

The effect of scheduling holon on the effective cost of a Fractal manufacturing system: An extracted search

Ebtihal Faris Ali,

*Faculty of Management and Economics, University of Al-Qadisiyah,
bus.ebtihal.faris@uobabylon.edu.iq*

Aseel Ali Mezher

*Faculty of Management and Economics, University of Al-Qadisiyah,
aseel.mezher@qu.edu.iq*

Abstract

The current research aims to highlight the fact that the continuous change in the industrial and production environment requires companies to have the ability to adapt quickly and effectively to respond to these changes and obtain an effective cost and thus achieve a competitive advantage within this framework. Holon scheduling is one of the components of the Holon manufacturing system and for rapid response to changing market demands, The scheduling holon can be implemented successfully by defining the requirements of the holon manufacturing system and working to provide these requirements. Therefore, the research problem arises in presenting a simplified model that describes the theoretical framework for the scheduling holon by distributing a questionnaire to a sample of the employees of the General Company for Electrical and Electronic Industries (104). And by using statistical analysis (spss) to analyze and evaluate the results, the study concluded several conclusions, the most important of which is that scheduling is one of the main pillars in the structure of the company, especially the production units, and it has an effective impact in achieving the effective cost of the company, He also concluded that the company should create holons with a manufacturing system to enable employees to contribute and preserve the company's resources, solve problems appropriately and achieve effective cost.

INTRODUCTION

The basic requirements and important for the success of organizations at the present time is their possession of the elements of superiority and competition and the ability to meet the needs and expectations of customers at a time that is characterized by sudden and continuous change and with the intensification of competition between organizations and the increase in changes in the environment, especially the industrial one. Therefore, organizations tended to draw up their new policies that guarantee them superiority and distinction among competitors, and among

these policies is the adoption of the holonic manufacturing system one of its components is scheduling, which makes the company able to face changes and challenges by gaining flexibility, effectiveness, and the ability to face competitors and outperform them, and the establishment of a holoni system and its management in a way that guarantees the company's survival and continuity in its work, achieving its goals, achieving effective costs, and thus in the business world.

First: problem the researching

The current study seeks to determine the requirements for the possibility of applying

the scheduling holon in order to provide these requirements for the advancement of the industrial reality in the company in light of an environment characterized by continuous change. Therefore, the biggest challenge that organizations face is the extent of their ability to adopt an appropriate application mechanism according to scientific frameworks and systems. The application of Holon Scheduling will increase productivity flexibility and increase effective cost and as well as the efficient use of production capacity and meeting the needs and desires of customers better and faster than competitors, and from this standpoint the problem arises in asking the following question: "How feasible is Holon Scheduling in the effective cost of the company under study?"

Second: Importance of research

The importance of the research is evident in the following aspects:

- 1- The importance of the research stems from the importance of scheduling as a component of a modern system that works on the basis of a set of manufacturing systems to reach flexibility and creativity to meet market requirements.
- 2- Shedding light on the role that scheduling plays in supporting the company and achieving effective costing.

- 3-Diagnose the company's preparations to adopt the scheduling holon and make the necessary adjustments in preparation for its effective implementation.

Third: Research objectives

- 1-Determine the requirements for applying the scheduling holon in the researched company.

- 2-Arouse the interest of the managers and employees of the researched company in the importance of the role played by the scheduling holon and work to provide the

requirements for the scheduling holon application in the company.

- 3-Presenting a set of proposals according to the analyzes and findings of the research to the senior management of the researched company, in a way that contributes to improving its performance.

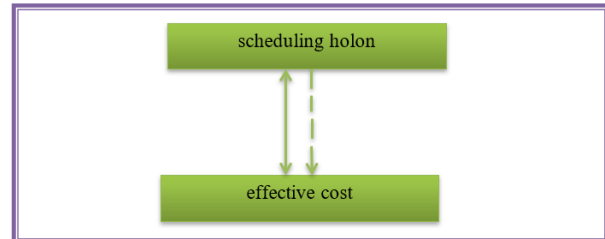
Fourth: research hypotheses

- 1-The first hypothesis is that there is a significant relationship between the scheduling frequency and the effective cost of the Fractal manufacturing system.

- 2- The second hypothesis is that there is an effect of the scheduling delay on the effective cost of the Fractal manufacturing system.

Fifth: the hypothetical scheme of the research

Figure(1) The hypothetical scheme of the research



Theoretical framework

First: Concept of Scheduling Holon

The Holon Scheduling is considered one of the Holon of the Holon Manufacturing System, which focuses its work on integrating employee skills effectively to allow for dynamic changes and the use of smart processes and flexible tools to achieve interaction by scheduling its tasks and works through a specialized Holon that works on arranging the required tasks and duties. Therefore, the main feature of the Holon Scheduling approach is that each holon is a

problem-solving entity and a decision-making entity that uses collaboration strategies in order to exchange information and mutually acceptable solutions and there is a mechanical mechanism to ensure that the constraints of the productive system are met and finally there is a central coordination mechanism to aggregate future manufacturing (Ramos et al., 2007: 167). Holon is responsible for collecting work orders, optimizing the Holon system that is being processed, and creating specific schedules. Holon can schedule to choose the best method to respond better to a specific situation (Barbosa et al., 2013:3) The scheduling holon is concerned with system scheduling tasks, just as the factory floor management holon is responsible for the management level of system services, that is, order management, life cycle services, collection services, and query services, and each element is managed through a specific functional holon, as the element acts as a manager for that specific department, that is Each administrative component needs a specific job such as a holon to be the manager of this component (Cheng et al., 2006:83).

Second: Importance of the scheduling Holon

Holon scheduling is a comprehensive approach that combines centralized and distributed strategies to improve the responsiveness of manufacturing systems. The Holon approach is introduced in manufacturing planning and control to allocate material handling operations to available system resources in integrated process planning. The scheduling system is applied to production and dynamic programming to select appropriate machinery sequences and processing equipment sequences in Manufacturing Control Systems and Comprehensive Planning (Zhao et al., 2010:22).

Sees (Giret & Botti, 2008:7) that scheduling highlights its importance in providing products of distinguished quality at an appropriate cost through the interaction of components with each other continuously without errors. This importance is evident through:

1-Defining the relationships that are compatible with other new holons.

2-Monitoring the production process and monitoring failures and suspensions in managing resources and planning for his future tasks.

3-Initiating the processing of the tasks of the production process, the holon responsible for accepting or rejecting a specific task on the basis of its objectives.

4-Maintaining the confidentiality of information about the production process plan, product specifications and quality requirements.

Third: Scheduling Holon Objectives

The main objective of Holon Scheduling is to generate good quality and periodic schedules in low CPU time, which will improve benchmarking and meet certain set of constraints. Diverse capabilities can be easily modeled by different tasks (production, transport, storage, etc.) needed by various orders allocated to an appropriate set of alternative resources. In this way, production tasks require machines, warehousing tasks require storage devices, transportation activities require vehicles, In addition time constraints are modeled to ensure correct sequence of tasks (Barbosa et al., 2013:6).

Fourth: Concept of effective cost

Effective cost management has become very important to drive improvement efforts along with the environmental, managerial and

technological changes that have taken place in the last 30 years. How much the current traditional cost management systems are very similar to those that were used in the mid 1920's to counter all these changes. Traditional cost accounting information is mostly not Relevant to advanced administrative work and not related to production planning and control (Marchesan & Formoso, 2001:2).

Information on costs, which is an important measure of organizational productivity, must be identified and linked to the organization's products that enter global markets from local markets with the impact of globalization. Organizations continue their activities with the aim of achieving maximum customer satisfaction. In this context, competitive advantage and customer satisfaction in global markets can only be achieved through Cost-effective performance in terms of quality, speed and cost in particular on it. This situation has led to a change in the structure and scope of information required by the management of the organization, especially in changing the structure of the information system that provides the necessary information for workers in the field of financial information and the tools it uses and has become suitable for the needs within the framework of these developments and has become The effective cost concept has the ability to produce and manage non-financial information as well as financial information (Yucenursen, 2021:146).

In addition, cost efficiency versus effective cost gives an indication of the cost associated with achieving the outputs. It does not consider whether these outputs lead to the desired results (effective cost). Therefore, it is important to ensure that the outputs of the designed program are appropriate to meet a specific need and that there is monitoring to

ensure that the results. A cost-effective program must also be able to interpret the results of cost-effectiveness together with other information when making a judgment. For example, complementary activities and support services may make a program less cost-effective, but can increase cost-effectiveness if people include access to the markets(Mello&Santos2016:95),defined (Istokovic et al., 2020:565) the relationship of economic resources in processing raw materials and converting them into finished products. The cost of production is all the costs incurred in creating one finished unit.

Fifth: Importance of effective cost

The importance of effective cost is evident as an interactive process of analysis, planning, organization and control, which states that important production information is linked with the organization's strategy for making strategic and tactical management decisions. It is a set of actions that focus on achieving goals and reducing costs and improving them. Because each organization was created to achieve the level of profitability, which is an important indicator that management aims at administrative procedures towards effective cost to increase the level of profitability (Baby & Manoj, 2012:36). The organization focuses on using materials, workers and financial resources more efficiently for this purpose, the organization must implement Planning (forecasting), that is, the cost mechanism that will make it possible to develop economic measures and focus on the long term (Ordynskaya et al., 2021: 501).

Effective cost of production mainly relates to materials, labor and energy consumption affecting product reliability and finally costs for defective products in manufacturing and after-sales service. Poor product reliability can

reduce customer satisfaction and increase the cost of warranty repairs. Therefore, a trade-off must be found between the cost of manufacturing and after-sales service. Selling and these costs depend on the quality of the materials used in manufacturing, including the density and strength of the materials and thus the relationships between the materials used, prototype tests, defective products, and costs (Relich et al., 2022:2), although the effective cost aspect is one of the vertices of the project triangle. The so-called iron triangle, and the issue of tracking costs is often dealt with as a dependent issue with time and product quality. (Mroz, 2020:13) indicated the importance of experience and the use of knowledge, taking into account the cost calculations of the implementation of organized projects.

Sixth: Effective cost objectives

The effective cost system can produce low-cost information, so it will increase the decision-making performance of the organizations and add value to the organization. It is the philosophy of cost optimization, which is of great importance in achieving the goals set by the organization. (Chen, 2020:268). Cost contributes to the continuous improvement of the workflow. It is expressed as a group of technologies that aim to create higher value at lower costs. Therefore, organizations in the production process collect and analyze cost data to reduce costs. To achieve this end, it is necessary to reduce the use of resources and increase the efficiency of existing resources. Production aims to increase the financial performance and operational efficiency of the organization and to identify the actual deviations of the planned costs, their causes, and the necessary infrastructure for decision-making processes to improve the cost (Yucenursen, 2021: 147).

In light of the constantly changing market conditions, effective cost is one of the main factors in ensuring the survival and competitiveness of industrial organizations. When adding to that the ever-increasing demand for product diversity and variable productivity volumes, production cost becomes more important in a complex field that has a very significant impact on the performance of the manufacturing organization. The most difficult batch-related tasks and decisions involve dividing the total production quantity into batches in order to improve certain parameters and allocating available production resources to batches over a period of time so as to ensure on-time delivery with the lowest possible production costs (Daneshjo, 2013:37)

The main reason behind the new increase in the interest directed to the systems of retail manufacturing and other forms of automated factory is the increasing competition that has increased dramatically in the age of globalization, and the (Klahorst) study indicated that the organizations that installed the systems of retail manufacturing and used effective cost methods reached the following results: (Baby & Manoj, 2012: 37):-

- 1-The benefits related to reducing production and the ability to adapt to an everchanging environment. Automated systems such as the fractional manufacturing system have the ability to improve the situation of organizations.
- 2-Benefits related to improving market responsiveness.
- 3-Benefits associated with flexibility in production.

4-It appears that the fractional manufacturing systems provide a significant improvement in the production cost.

The practical framework / the applied side of the research

After the theoretical side related to the variables of the study has been addressed in the previous two sections, the applied side of the research hypothesis tests will be addressed in this section.

First: Research community and sample: The research community represents the General Company for Electrical and Electronic Industries. The research sample is a group of managers, administrative units and production units, The sample consisted of distributing (110) questionnaires, and (104) questionnaires valid for testing were obtained.

Second: Variables and Research Tool The research included two types of variables: the independent variable, which is the scheduling frequency, and the dependent variable, the effective cost of the Fractal manufacturing system. These two variables were measured by adopting the questionnaire form.

Table No. (1) Research variables

variable	The number of questions in the questionnaire	NO.
independent variable(Scheduling Holon)	15	1-15
Dependent variable (effective cost of Fractal manufacturing system)(9	16-24

The table is prepared by the researchers

Third: Descriptive analysis of the research

1-The questionnaire stability test: The Cronbach alpha test was used to verify the stability of the questionnaire, as this test

represents one of the main tests to ensure the stability of the sample answers to the questionnaire, and the stability is accepted according to this test at the level of (60%), which means that there is stability in the answers and Table No. (2) Shows Cronbach's alpha test values for the total questions of the questionnaire.

Table No. (2) Cronbach's alpha test

number of questions	Cronbach Alpha
24	0.847

The table was prepared by the two researchers based on the outputs of the(spss) program

It is clear from Table No. (2) that the Crombach alpha coefficient has reached (0.847), and this is a very good percentage It can be said that the questionnaire is fixed and if the percentage is greater than (0.60) based on the Alpha Cro-Mach test.

2-The normal distribution test: the normal distribution can be tested through the deviation coefficient ratio that lies between (-1 , +1) If this percentage falls within this value, then this means that the data is distributed normally. Table No. (3) shows the deviation coefficient values.

Table (3) shows the values of the deviation coefficient

variable	Statistic	Std.Error
Independent variable (Scheduling Holon)	0.364	0.235
Dependent variable (effective cost of Fractal manufacturing system)	-0.126	0.235

The table was prepared by the two researchers based on the outputs of the(spss) program

It is clear from Table No. (3) that the percentage of the deviation coefficient in the questionnaire form is very good, as it amounted to (0.364, -0.126) for the scheduling color and the effective cost of the Fractal manufacturing system, respectively, meaning that it falls within the value of (-1 ,+1), which is an acceptable value for the deviation coefficient and indicates The data is normally distributed.

3-Descriptive statistics test: No. (4) shows descriptive analysis tests through the arithmetic mean and standard deviation of the research variables.

Table No. (4) Descriptive Statistics Test

variable	N	Mean	Std.Deviation
Scheduling Holon	104	1.643	0.382
effective cost of Fractal manufacturing system	104	1.720	0.404

The table was prepared by the two researchers based on the outputs of the(spss) program

It is clear from Table No. (4) that the value of the arithmetic mean lies between (1.643 and 1.720), respectively, for the scheduling and effective cost of the fractional manufacturing system, meaning that the answers you get are centered between (strongly agree 3 and agree 2) and the standard deviation is at a level of significance (0.382 , 0.404) for the scheduling color of the Fractal manufacturing system, respectively, which is less than (1), which indicates the presence of consistency and lack of dispersion in the opinions of the sample members about their agreement in realizing the importance of the research variables.

It is possible to indicate the compatibility of the research sample about the research

variables through the use of the (T) test for one sample, as shown in Table No. (5).

Table No. (5) T-Test

variable	T	df	Sig.(2-tailed)
Scheduling Holon	42.670	103	0.000
effective cost of Fractal manufacturing system	42.560	103	0.000

The table was prepared by the two researchers based on the outputs of the(spss) program

It is clear from Table No. (5) that the value of (T) (42.670, 42.560) for the scheduling hole and the effective cost of the Fractal manufacturing system, respectively, with a level of significance (0.000) for the two variables is less than (0.05), so it can be said that there is a significant difference between the scheduling hole and the effective cost of the system Fractal manufacturing.

4-Testing hypotheses The research included two hypotheses as follows:

The first hypothesis is that there is a significant relationship between the scheduling frequency and the effective cost of the Fractal manufacturing system

This hypothesis was chosen using the Pearson coefficient, and Table No. (6) shows the value of this relationship.

Table No. (6) Correlation test

variable	scale	effective cost of Fractal manufacturing system
Scheduling	Pearson Correlation	0.707

Holon	Sig.(2-tailed)	0.000
	N	104

The table was prepared by the two researchers based on the outputs of the(spss) program

It is clear from Table No. (6) that the ratio of (Sig 2-tailed) and it was at the level of significance (0.000) for the scheduling and effective cost of the Fractal manufacturing system, respectively, so it can be said that there is a significant correlation because it is smaller than (0.05), which is an acceptable

Table No. (7) The effect of scheduling on the effective cost of the retail manufacturing system

Regression	Sum of Squares	df	Mean of Squares	F	Sig.
	8.448	1	8.448	108.205	0.000

The table was prepared by the two researchers based on the outputs of the(spss) program

It is clear from Table No. (7) that the value of (F) has reached (108.2), which is significant, and this indicates the validity of the regression model and confirms the effect of scheduling on the effective cost of the segmented manufacturing system. It can be said that the second hypothesis of the research is accepted.

Conclusions

1-The study showed that there is availability of the raw materials necessary for applying the scheduling holon at an effective cost for the fractional manufacturing system.

2-The study showed that there is the availability of the basic and automatic criteria necessary to establish a productive system for continuous improvement.

3-Scheduling is one of the main pillars in the structure of the company, especially the production units, and it has an effective impact in achieving the effective cost of the company.

percentage in the correlation test, and this means that the first hypothesis is accepted.

The second hypothesis: There is an effect of scheduling time on the effective cost of the Fractal manufacturing system.

The effect of the independent variable on the dependent was chosen by presenting a simple regression equation through which the importance of the effective cost of the Fractal manufacturing system is estimated in terms of scheduling, Table No. (7).

4-Whenever the scheduling schedule is highly efficient, this is reflected in the cost of the segmented manufacturing system in the best way, and thus this is reflected in the efficiency of managers in making their appropriate production decisions.

5-The success of any company depends mainly on the availability of tabulating holon, one of the components of the holon manufacturing system, with high efficiency.

Recommendations

1-The company under study increases interest in what is included in management ideas in the two fields of the holonic manufacturing system, and one of its components is scheduling, and works to deepen it among working individuals, because this will contribute to raising the level of interest in effective cost.

2-The need to create holons with a manufacturing system to enable workers to contribute and preserve the company's

resources, solve problems appropriately, and achieve effective cost.

3-Considering the scheduling holon, which is one of the components of the holon manufacturing system, as an integrated system that requires harmonization of policies, programs and efforts through awareness seminars and conferences.

4-Emphasis on the rationalization of the company's use of its resources and the elimination and reduction of waste in all its forms through the optimal use of resources.

5-Continuing the application of modern technology by the company in its operations, through the company's follow-up of technological developments in the field of manufacturing and trying to apply it in its manufacturing system.

Reference

- 1-Baby, P. P& Manoj, P. K.,(2012)," Manufacturing Friendly Cost Management For Enhanced Production Competitiveness Of Indian Industry: Flexible Manufacturing Systems", Journal of Trade & Global Business Perspectives Pezzottaite Journals, Volume 1, Number 1,p36-43.
- 2-Barbosa ,Jose & Leitaó ,Paulo & Adam, Emmanuel and Trentesaux ,Damien,(2013)," Improving the ADACOR2 Supervisor Holon Scheduling Mechanism with Genetic Algorithms ",Polytechnic Institute of Bragança, Campus Sta Apolónia, Apartado 1134, 5301-857 Bragança, Portugal,p1-4.
- 3-Chen ,Dayu,(2020)," Application of Target Cost Management in Enterprise Economic Management", 3rd International Conference on Global Economy, Finance and HumanitiesResearch,p265-269.
- 4-Cheng,Fan-Tien &Chang,Chih-Feng&Wu,Shang-Lun,(2006),"Development of Holonic Manufacturing Execution Efficiency Systems ", Manufacturing the Future, Concepts - Technologies - Visions ,p77-100.
- 5-Daneshjo ,Naqib,(2013)," Production Management Systems" Transfer inovacii 28, doc. Ing,p36-38.(work paper).
- 6-Istokovic, D.& Pernik M.& Flatkovitch, M. & Prezonik, M ,(2020),"Minimizing Total production cost in Ahybrid Flow Shop: Asimulation-Otimiztion Approach" Original Scientific Paper,Int simul model 19 (4),p559-570.
- 7-Marchesan, P.R.C.& Formoso, C. T(2001)," Cost management and production Control For Construction Companies", Carlos T. Formoso, Brazil,p1-12.
- 8-Mello, Mario Fernando & Santos ,Amanda Barbosa,(2016)," The Importance of Cost Management in Manufacturing Company of Hydroelectric Plants - A case Study" Brazilian Journal of Operations & Production Management, Volume 13, p 94-99.
- 9-Mroz ,Andrzej,(2020)," The Role of Product Cost Deployment in The Early Product Management Methodology Within The Wcm System – A case Study", Management and Production Engineering Review, Volume 11 , Number 4 , p 13–24.
- 10-Ordynskaya, Marina Evgenievna & Silina,Tatyana Alexandrovna & Divina ,Lala Eldarovna& Tausova, Irina Fedorovna& Bagova ,Saida Aslanbievna,(2021)," Functions of Cost Management Systems in Modern Organizational Management", Universal Journal of Accounting and Finance 9(3): 498-505.

- 11-Relich ,Marcin & Nielsen ,Izabela & Gola ,Arkadiusz,(2022)," Reducing the Total Product Cost at the Product Design Stage", applied sciences,University of Zielona Gora,p1-17.
- 12-Shrestha,Rajesh& Takemoto,Toshihiro &chinose, Koji& Nobuhiro Sugimura,(2008)," A study on integration of process planning and scheduling system for holonic manufacturing with modification of process plans", Manufacturing Technology and Management, Vol. 14, No 3/4,P359-378.
- 13-Zhao , Fuqing; Hong, Yi; Yu, Dongmei; Yang, Yahong & Zhang, Qiuyu, (2010)," A hybrid particle swarm optimisation algorithm and fuzzy logic for process planning and production scheduling integration in holonic manufacturing systems", International Journal of Computer Integrated Manufacturing, Vol. 23, No. 1, January, p20–39.
- 14- Ramos, Carlos&Sousa, Paulo& Neves, Jose,(2007),"Scheduling in Holonic Manufacturing Systems/ Process Planning and Scheduling for Distributed Manufacturing", 1th, ed, Publishing in Springer Series, Springer, London, ISBN, 978- 84628–752–7.
- 15- Giret, Adriana, & Botti, Vicente, (2008)," A Multi-agent Methodology for Holonic Manufacturing Systems", 1th,ed, British Library Publication, Springer Series in Advanced Manufacturing, ISBN 978 - 1- 84800 - 309 – 5.