. When adding 1 correct to the artificial intelligence, this will increase production efficiency by 24.9%. When adding 1 correct to the result of robotic operations and artificial intelligence together, this will affect the increase in efficiency by 62.3%.

Table 2. Results of correlation and impact relationships between the study variables (in general and individually)

Independent variable intelligent process automation									
Dependent variable Productivity efficiency	B_0	Robotic operations B_1	artificial intelligence B_2	**R**	**R_2**	**F**		**N**	**DF**
	0.249	**0.357**	**0.377**	**0.789**	**0.623**	**Cal** **32.55**	**Tab** **2.353**	**50**	**5,44**

6. Conclusions and proposals

The study reached a number of conclusions, the most important of which are:

1- The theoretical aspect of the study concluded that there is a logical relationship between automation of processes and production efficiency. The more the company automates its activities, the more this enhances production efficiency.

2- The results of the description and diagnosis related to the automation of intelligent processes indicate that the majority of individuals working in the company sample of the study agreed that the company applies process automation in its operations at a rate of 62%, and it tried to increase that percentage to raise production efficiency.

3- The results of production efficiency show that the company uses its resources efficiently and effectively, making its production efficiency rate 92%, which is a very high percentage.

4- The correlation and impact relationship revealed that there are correlations and influences with statistical significance between the automation of intelligent processes and improving production efficiency, which indicates the accuracy of choosing the title of the study, and these relationships led to the acceptance of the study's hypotheses.

Proposals:

1- The necessity of applying intelligent process automation to reduce dependence on the human element and simplify production and service process procedures, and this ensures an increase in the company's production efficiency.

2- Working to introduce process automation into all activities in order to reduce human errors at work, as well as use resources with the least possible time, effort and costs.

3- The company must gain customer loyalty by automating its intelligent operations in many areas, such as automatically updating appointment forms, automating scheduling, and analyzing customer data to know their needs.

4- Educating the company's employees to adopt automated work instead of the human element, that this does not mean abandoning them, but rather to help them complete their work quickly on the one hand, in addition to making use of time to focus on innovation and strategic thinking tasks.

5- Continuously improving production efficiency through automation of intelligent processes, as well as continuous improvement of production plans to ensure rapid access to customers.

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