APPLICATION OF SCHEDULING PREVENTIVE MAINTENANCE PROCESSES USING THE GENETIC ALGORITHM OF THE SEWING LINE / CASE STUDY IN LABORATORY 7 OF THE GENERAL COMPANY FOR TEXTILE AND LEATHER INDUSTRIES

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ABSTRACT

The study aims to achieve several objectives, including follow-up scientific developments and transformations in modern concepts of scheduling operations for the purpose of identifying the ways of switching to the entrances of artificial intelligence, clarifying the mechanism of scheduling operations to benefit from the advantages of systems and to achieve the maximum savings in time and cost of machines. Higher efficiency, using the genetic algorithm, which allows to determine the optimal preventive maintenance time and reduce the total maintenance costs, which in turn enable the workers on these machines to control the holidays in which, and from the dilemma of thought And the field problem, one can ask the question of how to achieve the scheduling of maintenance operations using the genetic algorithm?In the light of this, the importance of the study and its objectives were determined. The analytical descriptive approach was adopted in the theoretical framework. In the practical framework, the quantitative approach was adopted. The quantitative indicators of the sewing line were used and the results were compared between the preventive maintenance scheduling method and the genetic algorithm method. Data using indicators. The results showed that the use of the genetic algorithm helped to reduce the effort, time and cost. It is possible to reach the optimal solution with very few steps when using the genetic algorithm as a random search algorithm. The most prominent recommendations were the adoption of laboratory management on the genetic algorithm in estimating the optimal preventive maintenance period The method leads to reducing costs and increasing the efficiency of machines by determining the optimal preventive maintenance time for these machines, and the completion of the study of some of the proposals, the most prominent of which is to conduct more research on the scheduling of processes of technology systems aggregates and integration with Genetic algorithm and in different industrial and service sectors.

Keywords: *scheduling operations, scheduling preventive maintenance, genetic algorithm.*

1-STUDY METHODOLOGY

1.1:Study problem

A. Has the scheduling of preventive maintenance using the genetic algorithm achieved productivity efficiency?

B . Is the maintenance of the time of each machine when the use of the genetic algorithm?

C. Has the scheduling of preventive maintenance using the genetic algorithm achieved preventive maintenance and efficiency in time?

D. Did the scheduling of preventive maintenance using the genetic algorithm determine the optimal arrangement for the maintenance of the production machinery?

1.2:Significance studying

A. Theoretical knowledge and the multiplicity of philosophical and philosophical views of the genetic algorithm.

B .the application of knowledge to schedule preventive maintenance operations in Iraqi laboratories in general and the laboratory under study in particular.

C. The attempt to combine the scheduling of preventive maintenance operations with the genetic algorithm and the possibility of reducing the stops of the production machines.

D . Scheduling preventive maintenance processes are not limited to the rapid response to the wishes and needs of customers, but the financial benefits of the application environment through the increase in sales of plants by reducing prices.

1.3: ObjectivesStudy

A.Follow-up developments and scientific shifts in the concepts of scheduling preventive maintenance operations for the purpose of identifying the types of transformation to the entrances of artificial intelligence.

B.Minimize preventive maintenance times when using modern and sophisticated manufacturing systems.

C.reduce the discontinuation of the machines of sudden production when relying on the intuition of the engineer instead of relying on advanced production systems such as scheduling preventive maintenance, and genetic algorithm.

D.Analysis of the laboratory environment through data collection and analysis to reach the strengths and weaknesses in the manufacturing environment and the possibility of development through the application of preventive maintenance schedule.

1.4:Methods of collecting data and information

To achieve the objectives of the study and to fully cover the theoretical and field aspects, the researchers relied on many tools and scientific methods to collect data and information, which is the basis of knowledge of the results of the study:

A.Theoretical side

The study relied on the theoretical framing of the variables of the study on Arabic and foreign references and books**,**

Periodicals, researches and miscellaneous studies, theses and scientific messages interested in the study variables, the international network of information.

B.Practical side

Guided by several methods to collect the information and data necessary for the research and analysis, which were the most importantField visits, interviews, records and documents of the company.

1.5:Approaches adopted

In our study, a case study was conducted and the use of the quantitative method using the equations and the genetic algorithm program was designed.

1.6:Methods of collecting data and information

The General Company for Leather and Textile Industries / Laboratory 7 was chosen to be the study society. The general manager of the company was hired to determine the number of continuous labs in production. The researcher was able to conduct field visits to the plant management, specifically the production line, The official management of the company is to use available data, conduct interviews, and access to financial records

1.7:Tools and statistical methods used

Two methods were used to determine the best time (optimal time) and the most suitable cost for preventive maintenance which is: Scheduling method, as well as finding optimal preventive maintenance time. The last method is to use the genetic algorithm. The results were presented. Prepare in(MATLAB 2018 a) to extract the results.

A.Method of scheduling preventive maintenance operations

The mechanism followed for this method is as follows:

$T_{pm} \times P_s = T$

$)F_T \div (F_R = P_S$

$A_{TS}) \div C_P) \times N = ((C_T$

$n_1 = N(p_1)$

$n_2 = N(p_1+p_2)+n_1p_1$

$n_3 = N(p_1+p_2+p_3)+n_2p_1+n_1p_2$

$n_j = N(\sum_{i=1}^{j} Pi) + \sum_{i=1}^{j-1} ni\ P(j-1)$

$)n_j) \times (C_f = (C_{fr}$

$)C_p(+ C_{fr} = C_T$

$T_{PM} + C_T = C_{PP}$

B.Genetic algorithm method

The traditional GA process includes the following steps:

1.Identify problems, define constraints, and what is the criterion of optimization.

.2.Representing the scope of problems as a chromosome

.3.Definition of the validity function to evaluate chromosome performance

.4.Building genetic effects

5.Determine the cycle of the genetic algorithm, and adjust its parameters.

2.THEORETICAL SIDE

2.1: concept of scheduling production processes

The concept of scheduling production processes and their importanceThe scheduling of production processes, or what is referred to as the main production schedule (MPS), creates possible tables based on product totals, taking into account several factors including energy constraints, holidays, leave periods, and work schedules. The updated production schedules are inputs for detailed scheduling, It is noted that this table is simple although there are thousands of products to be produced and scheduled over a year. The main production schedule is an input to MRP system and is usually fixed in Short term It is not permissible to change them during this period(David et al., 2003: 572(Evans, 1997: 627) as it helps in the development of the material requirements plan, identifies the purchased and manufactured parts and the components required for the final products and the time they are completed (Render, 2017: 603) (Slack et al., 2004: 489) is an ongoing process of allocating resources to perform certain tasks, the final stage of pre-production planning (Russell & Taylor, 2011: 756), indicating the designation or identification of precedents or sequences Completion of production orders, and allocation of work on stations or duty stations, that is The amount of iron volume of work done over a specified period of time according to the resources available to the organization, whether those resources, material or human. Is associated with the concept of scheduling more efficient use of resources or the allocation of facilities, and production planning process through two fundamental concepts of scheduling two major production schedulingScheduling (MPS), and Operations Scheduling (OS) (Mohsen & Al-Najjar, 2012: 491). The researchers devised a specific procedural definition after reviewing the literature of the scheduling process. The process of planning,

organizing, selecting, timing and determining the best tactical method for all activities required for production to deliver outputs of high efficiency and quality in a timely manner to the customer through the budget And the meeting between activities and resources and optimize their allocation under constraints and limitations within the organization).**(**

It is clear from the foregoing that most of the literature confirms that the main production schedule is a detailed plan of production that can not be changed. It includes a set of tables with a short time horizon, specifying the time and volume of products to be satisfied to satisfy the demand .

The scheduling of operations is concerned with splitting the main production schedule into more detailed and more accurate tables of the main processes and activities (loading, sequencing, control and control of input / output), and is therefore an operational and monitoring tool with specific timetables of short duration (weeks, days) **,**

(Krajewski&Ritzman,2005: 770) and(Heizer& Render ,2017: 602) point to the importance of scheduling as industrial organizations strive by scheduling operations to harness the resources they own and are often rare or costly. Which can not be achieved without effective work schedules. It is important for the customer to be satisfied with the performance of an accurate schedule that contributes to providing the best services to customers by delivering products on time and with the necessary flexibility. While the importance for the Organization is the ability to use resources more efficiently and efficiently, reduce costs and create greater energy, and enable the Organization to acquire experience and achieve competitive advantage .

(Russell &Taylor ,2011: 757) agreed that there are many goals to schedule operations, as managers see, including meeting due dates or delivery dates for customers, reducing business latency, reducing response time, Reduce the time of completion or flow time of work, reduce idle time, reduce operating stock or the number of works in the system, increase the level of use of resources (machines or workers), and reduce overcrowding within the factory. These objectives contribute to the completion of the work as fast as necessary and reduce the holidays, Customer-related goals such as interest in Mo Delivery feast and speed of response, as well as targets related to the organization as a reduction of operating time and increased use of resources also contribute to scheduling operations to find the appropriate flow of work and workers (Mohsen Al-Najjar 2012: 493) and (Russell & Taylor, 2011: 757).

2.2:Scheduling maintenance operations

Maintenance is one of the most important responsibilities of the administration to maintain the productivity of the system and increase profitability, especially in the energy systems, industry and sensitive equipment that depend on the employees and beneficiaries such as medical devices and we see that it is normal to vary maintenance activities that take place on the production units and when the institution is in the case of economic recovery or the device Subject to warranty from the manufacturer, it will replace the damaged unit or the damaged piece, either if the failure is repairable and the cost of repair less than the switch, the institution will repair the holidays.The maintenance process went through different historical stages and many developments. It was limited to repair of the holidays after the period of time (1940-1950), and before that the next period (1950-1970), this stage was developed by increasing the productivity of the machine or device and prolong life (2000-2000). The development of maintenance was achieved by increasing the availability and reliability of equipment and safety, maintaining the environmental damage and prolonging the useful life of the equipment. As for the period from (2000) to the present time, the development of the computer and the use of its tools in maintenance operations have played an important and prominent role as well as the continued development of preventive maintenance and the use of comprehensive productive maintenance.

(Al-Ghurairi, 2013: 465) pointed out that maintenance is the process of repairing the damage resulting from the use, rather than preventing and avoiding this damage while maintaining the ability to do the work with machinery and production equipment economically**.**

It was also defined as a function to restore or maintain the operational status of the device and its continuous availability (Sagior, 2009: 1).

This type of scheduling operations is important for operations research in scheduling and determining the optimal maintenance time. This method requires data concerning the number of machines, maintenance costs and times of preventive maintenance, and maintenance of machines. Maintenance is one of the most important responsibilities of the administration to maintain the productivity of the system. Profitability, especially in the energy systems, industry and machinery on which the employees and beneficiaries depend and we see that it is normal that the maintenance activities that take place on the productive units and when the institution is in the case of economic recovery or when the machine is subject to In order to ensure that the producing company will replace the damaged unit or the damaged piece. If the defect is repairable and the repair cost is less than the switch, the company will repair the fault (Lami and Al Bayati, 2008: 409).(Al-Ghurairi, 2013: 466) pointed out that maintenance is the repair of damage resulting from use, in addition to preventing and avoiding this damage, while maintaining the ability to carry out the work through machinery and production equipment economically:

A. Scheduling preventive maintenance operations

It is one of the most important types of maintenance and it is a set of steps taken to prevent the stops which result in a great loss for the company. In other words, preventive maintenance is concerned with the periodic examination and taking the necessary measures to perform the services, which reduces the possibility of stopping. Preventive maintenance depends on the knowledge of the failure rate of the machine by studying the failure times and analyzing them. If the failure times follow the exponential distribution, Preventive maintenance will not reduce the possibility of machine failure, but will require simple periodic maintenance. If the failure times are many and follow other distributions such as normal distribution or Weibull distribution or other probability distributions, The machine needs to develop a scientific approach to preventive maintenance because in this case it is very useful and reduces the possibility of sudden failure.

There are many advantages of preventive maintenance, including reducing the downtime of the machine to the minimum possible to perform maintenance and reduce the need for overtime (Sagior, 2009: 4) during the performance of tasks and it leads to an increase in the efficiency of machines performance, rather than This is a key element in increasing the security and safety conditions for operators and technicians as well as all operations and stops programmed so as to enable the knowledge of holidays to avoid downtime (Sagyor, 2009: 4).

B. Scheduling therapeutic maintenance operations

Which is maintenance after the malfunction of the device, in order to detect and repair the part of the unemployed and restoration to return to its first condition (works) and the performance of his job as required (Al-Ghurairi, 2013: 475).

C. Scheduling emergency maintenance operations

It is the maintenance of the faults that must be repaired immediately in case of occurrence to prevent more and more failures and this type of maintenance is appropriate only in conditions that are difficult to predict and on sudden holidays (Lami and Bayati, 2008: 480).

D. Scheduling predictive maintenance operations

It is a modern type of maintenance based on Future Prospects. The problems and the machine are determined to continue to work satisfactorily, as the holidays can be expected and remedial maintenance is scheduled at times when the machine is not working (Al Ghurairi, 2013: 475).

E. Scheduling of overall productive maintenance

This type of maintenance has been invented by the Japanese. It is an operational system that combines preventive maintenance with predictive maintenance. The organization maintains its machines by keeping them in good working condition (Lami and Al Bayati, 2008: 484). When implementing and

preparing maintenance programs, types and schedules, The main objectives are to choose the correct scientific method that helps the maintenance department to find the best methods in the maintenance operations, so maintenance achieved a number of goals, most important: (Lami and Bayati, 2008: 410):

-Enhancement of safety in the case of new maintenance leads to the safety of workers on the devices and beneficiaries by reducing the risks resulting from the failure of the machine or machine.

)-increase the reliability of machines and machines by reducing the number of holidays

)-reduce operating costs and increase the efficiency of the devices and reduce the time of holidays and treatment.

- Prolong the useful life of the equipment or equipment by reducing the bottlenecks and problems that occur in the operations and the maintenance of the devices from obsolescence.

-balancing maintenance costs and existing purchase costs.

The researchers will explain the components of preventive maintenance as follows

1.Inspection and inspection: Checking & Inspection

Inspection and inspection are vital to a preventive maintenance program through which maintenance personnel can determine the operational situation (Al-Ali and Fatah, 1997: 27-28).

2.Lubrication Lubrication

Lubrication is an important and essential part of a preventive maintenance system because of its near and far-reaching economic impact in maintaining machinery and industrial equipment to function properly, as friction between two moving parts will lead to corrosion and oatting (Patton, 1983: 73).

3.Planning& Scheduling Planning & Scheduling

It is the component in which the detailed schedules of the preventive maintenance plan are prepared based on the analysis of the previous data. The maintenance schedule must be prepared in advance (Fattah and Ali, 1993: 28). And commitment to ensure that the successful planning of preventive maintenance activities requires the establishment of a regular time schedule to determine the time periods necessary to conduct preventive maintenance activity, determine the type of activity appropriate (examination, cleaning and replacement), and clarify the duties and determine the actions to be taken and the duration of each procedure so that the maintenance section All the requirements and skills required to implement each step, this facilitates the process of control and follow-up of the implementation of preventive maintenance work and can identify the deviations and their treatment simultaneously (Hadith and others, 2004: 52).

4.Documentation

The maintenance department must have a complete system for documenting all maintenance operations in all its precise details within the lifetime of the machine, with all its precise details, which helps maintenance officials prepare and predict preventive maintenance (Patton, 1983: 110).

5.Job Orders

This component is the document that authorizes the maintenance technician to start maintenance. The work order is an essential element for carrying out the maintenance activities of any industrial company, so it helps to plan, distribute and implement the work as important (Patton, 1983: 110).

2.3:Problems of scheduling operations and obstacles

Manufacturing environments are not without complications and difficulties that cause problems and obstacles surrounding the process of scheduling and executing operations on the ground. In spite of the intensive studies that included the scheduling function and which have been applied in practice

since they were purely academic practices, the effective applications of scheduling techniques in practice are still rare, especially in the Iraqi environment.

Most applications have been implemented in highly controlled production systems such as mass-assembly systems. Most practitioners in the field of production planning and control believe that this function can be performed manually (Manual Scheduling) However, some companies believe that it is not necessary for the scheduled person to be fully qualified to plan and control large and complex systems. The task of scheduling the production will become more complex. This can be determined by knowing the problems and obstacles encountered in the following cases: -Harkan, 1997: 5) Problems scheduling operations Divided into four main types of problems, a specific scheduling problems, a pre-defined set of elements and does not include any random factors. Such as the state of business access to the workshop, business due dates, processing times, and machine availability. The problems of static scheduling are similar to those of specific problems, but the nature of business access is different.

The set of work orders does not change over time, and is known in advance. In the face of Danish scheduling problems, the set of work orders changes over time. Works come at different times and lastly random scheduling problems when one element of the problem involves a random variable (Al-Harkan, 1997 : 5)

The obstacles to scheduling operations

There are many obstacles to the process of preparing and implementing the scheduling of operations, including the emergence of a major obstacle between theory and application in the issues of scheduling production, as the theory of scheduling production has limited impact on the actual application, and the reason that most scheduling applications do not include the important characteristics of the manufacturing environment prepared Therefore, there will be many problems when scheduling is carried out, namely the difficulty of predicting, responding, and then adapting easily to the changes that occur in that environment (Selim, 2007: 64).

Many of these problems occur, sometimes due to the dynamic nature of the manufacturing environment, which necessitates scheduling frequently and sometimes manually, thereby reducing the current scheduling ability of the company to fulfill commitments and commitments to customers. Difficult and complicated and requires some quick adjustments to them. These changes include: malfunction of machinery, scarcity of resources, changes in the priority of work orders, changes in business due dates, erroneous assessment of processing times, absence of operators, cancellation of business, etc. (Larsen &Pranzo, 2012: 1).

Scheduling techniques and rules work within their constraints and problem limits, and can not be extended to larger and more complex problems (Narrator, 2014: 44). We can consider the function of optimizing the optimal output scheduling from the point of view of harmonic optimization as an inter- - Hard). Therefore, the focus is on instructional methods that seek initial solutions, which focus on the problems of Static Job Shop Problems.

Since production activity is a continuous pursuits activity, production scheduling becomes a dynamic task, requiring techniques that seek optimal solutions (Sun, 2012: 1). Most scheduling scheduling assumptions do not reflect the real reality of the workshops. The scheduling often assumes that resources are available, that the data is pre-defined and known, but this is not true. Data may be uncertain or change over time (Selim, 2007: 64) Which will create many problems and constraints, are the techniques used in scheduling, and the information systems on which they depend, as the scheduling of such techniques is usually changed by the scheduled person, or it is not fully implemented in the sections of the plant, Various limitations.

These limitations may be either limited power resources, precedence relationships between work orders, or commencement and entitlement times for work orders (Narrator, 2014: 44), and scheduling operations determines the production system downtime for maintenance purposes or the preparation and preparation of certain machining processes As well as the timing of the transition from

one product to another. Therefore, any change in the special times of these scheduled stops will have a large impact on the scheduling, which leads to confusion of the production system as a whole, and the methods of scheduling operations do not look at the duty stations Which precedes my work And do not take into account idle resources, bottlenecks in other business workshops, and do not look beyond maturities. In some cases, work orders have the same due dates but scheduling does not discriminate Between the importance of a business order and a timely delivery (Larsen &Pranzo, 2012: 1)

Multi-Pass Scheduling requires different decisions such as prioritization, the best sequence of work orders, and then generating multiple scheduling options before actual execution to improve performance in workshops. This problem requires selecting the best strategies and inputs (Sun, 2012 : 1)

3.PRACTICAL SIDE

Presentation of the study results and analysis of the sewing line

The sewing line consists of

).1.The total number of machines (11

2.The cost of implementing preventive maintenance (Cp) for one machine is (800000) thousand dinars per month.

3.The cost of stopping work for each machine for preventive maintenance (Cf) amounted to (1100000) thousand per month in the case of stop.

The stops for the machines were approved during the period from 1/1/2016 to 31/12/2017. The probability of discontinuation was calculated in Table (3-27). Each period was collected within three consecutive months. Ie, the first period is for the months (1-2-3) and the second period represents the months (4-5-6) and so on for the rest of the periods and for the end of the study period we have eight extended.

Table (1) Probability of stopping sewing line machines for the period (2016-2017)

Durations	Repeat stop	Probability of stopping
1	29	**0.1585**
2	21	**0.1148**
3	18	**0.0984**
4	20	**0.1093**
5	26	**0.1421**
6	28	**0.1530**
7	19	**0.1038**
8	22	**0.1202**
Total		**1.00**

Source: Preparation of the researchers.

Table (2) The cost of preventive maintenance and according to the length of the sewing line

Duration	Probability of stopping	Expected (nj) number	Stop cost Cfr	cost Maintenance Preventive measures cp	Stop cost Cost of + preventive maintenance	Cost of maintenance and according to duration	Cost of maintenance College for 3/the month
1	0.1585	1.7432	5752459	800000	8152459	8152466	**2717488**
2	0.1148	3.2817	10829624	800000	13229624	13229632	**4409877**
3	0.0984	4.8075	15864812	800000	18264812	18264820	**6088273**
4	0.1093	6.5995	21778393	800000	24178393	24178400	**8059466**
5	0.1421	8.9633	29578780	800000	31978780	31978788	**10659596**
6	0.1530	11.7924	38915048	800000	41315048	41315056	**13771685**
7	0.1038	14.4824	47792006	800000	50192006	50192014	**16730671**
8	0.1202	17.6173	58137057	800000	60537057	60537064	**20179021**

Source: Preparation of the researchers.

From the observation of Table (2), preventive maintenance when implemented within the first period, costs the company (2717488) Iraqi dinars per month, and then begins to escalate up to the cost (20179021) Iraqi dinars in the implementation of maintenance within the period (8). Based on Table (3-28), we find that the best time for preventive maintenance is to be carried out within the first period, ie maintenance is within the three months allocated for this period (January, February, and March) as the lowest cost, Maintenance according to this method Each period depending on the month selected in the first period, so if we choose the second month of maintenance within the first period, the choice for the fifth month within the second period and the same mechanism and cost for the other periods that have been adopted, which causes a significant reduction in costs than it was previously.

1.Genetic algorithm method

When the preventive maintenance scheduling method was implemented using the genetic algorithm under the Holonic system, the best duration of preventive maintenance was obtained according to each machine. After that, the machines were divided into holons based on preventive maintenance costs. The results were as follows:

Results of the first machine:

Table (3) Cost of preventive maintenance and according to duration
For sewing line in the way of the genetic algorithm (first machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	28762	2428762	2428763	809587
2	243666	2643666	2643667	881222
3	237972	2637972	2637972	879324
4	54445	2454445	2454446	818148
5	147893	2547893	2547894	849298

6	194575	2594575	2594576	864858
7	716880	3116880	3116880	1038960
8	145342	2545342	2545343	848447

Source: Preparation of the researchers.

From the observation of Table (3), it is clear that the preventive maintenance of the first machine when implemented within the first period, cost the company (809587) Iraqi dinars per month, and then start to rise and reach the cost (1038960) Iraqi dinars when the maintenance within the period (7) The best time for preventive maintenance of the first machine is to be implemented within the first period, ie maintenance is within the three months allocated for this period (January, February and March) as the lowest cost.

Results of the second machine

Table (4) Cost of preventive maintenance and according to duration
For sewing line in the way of the genetic algorithm (second machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	43143	2443143	2443144	814381
2	189518	2589518	2589519	863173
3	118986	2518986	2518986	839662
4	108891	2508891	2508892	836297
5	221840	2621840	2621841	873947
6	291862	2691862	2691864	897288
7	358440	2758440	2758440	919480
8	290685	2690685	2690686	896895

Source: Preparation of the researchers.

(4 **(**It is clear that preventive maintenance of the second machine when implemented within the first period, cost the company (814381) dinars per month, and then start to escalate up to the cost (919480) dinars in the implementation of maintenance within the period (7) Based on these results, we find that the best time for preventive maintenance of the second machine is to be implemented within the first period, ie, maintenance is within the three months allocated for this period, ie the month (January, February and March) as the lowest cost.

Results of the third machine:

Table (5) Cost of preventive maintenance and according to periods
For sewing line in the way of the genetic algorithm (third machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	143811	2543811	2543812	847937
2	135370	2535370	2535371	845123
3	158648	2558648	2558648	852882
4	163337	2563337	2563338	854446

5	**739469**	**3139469**	**3139470**	**1046490**
6	**972876**	**3372876**	**3372877**	**1124292**
7	**477920**	**2877920**	**2877920**	**959306**
8	**436027**	**2836027**	**2836028**	**945342**

Source: Preparation of the researchers.

)5 (It is clear that preventive maintenance of the third machine when implemented within the second period, cost the company (845123) Iraqi dinars per month, and then start to rise and reach the cost (1124292) Iraqi dinars when the maintenance within the period (6) In the seventh and eighth periods. Based on these results, we find that the best time for the preventive maintenance of the third machine is to be implemented within the second period, ie maintenance after the third month and within the three months allocated for this period (April, May and June).

:Results of the fourth machine

Table (6) Cost of preventive maintenance and according to the periods
For sewing line in the way of the genetic algorithm (fourth machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	100668	2500668	2500669	**833556**
2	162444	2562444	2562445	**854148**
3	79324	2479324	2479324	**826441**
4	598905	2998905	2998906	**999635**
5	517628	2917628	2917629	**972543**
6	1070163	3470163	3470165	**1156721**
7	238960	2638960	2638960	**879653**
8	1598769	3998769	3998769	**1332923**

Source: Preparation of the researchers.

From the observation of Table (6), it is found that preventive maintenance of the fourth machine when implemented within the third period, cost the company (826441) Iraqi dinars per month, and then start to escalate and reach the cost (1332923) Iraqi dinars in the implementation of maintenance within the period (8) We find that the best time for preventive maintenance of the fourth machine is to be implemented within the third period, ie the maintenance is after the sixth month and within the three months allocated for this period any month (July, August and September) as the lowest cost.

Results of the fifth machine

Table (7) Cost of preventive maintenance and according to the periods
For sewing line in the way of the genetic algorithm (fifth machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	71905	2471905	2471906	**823968**

2	27074	2427074	2427074	**809024**
3	198310	2598310	2598310	**866103**
4	326675	2726675	2726676	**908892**
5	369734	2769734	2769735	**923245**
6	389150	2789150	2789151	**929717**
7	597400	2997400	2997400	**999133**
8	872055	3272055	3272056	**1090685**

Source: Preparation of the researchers.

From the observation of Table (7), it is clear that preventive maintenance of the fifth machine when implemented within the second period, cost the company (809024) Iraqi dinars per month, and then start to escalate and reach the cost (1090685) Iraqi dinars in the implementation of maintenance within the period (8) These results show that the best time for the preventive maintenance of the fifth machine is to be implemented within the second period, ie maintenance after the third month and within the three months allocated for this period (April, May and June) as the lowest cost.

Results of the sixth machine:

Table (8) Cost of preventive maintenance and according to the periods Of the sewing line in the manner of the genetic algorithm (sixth machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	158192	2558192	2558193	**852731**
2	216592	2616592	2616593	**872197**
3	39662	2439662	2439662	**813220**
4	217783	2617783	2617784	**872594**
5	813416	3213416	3213417	**1071139**
6	778300	3178300	3178302	**1059434**
7	119480	2519480	2519480	**839826**
8	581370	2981370	2981371	**993790**

Source: Preparation of the researchers.

Table (9) Cost of preventive maintenance and according to the periods Of the sewing line in the manner of the genetic algorithm (seventh machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	57524	2457524	2457525	**819175**
2	108296	2508296	2508297	**836099**
3	317296	2717296	2717297	**905765**
4	544459	2944459	2944460	**981486**
5	295787	2695787	2695788	**898596**

6	97287	2497287	2497288	**832429**
7	955840	3355840	3355840	**1118613**
8	1453426	3853426	3853427	**1284475**

Table (10) Cost of preventive maintenance and according to the periods Of the sewing line in the manner of the genetic algorithm (Eighth machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	14381	2414381	2414382	**804794**
2	297814	2697814	2697815	**899271**
3	277634	2677634	2677634	**892544**
4	272229	2672229	2672230	**890743**
5	73946	2473946	2473948	**824649**
6	583725	2983725	2983726	**994575**
7	836360	3236360	3236360	**1078786**
8	726713	3126713	3126714	**1042238**

Source: Preparation of the researchers.

Table (11) Cost of preventive maintenance and according to the periods Of the sewing line in the manner of the genetic algorithm (ninth machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	86286	2486286	2486288	**828762**
2	270740	2670740	2670741	**890247**
3	436282	2836282	2836283	**945427**
4	435567	2835567	2835568	**945189**
5	443681	2843681	2843682	**947894**
6	486438	2886438	2886439	**962146**
7	1314280	3714280	3714280	**1238093**
8	1162741	3562741	3562742	**1187580**

Source: Preparation of the researchers.

Table (12) Cost of preventive maintenance and according to the periods Of the sewing line in the manner of the genetic algorithm (tenth machine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	129430	2529430	2529431	**843143**
2	81222	2481222	2481223	**827074**
3	356958	2756958	2756959	**918986**

4	381121	2781121	2781122	**927040**
5	591575	2991575	2991576	**997192**
6	875588	3275588	3275589	**1091863**
7	1075320	3475320	3475320	**1158440**
8	1017398	3417398	3417399	**1139133**

Source: Preparation of the researchers.

Table (13) Cost of preventive maintenance and according to the periods Of the sewing line in the manner of the genetic algorithm (eleventhmachine)

Duration	Cfr	Stop cost Cost of preventive + maintenance	Cost of maintenance and according to duration	Cost of maintenance 3/College for the month
1	115049	2515049	2515050	**838350**
2	54148	2454148	2454148	**818049**
3	396620	2796620	2796621	**932207**
4	490013	2890013	2890014	**963338**
5	665522	3065522	3065523	**1021841**
6	681013	3081013	3081014	**1027004**
7	1194800	3594800	3594800	**1198266**
8	1308083	3708083	3708084	**1236028**

Source: Preparation of the researchers.

4:CONCLUSIONS AND RECOMMENDATIONS

4.1:Conclusions

1.The scheduling of preventive maintenance operations has several successes over the past decades in terms of developing and applying new technologies that helped companies to find solutions to real scheduling problems.

2.Absence of scientific method in all lines make the process of follow-up each line and analysis of its components semi-slow, which is the lack of clarity of the number of work machines or the size of output for each machine and the time it takes to complete the process of producing a specific product or determine the times of preparation and preparation for each batch clearly and accurately. And that balancing the lines at best is subject to simple personal assumptions that do not fit the nature of the work.

3.of the results that appeared in the sewing line preventive maintenance within the second and the third and distinguish this line with the number of large machines measured by other lines and facilitated the process of the duration to know the machines that need early preventive maintenance rather than reduce costs and time.

4.2:Recommendations

1.the management of the laboratory use preventive maintenance schedule as a tool for planning and control by scheduling the sewing line in the laboratory and tracking the implementation and update and forecast the completion of the deadlines in time to reach the low costs.

2.The management of the laboratory to follow the product in the production processes to avoid errors as well as to match the product to specific specifications, and follow-up tasks and also reduces the times of these processes.

3.Adoption of the plant management on the use of genetic algorithm in the estimation of the duration of preventive maintenance is optimal as this method leads to reduce costs and increase the efficiency of machines by determining the optimal preventive maintenance time for these machines.

4.The plant management must record the maintenance time and cost data regularly as it contributes greatly to ensuring accurate results in obtaining optimal preventive maintenance time.

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