

Production Planning and Loading on CNC Machines

Servet SOYGUDER^{1*}, Merve GURCAN²

¹ Ankara Yıldırım Beyazıt University, Faculty of Engineering and Natural Sciences, 06010, Ankara, Turkey,

ORCID No: <https://orcid.org/0000-0002-8191-6891>

² Ankara Yıldırım Beyazıt University, Institute of Science and Technology, Department of Engineering Management, 06010, Ankara,

ORCID No: <https://orcid.org/0000-0001-8840-7726>

Keywords	Abstract
Scheduling, Production Planning, Workloading	<i>The most important step in a production process is the correct work flow planning. The production planning process is the creation of a plan with steps such as which goods will be produced and how much will be produced, when will be produced, what will be the capacity need, determination of the necessary machines and workforce, and the most appropriate job assignment by bringing the appropriate jobs and personnel to the machines. Today, many companies use various methods for production planning, which we divide into two as long-term planning and short-term planning. In this study, it is aimed to emphasize the importance of production planning and to do business planning correctly. The increasing competitive environment has made it necessary to plan the production correctly, which is the most important place for a company. The study was evaluated by making short-term production planning for Küçükpazarlı Aviation company, which produces machining in the aviation sector in the mainland. The current works and the qualifications of production in the enterprise were determined, and the classical method, Gantt method and Johnson method were tried. Three methods were examined and the Gantt method was chosen as the most suitable scheduling method among the methods. The aim of this study is to ensure timely delivery performance by making the right business plan of the company. The results obtained were compared and analyzed with the current classical situation in the enterprise. As a result, more successful results of the applied Gantt method in production planning than the current classical method were obtained and examined.</i>

Research Article

Submission Date : 06.04.2023

Accepted Date : 01.11.2023

1. INTRODUCTION

Developing fast technology, market competitive environment affects the share of companies in the business world. One of the methods used for production planning is ERP (Enterprise Resource Planning). It is one of the requirements brought by technology. Integrating the company's data and

*Resp author; e-mail: merve.gurcan@gmail.com

departments into ERP will be the most important investment the company has made for the future. Corporate systems trying to adapt to developments mean commercial software packages that allow uninterrupted information flow, which reflects the physical reality and functionally available opportunities moment by moment in an environment where environmental conditions are constantly changing, can show the results depending on possible scenarios according to the new situation, and enable the right decisions to be taken. Fui-Hoon,F.,2002). In other words, ERP allows all components of an organization to be seen as a whole. In other words, it allows an institution to carry out its own business processes in an integrated structure, while also supporting and monitoring the part of the work that goes beyond the boundaries of the institution (Genoulaz, at all., 2005). The ERP system is an integrated software that provides a holistic perspective to all business processes of companies and creates a bridge between all business processes. This software can also be expressed as the interface associated with all units fed from a database used in all units of the company (Ehie at all, 2005). It enables the most accurate planning with the least error for short-term production planning. It is very important in this method that the data entered into the ERP system is correct.

In the study by Halil İbrahim Koruca et al., flexible workflow editor module was developed and gantt chart scheduling representation was made (Koruca at all,2010). In the study conducted by Gülçin Bektur et al., the method of assigning the workforce to the tasks, shifts and leave days with the goal programming model was made, taking into account the skills, seniority levels, preferences of the employees and the demands of the system (Bektur and Hasgül, 2013). In the study conducted by Erçin Tevfik Öztuncel, a scheduling method integrated into Uyumsoft database was used for the capacity study of the enterprise (Öztuncel, 2007). In the study conducted by Tuğçe Kaçar et al., they used a package program and Gantt method for job scheduling (Kaçar and Olgun, 2020). In the study conducted by Osman Demirdöğen and his friend, researches were made and methods were mentioned in order to be able to load the work correctly, and a study was conducted by entering the determined constraints and purpose into the WINQSB package program (Demirdöğen and Güzel, 2009).

2. PRODUCTION PLANNING

Production planning decisions include decisions such as workforce level, sequencing of production decisions, and job loading (Graves, 1999). Production planning according to the definition of APICS (American Production and Inventory Control Society); It is a function that determines the levels or limits of future manufacturing activities or quantities (Yamak, 1993). Production planning according to the definition of APICS (American Production and Inventory Control Society); It is a function that determines the levels or limits of future manufacturing activities or quantities (Yamak, 1993). Production planning performs the following functions: Using the available production resources and possibilities in the best way, carrying out the works with the least expense, reaching the desired quality and quantity in a short time and getting the most efficient result (Yelken and Demir, 1978). Production planning; It is related to many different activities such as determining the production and stock level, sequencing the processes with minimum cost, supplying the raw materials in a way that will not disrupt the production, purchasing new workbenches, commissioning additional buildings and so on (Yıldız, 2000). The processes are carried out in order and according to the details determined in the production systems. On the other hand, control initiates and supervises the processes by means of information feedback in order to achieve the goals (Alptekin, 1994).

2.1. Machine Capacity

While preparing production programs, the actual and maximum capacity of the machines in the factory should be known. Maximum capacity of a machine; It can be calculated based on measures

such as working speed, durability, reliability. For example; In case of working 24 hours a day in 3 shifts and 30 days a month in an enterprise; It is seen that there is a suitable capacity of $24 \times 30 = 720$ hours/month. This capacity is only the capacity of a machine. In the enterprise, machines can work alternately in accordance with a certain production process and workflow. If the machine works 12 hours a day and 30 days a month, the machine capacity; $12 \times 30 = 360$ hours/month. In this case, $720/360 = 2$ machines are needed to do the same job. As a result, in the planning of machine capacity, the number of shifts of the enterprise determines the number of machines to be used in daily production (Ödeniyazov, 2006).

3. TECHNICS

3.1. Classic Method

This classical method, which is done completely manually, causes a high margin of error. Momentary inattention allows situations such as incorrect examination of the list.

Table 1. Order list used in the classical method

Part No	Bench	Order Opening Date	Open Quantity	Contract Term	The Shipment Date
111A532..	X	12.12.2022 00:00	22	21	21.12.2022 00:00
112A533..	X	12.12.2022 00:00	22	21	19.1.2023 00:00

Table 2. Bench program in classical method

X Bench						
Production Completed		File	Part No	Quantity	The Shipment Date	Note
1. Operation	2. Operation					
		x	112A533..	22	30.11.2022 00:00	A surface -B surface
		x	111A532..	22	29.12.2022 00:00	

The parts requested according to the list in the bench production programs are sent to the raw material area by the warehouse together with their files. In the program, the parts groups whose production turn is approaching are pulled from the raw material area to the sides of the bench by the relevant operator. (See Fig 1)

3.2. Gantt Method

A Gantt timeline chart is used to track work in progress. It is also used for project scheduling. It shows which jobs are on schedule and which are ahead or behind schedule. In practice, there are many versions of the chart (Wikipedia, 2022). The steps followed for the Gantt Method performed on excel during the implementation phase are as follows: Step 1: Create a data range that includes the track name, start date, and duration:

Table 3. Part name, duration and start date

Part No	Duration (Day)	Starting Date
112A533..	0,43	7.12.2022 00:00
111A532..	1,68	7.12.2022 10:20

Table 4. Time calculation table

Quantity	Set up Time	Run Time	Duration (Hour)	Duration (Day)
22	0,5	0,33	7,76	0,43
22	1	1,33	30,26	1,68

The time calculation is calculated by taking into account the set time and processing time withdrawn from the system: $\text{Time (Hour)} = \text{Setting Time} + (\text{Processing Time} * \text{Amount})$. Since the daily working time is 18 hours (2 shifts * 9 hours), the day is calculated by dividing the hourly working time by 18. This calculation is given in Table 4. The Start Date shown in Table 3 is calculated cumulatively. The process continues with the other piece being taken to the bench immediately after the first piece is finished on the bench. Step 2: Add a bar chart and data series: Regular forecasting is required which is a time consuming task (<https://know-base.net/7581270-gantt-chart-in-excel>, 2022).

3.3. Johnson Algorithm

Johnson algorithm is also known as Johnson Ranking Algorithm. It gives the best solution for a group of jobs to run sequentially on two machines (wikipedia, Johnson Algorithm, 2022). Flow Time: The time a job or service spends on the workstation is called flow time. This time is the sum of all the preparation times required at the workstation, the processing time, the time spent switching between productions, the delay times due to input exhaustion. $\text{Delay} = \text{time to complete work} - \text{time to deadline}$ (Topoyan, 2022)

5. CONCLUSION

The classical method and the Gantt and Johnson Method have been tried and compared. It has been determined that the classical method used allows for shipment delays, it is a method that we cannot see the forward plan due to its being completely manual, and the Johnson Method causes shipment delays because it creates a plan based on time rather than shipment dates. The Gantt Method was chosen as the most suitable method among the three methods. Thus, we started the continuation process with a method where we can plan the production area more easily and systematically. We have become so that we can more easily catch up with the speed in the industry. Errors arising from the planning process, which are completely manual and have a high margin of error, have been minimized. With the Gantt method, which is one of the scheduling methods and was chosen because of its success in the study, delays in shipments and unnecessary workloads on the counter and personnel were prevented. As a result, instead of a system in which the human burden is lightened and dependent on the initiative of the person; a system in which more accurate planning was made has been started.

REFERENCES

- Alptekin, Ü. (1994). Konfeksiyon İşletmelerinde Üretim Planlaması ve Optimizasyon Çalışmaları (Yüksek Lisans Tezi). İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü, İstanbul, s.12.
- Altındaş, M. (2011). Üretim Çizelgeleme ve Bir Uygulama. (Yüksek Lisans Tezi). Bozok Üniversitesi, Yozgat.
- Botta-Genoulaz, V., Millet, P. A., & Grabot, B. (2005). A survey on the recent research literature on ERP systems. *Computers in industry*, 56(6), 510-522. doi: <http://dx.doi.org/10.1016/j.compind.2005.02.004>

- Demirdöğen, O., & Güzel, D. (2009). ÜRETİM PLANLAMA VE İŞ YÜKLEME METOTLARI. Atatürk University Journal of Economics & Administrative Sciences, 23(4). <https://dergipark.org.tr/tr/download/article-file/29720>
- Ehie, I. C., & Madsen, M. (2005). Identifying critical issues in enterprise resource planning (ERP) implementation. Computers in industry, 56(6), 545-557. doi: <http://dx.doi.org/10.1016/j.compind.2005.02.006>
- Öztuncel, E. T. (2007). Sonlu kapasiteli çizelgeleme ve bir uygulama (Doctoral dissertation). Sakarya Üniversitesi, Turkey.
- Fui-Hoon, F. (2002). Enterprise Resource Planning Solutions and Management, Travers, J.
- Graves, S. C. (1999). Manufacturing planning and control. Massachusetts institute of technology, 1-26. https://www.researchgate.net/publication/246760677_Manufacturing_Planning_and_Control
- Bektur, G., & Hasgöl, S. (2013). KIDEM SEVİYELERİNE GÖRE İŞGÜCÜ ÇİZELGELEME PROBLEMİ: HİZMET SEKTÖRÜNDE BİR UYGULAMA. Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 15(2), 385-402. <https://dergipark.org.tr/en/pub/akuiibfd/issue/1618/20270>
- KORUCA, H., ÖZDEMİR, G., AYDEMİR, E., & ÇAYIRLI, M. (2010). BİR SİMÜLASYON YAZILIMI İÇİN ESNEK İŞ AKIŞ PLANI EDİTÖRÜ GELİŞTİRİLMESİ VE İŞLEMLERİN GANTT ŞEMASINDA ÇİZELGELENMESİ. Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi, 25(1). <https://dergipark.org.tr/en/pub/gazimmfd/issue/6683/88454>
- Ödeniyazov, S. (2006). Bir Tekstil İşletmesinde Üretim Ve Pazarlama Planlaması (Türkmenbaşı Tekstil Kompleksinde Bir Örnek Uygulama), (Yüksek Lisans Tezi). Selçuk Üniversitesi Sosyal Bilimler Enstitüsü İşletme Anabilim Dalı, Konya.
- Tekbaş, H. (2011). Esnek sipariş tipi üretim sistemlerinde müşteri siparişlerinin çizelgelenmesi (Doctoral dissertation). İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü.
- OLGUN, M. O., & KAÇAR, T. (2020). Bir Metal Fabrikası İçin İş Çizelgeleme Yazılımı Hazırlanması. Bilecik Şeyh Edebali Üniversitesi Fen Bilimleri Dergisi, 7(1), 421-443. doi: <https://doi.org/10.35193/bseufbd.589585>
- Yamak, O. (1993). Üretim yönetimi: sistemler, ilkeler ve teknikler. Alfa.
- Yelken, N., & Demir, H. (1978). Üretim planlaması ve kontrolü. Ege Üniversitesi.
- Yıldız, S. (2000). Sanayi İşletmelerinde Ana Üretim Planlama ve Bütünleşik Üretim Planlama Uygulaması. (Doktora Tezi). Atatürk Üniversitesi.
- Yrd. Doç. Dr. Mert Topoyan, Üretim Çizelgeleme, 2022. https://tr.wikipedia.org/wiki/Gantt_%C3%A7izelgesi#cite_note-1 , Gantt çizelgesi, 2022. <https://tr.know-base.net/7581270-gantt-chart-in-excel> , 2022. www.cengizpak.com.tr/ İş Sıralama Kuralları –201/Johnson Algoritması , 2022.