Enhancing Production Capacity Planning with Artificial Intelligence: The Role of Artificial Neural Networks: A Diagnostic and Analytical Study of the Opinions of a Sample of Workers in the General Company for Electrical and Electronic Industries, Baghdad

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Abstract

The current research seeks to activate the role of artificial intelligence and leverage it in a manner that contributes to successful production capacity planning by utilizing the artificial neural networks available in the field under study. This is done with the aim of creating an advanced industrial setting adept at delivering items that satisfy the continually evolving goals and demands of consumers. This is in addition to positioning the organization under study at the forefront of organizations that utilize artificial intelligence in their work tasks, with the aim of achieving successful production capacity planning, from the moment raw materials enter the factory until the final product is delivered to the customer. Based on the above, the researcher distributed (217) questionnaires to identify the most significant obstacles that may prevent the use of artificial neural networks in production capacity planning.

This was completed by responding to several inquiries that help to define the issue of the study, specifically:

i. How well-versed in artificial intelligence methods are the managers of the organization being studied?
ii. Does the company's management aim to implement effective production capacity planning?
iii. Which apps are best suited to be used in the business being studied?

The investigation yielded several conclusions, the most significant of which are:

i. The organization under study is committed to having effective neural networks by subjecting its employees to intensive training courses.
ii. The organization's management strives to ensure that production capacity is planned and managed continuously, without interruptions, throughout the production period.

In light of the previous conclusions, a number of proposals were presented, perhaps the most prominent of which are:

i. Work to provide financial, economic, and technological alternatives to determine the amount of capacity required to meet the organization's needs.
ii. Work to achieve a balance in workloads by providing a suitable and comfortable working environment that contributes to reducing stress and fatigue.

Keywords: *Artificial neural networks; production capacity planning* .

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1. Introduction

The first practical application of artificial neural networks appeared in the late 1950s, when researcher Frank invented the first neural network capable of handling adaptive linear sensors. These networks, using computers and algorithms, helped address many of the problems and failures facing manufacturing processes, including the failure to properly and successfully plan production capacity, which previously required a significant amount of computing power. The use of these networks provided many industrial organizations with the opportunity to solve complex industrial problems that had a significant impact on the success and progress of these companies in a highly dynamic environment. This, in turn, led to a significant breakthrough that contributed to creating an industrial environment free of problems and obstacles. In view of the above data, the researcher has built a comprehensive framework based on the proposals of writers and researchers on the extent of the possibility of investing artificial neural networks in achieving sound and fruitful planning of production energy in the field under study, in a way that ensures maximum benefit from the available resources, whether material or human. Accordingly, what the researcher has reached has been documented in the axes of this research, which are sequenced as follows: The first section addressed the research methodology in all its details in terms of importance and objectives, while the second section came to address the theoretical aspect with all its concepts, components and characteristics. The third section came to prove to us The results of the statistical analysis between the study variables, and the fourth section wrapped up this scientific accomplishment with the key findings and recommendations the researcher came to as a result of carrying out this investigation.

2. First Axis: Research Methodology

2.1. First: The Research Problem: Many organizations in the twenty-first century are seeking to adopt new mechanisms to implement their production processes by relying on artificial intelligence technologies in an attempt to achieve distinctive levels of quality at an acceptable cost and reasonable price. However, all of this may face obstacles that prevent the successful exploitation of these mechanisms. Perhaps the most prominent aspect mentioned in the researchers' writings is the organizations' endeavor to adopt artificial neural networks and how to successfully invest these networks in production capacity planning with the aim of achieving distinctive levels of quality, through which organizations can gain a competitive advantage that gives them the ability to outperform their counterparts in other industrial organizations working with them in the same field, especially since these organizations live in a dynamic, rapidly changing environment. Therefore, through the researcher's review of the topics of artificial neural networks and how to invest these networks in production capacity planning, it became clear that they have not received sufficient attention at the level of the organization under study, especially since the components of these networks are actually available, but they are not invested in production capacity planning, and the resulting reduction in costs is unjustified due to the limited knowledge of administrative leaders of their theoretical and practical concepts. Based on the above, and in order to determine the possibility of Investing in Artificial Neural Network Components in Planning Production Capacity at the Field Level: This research attempt addresses the above-mentioned problem by introducing workers in the field to how to invest and apply this mechanism, based on its available capabilities, to maximize its benefits.

2.2. Second: The Importance of the Research : The significance of this study arises from the relevance of the two variables under investigation and the practical benefits and returns they provide to the organization under study. In particular, the research highlights the one hand, and the external environment, on the other. The researcher emphasized that the organization's reliance on the use of artificial neural networks, with their subcomponents, to carry out its manufacturing tasks contributes significantly to improving quality and organizing the production process. This contributes to organizing the flow of resources through production channels in a sequential and systematic manner, enabling it to plan its production capacity with complete accuracy and objectivity, ensuring flexibility and continuity in the production process, thus contributing to meeting the ever-fluctuating needs and desires of customers.

2.3. Third: **Research Objectives**: Our current research aims to:

i. Benefit from the theoretical aspects of the research and attempt to identify the most important indicators that can serve the field under study.
ii. Identifying the obstacles that the research organization may face in successfully and properly planning production capacity, in order to identify and address them.
iii. Striving to develop the actual reality of the research organization and keep pace with the developments surrounding it.
iv. Developing solutions and proposals, in light of the research results, that will significantly contribute to the investment of artificial neural networks in the research organization with the aim of achieving sound production capacity planning.

2.4. Fourth: Research Hypotheses: The research hypotheses can be formulated as follows:

2.4.1. First Main Hypothesis: There is a statistically significant correlation between the components of artificial neural networks, when considered collectively, and production capacity planning.

Sub-Hypothesis (A): A statistically significant correlation exists between each individual component of artificial neural networks and production capacity planning.

2.4.2. Second Main Hypothesis: The components of artificial neural networks, taken together, have a significant effect on production capacity planning.

Sub-Hypothesis (A): Each component of artificial neural networks, when examined separately, exerts a significant effect on production capacity planning.

2.5. Fifth: Statistical Analysis Methods: To obtain objective indicators consistent with the aims of the study and to provide mechanisms for testing its hypotheses, the statistical package **SPSS (version 23)** was employed to carry out the necessary analyses and produce scientifically reliable results supporting the proposed hypotheses. **Confirmatory Factor Analysis (CFA)** was conducted to evaluate the suitability of the research variables within the field under study and to examine both the correlation and impact relationships between the independent and dependent variables. This analysis enabled a clearer understanding of the relationships among the variables and confirmed the validity of the hypotheses regarding the strength of association and the influence of the independent variable on the dependent one.

2.6. Sixth: **Hypothetical research plan**: The systematic treatment of the study problem requires the design of a hypothetical plan that indicates the possibility of investing in artificial neural networks to achieve sound and effective planning of production capacity, as shown in Figure (1).

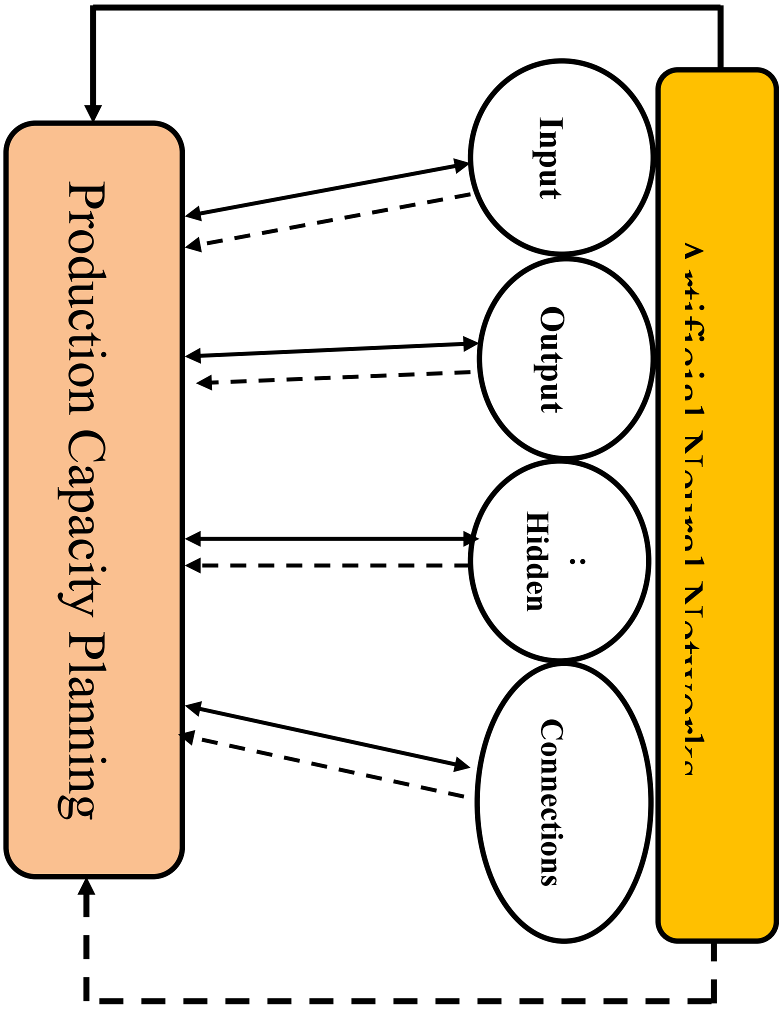

Figure (1) Hypothetical research plan

2.7. Seventh : Research Methodology: The researcher relied on both descriptive and analytical approaches to complete this research.

2.8. Eighth : Research Limits :

A. Spatial Limits: This research was conducted at the General Company for Electrical and Electronic Industries in Baghdad. The researcher chose the company because it is one of the leading companies seeking to implement modern approaches in production and operations management. Furthermore, it is one of the companies that relies on modern methods in the production of electrical and electronic products. Furthermore, the company under study needs to adopt successful and sound planning for its production capacity to avoid various types of waste that other industrial companies may be exposed to.

B. Temporal Limits: The research period was limited to the period between January 12, 2025, and June 18, 2025.

C. Human Limits: The current research was limited to employees in senior management and decision-makers at the General Company for Electrical and Electronic Industries in Baghdad, including the company director and his assistants, department heads, division and unit managers, distribution line supervisors, and maintenance and network engineers.

3. Second Axis: Theoretical Aspect

3.1. First: Artificial Neural Networks

Concept: Artificial neural networks are one of the intelligent applications relied upon for pattern recognition or data classification in a way that enables organizations to achieve significant savings in time and cost by activating the systematic programmed learning process. Learning in biological systems involves modifications to the synaptic connections between neurons, which contributes to reducing the time and effort required for implementation. (Karun, 2016, 38) emphasized that artificial neural networks are a computing system consisting of a group of nodes called neurons, or nerve cells, connected to each other. They operate similarly to neurons in the brain. These nodes receive data (inputs), process them through mathematical operations, and produce outputs based on the needs and desires of each customer. (Al-Maamouri & Al-Hussaini, 2020, 4) defined artificial neural networks as an artificial intelligence technology that leverages information by using the computer hardware available within an organization in a manner similar to the human mind's investment in information and its use for the benefit of the process. Productivity is achieved through the large number of sub-cells called neurons that connect to each other in three layers: the input layer, the output layer, and between them an intermediate layer called the hidden layer. (Basheer & Hajmeer, 2000, 3) explained that artificial neural networks are relatively new computing tools that have been widely used to solve many complex real-world problems. Their distinctive properties enable them to address failures or stoppages in production lines by directly processing information and achieving a special type of connection for production lines characterized by nonlinearity or high parallelism. (Ashour, 2020, 4) defined artificial neural networks as an information structure through which production processes are processed in parallel. These structures contain special processing elements that are linked to each other via a set of connectors and processing elements with the aim of activating their inputs to obtain optimal outputs. (Mark, 2022, 17) defined the artificial neural network as a mathematical model that attempts to generate a kind of simulation between production functions that overlap with each other in a way that resembles biological neural networks with the aim of linking and unifying production lines within the factory and making them into a single independent component (industrial cell) in an attempt to reduce production time and effort expended in the production process as well as accuracy in implementing tasks.

The Importance of Artificial Neural Networks: Many industrial organizations are adopting artificial neural network applications due to their prominent role in generating significant financial returns, positioning the organization at the forefront of the market in a volatile industrial environment. This is achieved by improving quality and meeting customer deadlines. Several researchers, including (Mark, 2018, 17), have emphasized that artificial neural networks are of great importance, different from human biological neural networks. These networks enable organizations to excel at performing their tasks in a manner that positively impacts their performance through:

a. **Size**: The human brain contains approximately 86 billion neurons and more than 100 synapses (connections), while artificial neural networks contain a much smaller number of neurons, which saves space for implementation.
b. **Signal Transmission and Processing**: The human brain operates asynchronously, while artificial neural networks operate synchronously, enabling the production of flawless products in record time.
c. **Processing Speed**: Individual biological neurons are slow, while standard artificial neurons in artificial neural networks are fast, enabling organizations to meet the fluctuating needs and expectations of their customers in a timely manner.
d. **Networking**: Biological neural networks are characterized by complex synaptic properties, while artificial neural networks are often in a tree-like structure, allowing organizations to more precisely allocate resources, thus executing work more quickly.

While he explained (Matog, 2022, 3-4) explained that artificial neural networks are of great importance, directly contributing to improving productivity through:

a. Neural networks perform well with inputs relatively similar to their training data, but they may produce completely unexpected outputs that are outside the norm.
b. Relatively fast, as interconnected neurons branch out gradually to achieve the primary goal.

c. When damaged, they fail gradually, unlike sequential computers, which can fail immediately after one of them fails.
d. Although they require no programming, the pre- and post-processing systems of neural networks can be very labor-intensive.

Components of Artificial Neural Networks: The operation of artificial neural networks depends primarily on the availability of a number of components that play a major role in the success of these networks by determining and organizing the sequence of entry of raw materials until the production of the final product and its delivery to the customer at the predetermined time based on the nature of the adopted production system. Both (Al-Maamouri & Al-Hussaini, 2020, 5), (Farid & Al-Arabi, 2019, 72), and (Bouadou, 2015, 138-139) agreed that artificial neural networks have a number of components that vary from one organization to another, each according to the adopted production system and based on the level of automation adopted by the industrial organization. However, the components most commonly used by most organizations can be explained in :

a. **Input Layer**: The input layer consists of a group of work units whose task is to distribute the input materials from the external environment to the intermediate (hidden) layer that follows it through the connections between them (the central processing layer). This network may consist, depending on its structure, of one or more processing units. Network inputs can be in the form of raw data, binary data, or connected data, and they can also be from other processing units (raw materials). Therefore, network inputs do not undergo any processing; rather, their task is limited to transferring data to the hidden layer (central processing units) through interconnections.
b. **The Output Layer**: This is the final layer of artificial neural networks. This layer consists of processing units that receive data or raw materials from the previous layers (the hidden layer) for the purpose of delivering them to their final destination. This layer can contain one or more processing units, depending on the architecture of the artificial neural network and the adopted production system. This layer receives signals coming from the input layer or the hidden layer, and retransmits them after performing the necessary processing. It also returns these outputs to the network when it is unable to process its data (i.e., when there is a disagreement over the nature of the output material, as it does not conform to the agreed-upon specifications). The outputs represent the final stage of the manufacturing process, providing the network with value. The network often contains a single output layer.
c. **Hidden Layer**: A hidden layer is a layer located between the input layer and the output layer. Its function is to process data or materials entering the production line in such a way that the process of converting inputs into outputs is completed (successfully and according to the required specifications in terms of quality, cost, etc.). An artificial neural network can contain one or more hidden layers. The hidden layer receives signals coming to it from the input layer via interconnections in order to process them and take the necessary action. It then, in turn, sends them via the connections to the output layer.
d. **Connections :** are links (communication units) between the different network layers (input layer, output layer, and hidden layer). This layer connects the layers to each other or connects the work units within each layer (processing units) via links or (connection belts) that are accompanied or attached to each interconnection. The task of these links is to transfer data, raw materials, or weighted signals between the layers or processing units in a way that ensures that the resources reach the subsequent stages at the specified time with the specified quality without any loss or damage.

Characteristics of Artificial Neural Networks: Artificial neural networks possess a set of characteristics that directly distinguish them from human biological networks. He confirmed (Mark, 2018, 35) emphasized that the characteristics of these networks can be identified as follows:

a. **Training**: The process by which network operators are trained to change their weights and orientations based on the nature and specifications of the product being produced, as well as the required quality level and delivery dates.

b. **Learning**: The process of providing operators in the internal environment with sufficient information to adapt the artificial neural system in a way that makes it automatically updateable/adaptable to changes in the surrounding environment.

c. **Comparisons**: Artificial neural networks provide the ability to compare the network's computerized output with the expected results. This allows for the identification of errors and the purpose of addressing or avoiding them before they occur. These errors can then be used to change the network's parameters in a way that may contribute to improving performance.

d. In the manufacturing process, the target product is not directly delivered to the distribution centers for the purpose of delivering it to the customer. Rather, the system is programmed through the programming available in the artificial neural network so that the system automatically acquires the necessary information about the destination of the product and the time period required to deliver it by discovering the structural features in the input patterns and adapting to them.

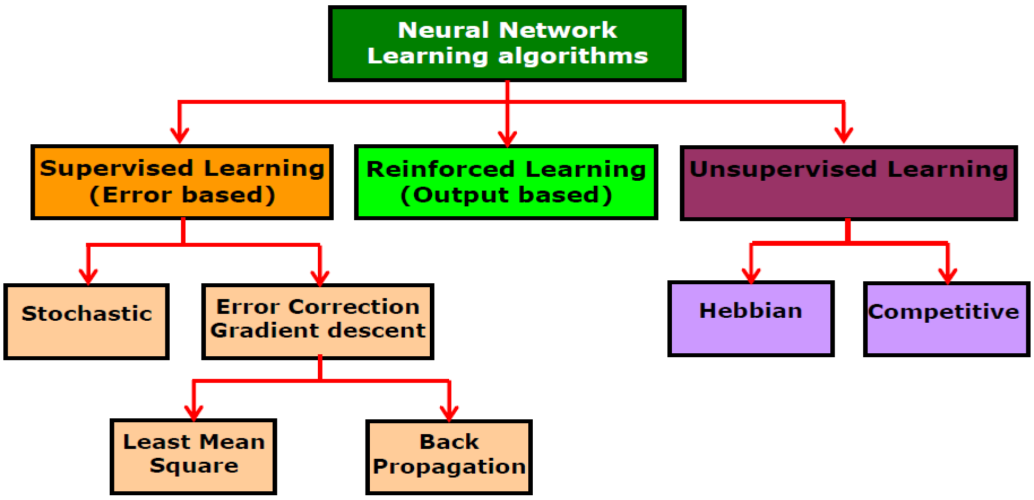

Figure (2) Properties of artificial neural networks

Source : Mark, Fillip Jon, (2018), Fundamentals Of Artificial Neural Networks , *Institute of Science and Technology Journal* , Vol 5, No 2 P5

3.2. Second: Production Capacity Planning

Idea: Unless the products are offered for a reasonable price, production is pointless. The anticipated level of demand usually determines a factory's capacity. Planning for production capacity is made easier by stable demand, but demand variations make it more difficult to acquire resources and match them to demand levels. Planning for production capacity is therefore a difficult procedure because market demands are ever-changing. According to his confirmation (Prindle, 2011, 33), production capacity planning is the process of figuring out how many workers a factory needs and how many machines and equipment it needs to have on hand in proportion to the size of the factory and the number of workers., This contributes to setting timetables for the production and timely delivery of the product. As he explained (Bhatia, 2014, 22) emphasized that production capacity planning is a long-term policy process that helps guide the plant's energy system in a way that contributes to determining the number of workers required in the plant, coupled with the number of machines and equipment available. Production capacity planning can be conducted with the participation of various stakeholders, including government agencies, local utilities, academia, and other interested parties. and also defined (Lora, 2024, 81) production capacity planning as a roadmap for meeting the energy needs of a factory or organization. This is accomplished by considering multiple factors, such as technology, economics, the environment, and society, that impact national energy issues .

And also defined (Gurumurthi & Rapatwar, 2025, 3) production capacity planning, or what is known as aggregate planning, as the process of assembling (unifying) all the requirements necessary to meet energy needs or requirements by determining the amount of energy needed to meet the changing demand for products during a specific period of time within the medium time horizon, as well as determining the best ways to provide the required production capacity.

While defined (Laoyan, 2025, 2) defined production capacity planning as the process of determining the requirements necessary to produce a specific product through capacity planning and providing the necessary resources to make the production process successful, such as highly skilled and experienced workers, the time required to produce the product, as well as providing the budget necessary to complete the production process until the product is delivered to the customer.

Production Capacity Planning Objectives: The production capacity planning process is characterized by a set of objectives that every effective organization seeks to achieve through the availability of a sufficient number of machines and equipment, as well as the availability of qualified and highly trained human resources whose goal is to produce the product and deliver it to the customer on time , He emphasized (Durns,2021, 43) that the objectives of production capacity planning can be represented in:

a. Achieving feasibility: meaning that internal needs are within the capabilities of the operating system.
b. Achieving optimal performance: meaning identifying the least costly methods to meet production capacity needs.
c. Evaluating available financial, economic, and technological alternatives to determine the appropriate capacity for each demand.
d. Selecting the most appropriate alternative to achieve the strategic mission embodied in producing the product and delivering it to the customer at the appropriate time and place.
e. Increasing the production of new products or developing existing products in a way that directly contributes to meeting customer demand at the appropriate time and place, thereby securing a distinct market share.

While he pointed out (Brad, 2021, 208) noted that an organization with outstanding performance strives to utilize its production capacity through a number of objectives, including:

a. Regulating the use of production capacity for storage during a specific period to meet demand at a later stage.
b. Enabling managers to determine the factory's production capacity in terms of the quantity of inputs and outputs, thus making appropriate decisions or plans that match the quantity of demand.
c. Identifying alternative production methods to address unstable demand conditions, and then selecting the most appropriate alternative financially, economically, and technologically, in a manner that optimally meets customer demand.
d. Emphasizing the importance of building a stock of finished goods during recessionary periods in order to prepare to meet expected demand in the future based on market fluctuations.

Principles of Production Capacity Planning: Successful organizations determine their production capacity based on the capacity of their factories or production units by implementing their main operations in a systematic scientific manner based on several rules that these organizations consider to be working principles in light of which they proceed in order to plan and manage their production capacity based on the capacity of the leading group of machines and equipment, workforce, material resources, etc. Therefore (Ortikmirzaevich, 2017, 66-67) has identified four basic and essential principles that any successful organization must adopt directly in implementing its production plans, which are:

a. **The Principle of Scientific Management**: This principle assumes that production capacity planning must be managed and organized according to clear and explicit scientific principles based on reliable information and scientific methodologies. This means avoiding random, uninformed guesses and expectations. This principle also means that production capacity management must utilize the latest scientific and technological equipment and machinery to carry out its tasks, in addition to the advanced methods of managing production capacity of globally recognized organizations.

b. **The Principle of Continuity**: This principle emphasizes that planning and managing production capacity within an organization must be carried out continuously without interruption. This is because all the conditions and environmental fluctuations surrounding the organization are in a state of constant change due to the instability of both the internal and external environments, making repetitiveness inherent in the nature of its work.

c. **The Principle of Flexibility**: The principle of flexibility is based on the fundamental conditions that necessitate the principle of continuity. Uncertainty, the volatility of the external environment, and the company's shifting assessments, positions, and intentions are what compel an organization to demonstrate complete flexibility, whether in its operations, its personnel, its resources, or otherwise. In this case, the principle of flexibility can grant planning and management of production capacity the ability to effect changes, both internal and external, to achieve the desired results. Production capacity must be planned and managed in a manner that enables the necessary changes to be made and linked to changing circumstances. Consequently, the flexibility of production capacity management confers additional stability on the organization itself and on the programs and plans implemented within it.

d. **4. The principle of precise objectives**: The principle of correct objectives and focus on the final result is assumed by ensuring that the organization is moving in the right direction in terms of achieving the objectives that were previously planned within its operational strategies based on the systematic nature of managing and planning production capacity, since all sectors of the organization have one final objective whose implementation is given full priority. At the same time, it is always necessary to choose the leadership circles in the organization from among the employees who have distinctive experiences and skills, as the selection of leadership circles is based on an in-depth analysis of the organization’s situation, the surrounding circumstances, as well as the factors that most influence its production capacity.

Types of productive capacity planning: In order to achieve success in planning productive capacity in a proper manner, organizations seek to differentiate between different types of plans in order to reach the planning that is appropriate to the size of the organization and the number of workers in it on the one hand and the size of the project to be implemented and the time required for implementation on the other hand.

He confirmed (Gurumurthi & Rapatwar, 2025, 3) that the types of productive capacity planning for any successful project can be determined in:

a. **Resource Energy planning**: Resource planning helps maximize the capacity of existing resources, which helps in selecting which resources will complement and which will be eliminated or primary. The required capacity is determined mathematically by calculating the number of employees in the production line multiplied by the weekly work hours. Therefore, most organizations are keen to seek the participation of skilled labor groups, sales lines, etc., to better understand capacity planning.

b. **Project Energy planning**: The organization's senior management conducts a comprehensive review of the project required by the executive developers in terms of the time required for completion. A number of task managers are assigned to the projects, and their task planning is determined by calculating the estimated time the assigned team will work on the project. This evaluation aims to achieve consistency in strong work performance with project performance points. This type of energy works in coordination with senior management to work on training, which contributes to improvements or deficiencies in the work, which may be reflected in achieving significant profits.

c. **Team Work Planning**: Organizations that rely on partnerships resort to adopting this method of planning their entire capacity, where the team works together in the future, such as the IT sector, the HR sector, the financial resources sector, and others, in an attempt by project managers to achieve sound planning for everyone by determining the amount of work that can be implemented weekly, and how this will affect the optimal schedule for the project.

4. Axis Three: Practical Aspect

4.1. First: Description of the research sample: The study relied on a purposive sample that consisted of individuals directly involved in the company's activities and familiar with its operations. This choice was made to ensure that the collected data would be both reliable and practically useful, while also allowing the researcher to obtain constructive opinions and suggestions that strengthen the value of the study. Accordingly, a total of (221) questionnaires were distributed to different administrative levels, including the general manager, heads of departments, branch managers, unit and division leaders, in addition to production line supervisors. Out of these, (217) questionnaires were returned in a valid form for analysis, which represents a response rate of (98%).

4.2. Second: Confirmatory factor analysis: Confirmatory factor analysis relies on a group of measures known as goodness-of-fit indicators. For a model to be considered valid and suitable for testing the research hypotheses, these indicators must fall within their acceptable ranges. In this study, the researcher adopted the generalized least squares method to conduct CFA rather than the maximum likelihood method, since the latter requires several assumptions to be satisfied. These include the normal distribution of data, the absence of outliers, and ensuring that the sample size is at least five to ten times greater than the number of observed variables. As these requirements were not fully met in the current dataset, the generalized least squares method was deemed more appropriate, as demonstrated in Figure (3) and Table (1).

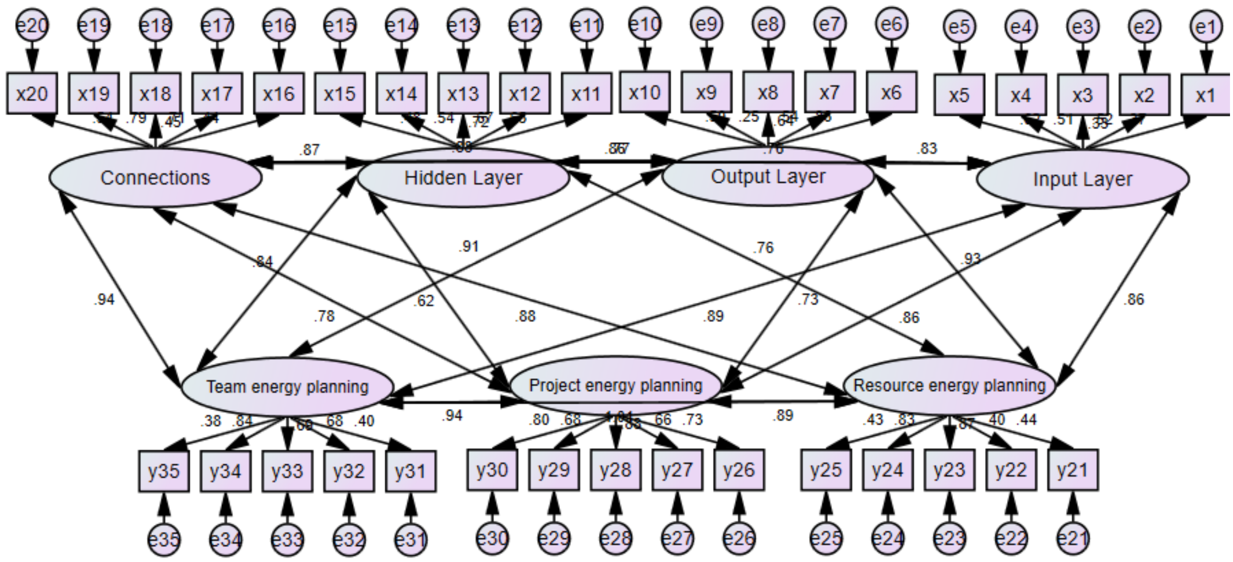

Figure (3) The prototype

Table (1) Quality indicators of the initial research model

Matching result	Model indicators	Acceptance limits	Standard indicators
Matching	0.966	GFI > 0.90 Model Quality	**GFI**
Matching	0.960	AGFI > 0.90 Best Match	**AGFI**
Matching	0.072	RMR value between 0.08 and zero	**RMR**
Matching	0.827	Close to one indicates a good match	**PGFI**
Matching	0.958	NFI > 0.90 Best Match	**NFI**
Matching	0.906	PRATIO > 0.90 Best Match	**PRATIO**
Matching	0.954	0.90 RFI >0.90 Data match with model	**RFI**

Source: Prepared by the researcher, derived from the results generated through on Computer

From Table (1), it is evident that the indicators of the hypothetical model fall within the acceptable range of quality criteria. Accordingly, the model can be considered valid and accepted without the need for modification, making it suitable for proceeding to the hypothesis testing stage.

4.3. Third: Hypothesis Testing: After performing the confirmatory factor analysis and confirming that the research model is consistent with the field data and satisfies the necessary goodness-of-fit standards, the next step is to proceed with testing the research hypotheses, as outlined below:

Hypothesis 1: Correlation Between Artificial Neural Networks and Production Capacity Planning

This part examines the validity of the first main hypothesis, which proposes that there is a significant relationship between the components of artificial neural networks (**Collectively**) and production capacity planning. The results presented in Table (2) demonstrate a positive and strong correlation between these variables, as the correlation coefficient reached (0.930*) at a significance level of 0.05. Accordingly, the first main hypothesis is supported and accepted.

Table (2) Components of artificial neural networks (combined) and production capacity planning

Components of artificial neural networks	Independent Variable / Dependent Variable
0.930*	**Production capacity planning**

Prepared by the researcher, derived from the results generated through on Computer

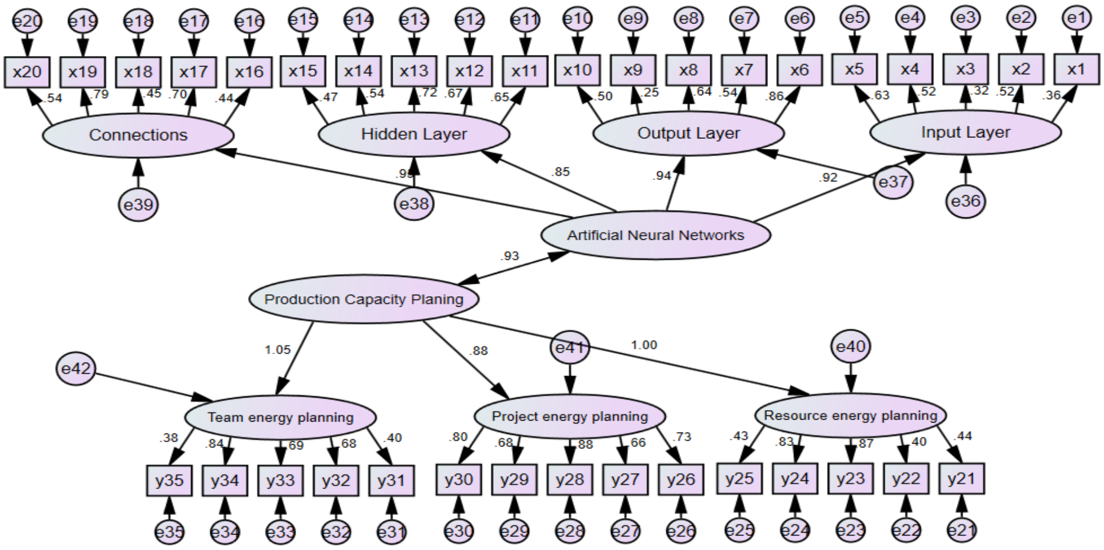

Figure (4) A model of the correlation relationships between the components of artificial neural networks (**Combined**) and production capacity planning.

Sub-Hypothesis (A) : Derived from the first main hypothesis, this assumption suggests that each component of artificial neural networks, when examined individually, has a significant correlation with production capacity planning, as illustrated in the following results:

a. **The Relationship Between the Input Layer and Production Capacity Planning**: This section addresses the validity of Sub-Hypothesis (A) derived from the first main hypothesis, which posits that the Input Layer component has a significant correlation with production capacity planning. Evidence from Table (3) provides the statistical results that clarify this relationship. indicate that there is a significant correlation between the (Input Layer) component and production capacity planning, as the value of the correlation coefficient reached (0.897*) at a significance level of (0.05).

b. **The Relationship Between the Output Layer and Capacity Planning** : This section tests Sub-Hypothesis (A) of the first main hypothesis, which proposes that the Output Layer has a significant correlation with capacity planning. The results in Table (3) confirm this relationship, as the correlation coefficient was (0.873*) at the **0.05** significance level, indicating a strong and statistically significant association.

c. **The Relationship Between the Hidden Layer and Capacity Planning** : This part examines Sub-Hypothesis (A) of the first main hypothesis, which states that *the* Hidden Layer is significantly correlated with capacity planning. According to the data in Table (3), the correlation coefficient reached (0.758*) at the **0.05** significance level, thus supporting the hypothesis.

d. **The Relationship Between the Connections Component and Capacity Planning :** This section addresses the verification of Sub-Hypothesis (A) of the first main hypothesis, which suggests that the Connections component has a significant relationship with production capacity planning. The findings reported in Table (3) show a correlation value of (0.890*) at the **0.05** significance level, confirming the existence of a statistically significant correlation.

Table (3): Correlation coefficients between each dimension of concurrent engineering and the hybrid manufacturing system

Connections	Hidden Layer	Output Layer	Input Layer	Artificial Neural Networks
0.890*	0.758	0.873*	0.897*	Production Capacity Planning

Prepared by the researcher, derived from the results generated through on Computer

In light of this, sub-hypothesis (A) of the first main hypothesis is accepted, as there is a significant positive correlation between the components of artificial neural networks (**Individually**) and production capacity planning**.**

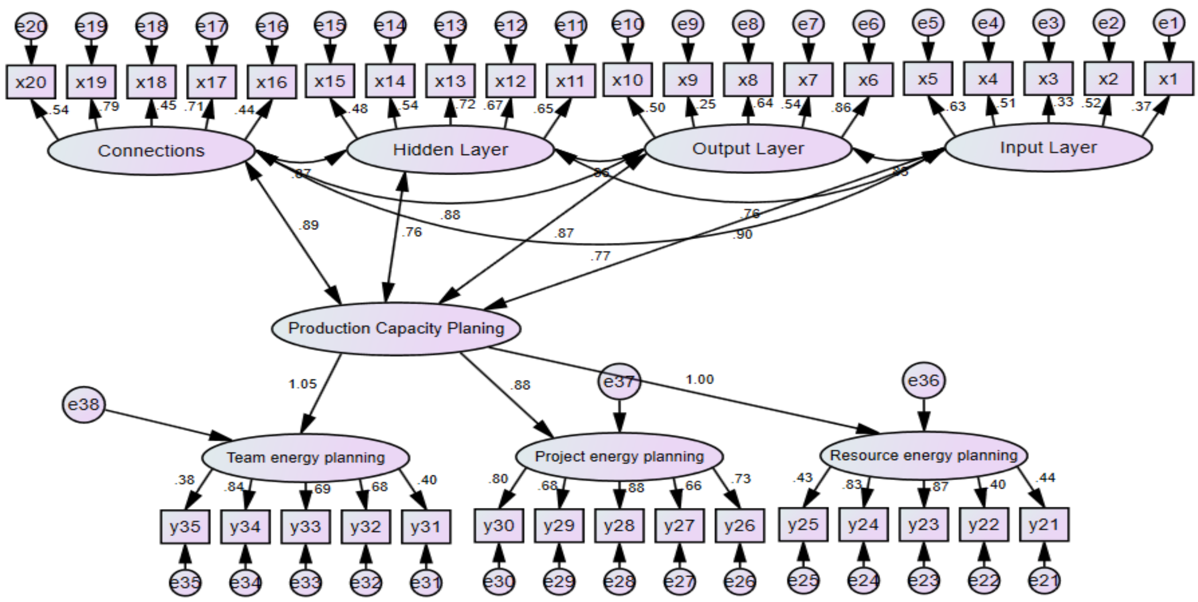

Figure (5) A model of the correlation relationships between the components of artificial neural networks (individually) and production capacity planning

The Second Main Hypothesis : There is a significant effect of the components of artificial neural networks, taken collectively, on production capacity planning within the organization under study. To evaluate this hypothesis, a structural equation model (SEM) was constructed, as illustrated in **Figure (6)**. The statistical test results derived from this model, which determine whether the hypothesis can be accepted or rejected, are presented in **Table (4)** as follows:

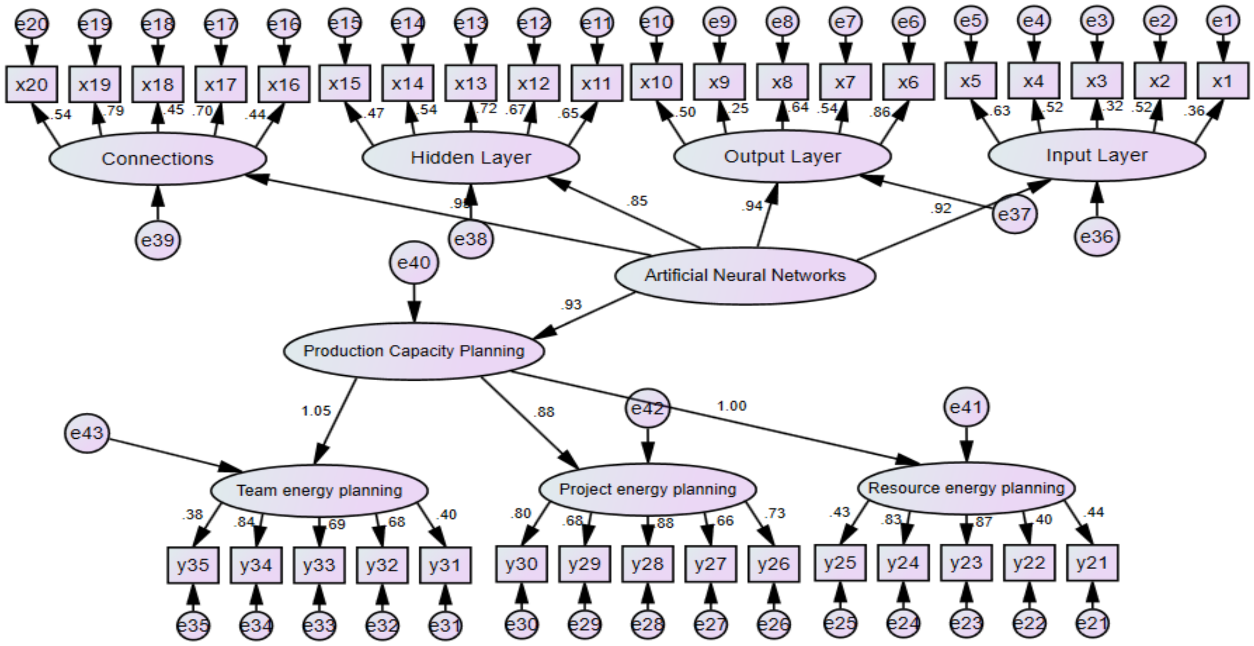

Figure (6) Model of the impact of artificial neural network components on production capacity planning

Table (4) Model test values

P	Lower	Upper	S.R.W	Estimate	The variable Affected by	Direction of Influence	The influencing variable
0.02	0. 879	0.978	0.930	0.731	**production capacity planning**	←	**Artificial Neural**

Prepared by the researcher, derived from the results generated through on Computer

The results shown in **Table (4)** demonstrate that the components of artificial neural networks have a direct effect on production capacity planning. This is evidenced by the standardized regression coefficient (SRW) of (**0.930)** and the unstandardized regression coefficient (**Estimate**) of (**0.731) …** The effect is statistically significant, as indicated by the probability value (P-value) of **0.01**, which is below the **0.05** threshold .. Further support is provided by the 95% confidence interval of the unstandardized regression coefficient, with lower and upper bounds of **(0.879 – 0.978)** , which excludes the value of zero. This exclusion confirms the importance and reliability of the explanatory variable's influence on the dependent variable. Based on these findings, the **second main hypothesis is accepted**, affirming the significant effect of artificial neural network components on production capacity planning.

Sub-Hypothesis (A):

Derived from the second main hypothesis, this assumption states that the components of artificial neural networks, when considered individually, have a significant impact on production capacity planning within the organization under study. To examine this hypothesis, a structural equation model (SEM) was developed, as illustrated in **Figure (7)**. The statistical test values obtained from this model, which determine whether the hypothesis is accepted or rejected, are presented in **Table (5)** as follows:

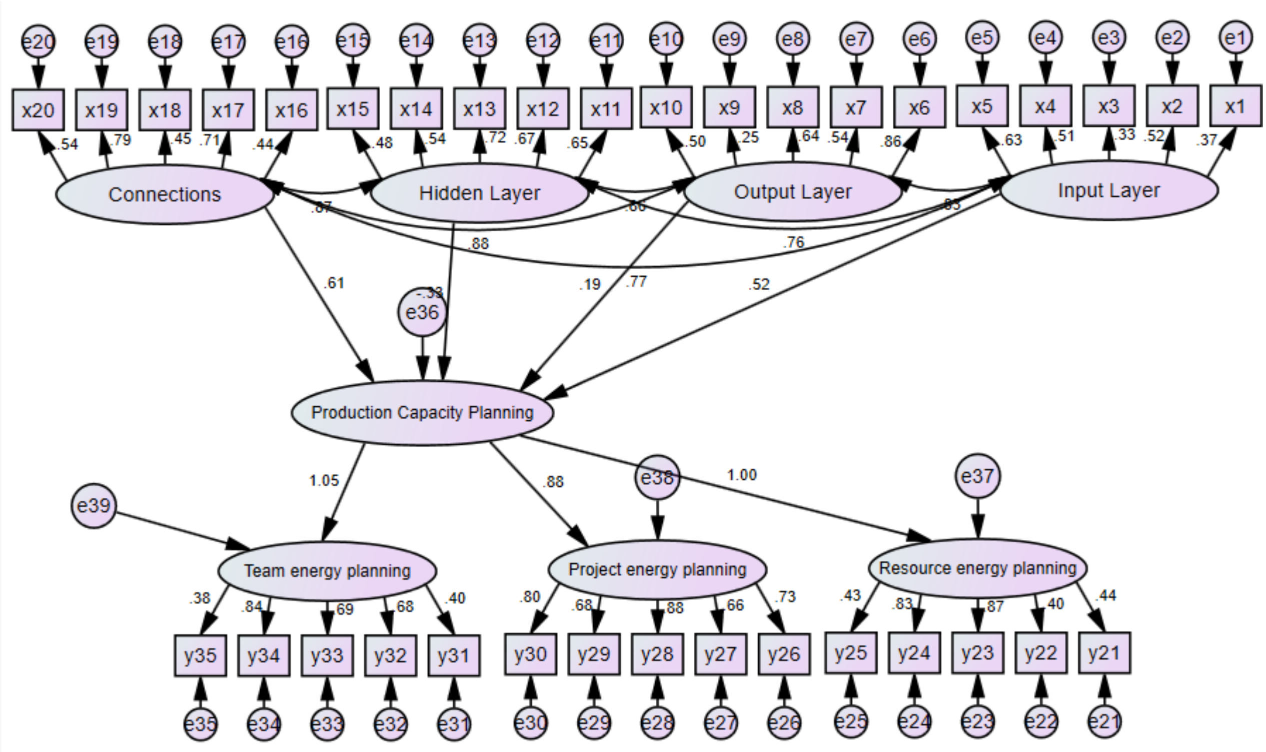

Figure (7) Model of the impact of individual components of artificial neural networks on production capacity planning

Table (5) Model test values

P	Lower	Upper	SRW	Estimate	The variable Affected by	Direction of Influence	The influencing variable
0.04	0.112	1.165	0.516	0.352	**Production Capacity**	←	Input Layer
0.579	0.677	0.705	0.192	0.130	**Production Capacity**	←	Output Layer
0.02	1.020	0.020	0.328	0.376	**Production Capacity**	←	Hidden Layer
0.03	0.048	1.309	0.608	0.454	**Production Capacity**	←	Connections

Prepared by the researcher, derived from the results generated through on Computer

The Second Major Hypothesis

The results of the statistical analysis of the structural equation modeling showed the significance of the model designed to test the sub-hypothesis (A) of the second main hypothesis, as indicated by the positive indicators obtained and shown in Table (5) as well as the high saturation values that exceeded (45%), as shown in Figure (7)... By following the standard error values, it becomes clear that the highest effect was in the (**Connections**) component in production capacity planning, while the lowest effect was in the (**Output Layer**) component in production capacity planning, while the critical ratio (C.R.) reached (3.91), which is higher than the standard value of (1.96) at a significance level of 0.005 and its value of (2.88) at a significance level of (0.01), which is equivalent to the (T) value in the normal regression test. However, by following the structural equation values, it became clear that the (**Output Layer**) component does not directly affect production capacity planning, as indicated by the (P) value, which showed its insignificance as it is greater than (0.05), and also The value of (**SRW**) of (0.192) is outside the confidence limits, which explains the fact that the organization under study does not have sufficient processing units through which the organization under study can process raw materials in an ideal manner that results in planning production capacity, as both layers (**Input Layer, Hidden Layer**) do not interact successfully in sending the necessary signals to the (**Output Layer**) layer in order to make the manufacturing process successful and thus obtain outputs that match the required specifications. Thus, the second sub-hypothesis is accepted to prove the existence of a significant effect of the dimensions of concurrent engineering individually in the dimensions of the hybrid manufacturing system.

5. Axis Four: Conclusions and Recommendations

5.1. First: Conclusions

a. The organization under study is committed to maintaining effective neural networks by subjecting its employees to intensive training courses based on the nature and specifications of the product being produced, as well as the required level of quality.
b. The organization under study places great importance on timelines, determining and organizing the sequence of raw material inputs, leading to the production of the final product and its delivery to the customer at the predetermined time, based on the nature of the adopted production system.
c. The organization's management strives to ensure that production capacity is planned and managed continuously, without interruptions, throughout the production period. This is achieved by developing effective strategies that organize the organization's work to keep pace with the constantly changing environmental conditions and fluctuations.
d. The researcher concluded that the organization under study is actively seeking to enhance teamwork by forming collective work teams at various levels to develop sound and appropriate plans and strategies that contribute to sound planning of production capacity.
e. The results of the analysis of correlation and influence relationships proved the existence of correlation and influence relationships between the components of artificial neural networks in planning production capacity in a way that reflects the role of neural networks in achieving successful and effective planning of production capacity and which has a positive impact on activating the production movement in the organization under study.

5.2. Second: Proposals and Implementation Mechanisms

a. Work to provide financial, economic, and technological alternatives to determine the amount of energy required to meet the organization's needs based on supply and demand, and work to provide them in a timely manner.
b. Establish timetables based on contracts obligating the organization under study to supply raw materials at the agreed-upon times. Penalties should be imposed if a supplier fails to meet the agreed-upon deadline. This is intended to ensure the organization fulfills its obligations to its customers and prevents delays in a manner that would weaken the organization's market position.
c. Organize periodic meetings and awareness-raising sessions between the organization's various departments (production, marketing, finance, etc.) to foster a sense of teamwork among employees, as well as to exchange experiences and skills, which will improve the quality of work and, consequently, the quality of output.
d. Working to achieve a balance in workloads by providing a suitable and comfortable working environment in a way that contributes to reducing stress and fatigue, which may be reflected in achieving distinctive profits. The organization is keen to adopt this type of energy planning in coordination with senior management to ensure that employees work in a suitable environment that enables them to achieve creativity and excellence in work.

The Sources

Al-Maamouri, A. M., & Al-Hussaini, H. K. (2020). *Using artificial neural networks to develop the auditor's role in detecting material errors: An applied study in the General Company for Electrical Industries and Nasr General Company for Mechanical Industries* [Applied study]. Higher Institute of Accounting and Financial Studies, University of Baghdad. https://www.researchgate.net/publication

Ashour, M. A. (2020). *Artificial neural networks* [Paper presentation]. International Scientific Conference of the Union of Arab Statisticians, Amman, Jordan.

Basheer, I. A., & Hajmeer, M. (2000). Artificial neural networks: Fundamentals, computing, design, and application. *Journal of Microbiological Methods*, *43*(1), 3–31. https://doi.org/10.1016/S0167-7012(00)00201-3

Bhatia, S. C. (2014). *Energy resources and their utilization*. Woodhead Publishing.

Bouadou, F. (2015). *Forecasting sales of Algerian institutions using time series models and artificial neural networks: A case study of the Sonmegaz Company in Champs-Elysées* [Doctoral dissertation, Ibn Khaldoun University].

Brad, N. (2021). *Capacity planning*. School of Business, Bangladesh Open University.

Durns, S. (2021). Energy problems confronting India. *Global Emissions Journal*, *9*(2), 45–60.

Farid, B. N., & Al-Arabi, N. M. (2019). Using artificial intelligence models to predict foreign exchange reserves in Algeria: Artificial neural networks model - ANN. *Journal of North African Economics*, *15*(20), 110–125.

Gurumurthi, A., & Rapatwar, S. (2025). *What is capacity planning? Definition, top methodologies, and more*. Simplilearn. https://www.simplilearn.com/capacity-planning-article

Karun, V. (2016). *Use of fuzzy set and neural network to extract fingerprint minutiae points and location*. ResearchGate. https://www.researchgate.net/publication/268363154

Laoyan, S. (2025). *What is capacity planning? Tips to apply the right strategy*. Asana. https://asana.com/resources/capacity-planning

Lora, F. (2024). What is U.S. electricity generation by energy source? *U.S. Energy Information Administration Journal*, *5*(1), 12–25.

Mark, F. J. (2018). *Fundamentals of artificial neural networks*. Department of Computational Intelligence, Malla Reddy College of Engineering & Technology.

Mark, W. (2022). *Neural networks*. Malla Reddy College of Engineering & Technology.

Matog, F. (2022). *Artificial neural networks*. Faculty of Engineering, Al-Manara University. https://manara.edu.sy

Ortikmirzaevich, T. B. (2017). Principles and functions of management of production capacity. *Journal of Process Management*, *5*(4), 88–95.

Prindle, B. (2011). Integrated resource planning: Delivering energy services at the lowest total cost. *ICF International Journal*, *3*(4), 33–47.