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Application of order priority strategies in project scheduling : qualitative study of industrial companies.

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Abstract

The scheduling process plays a crucial role in project management. The goal is to define the timeline of tasks and operations in order to optimize resource utilization and achieve set objectives within the given timeframe. There are numerous project scheduling strategies that can be applied in business to better organize the sequence of operations and orders.

In this article, we sought to identify the most commonly used customer order priority strategies in companies across several sectors in Tetouan, Tangier, and Casablanca through telephone interviews. The results showed that the most widely adopted strategies are FIFO and EDD, the latter particularly in the textile and upholstery sectors.

Keywords: Project; Scheduling; Priority; Strategies; Order; Industry.

1. Introduction

Scheduling is the process of establishing an order for the execution of the various tasks and orders of any system. The essence of the problem lies in determining the correct order based on the constraints imposed on the system, constraints that arise from the dynamics of the physical process being controlled. Typically, deadlines for execution purposes (or deadlines) will need to be met, but there are many other constraints such as the deadline or the simultaneity for the occurrence of events such as the triggering of actions.

Scheduling is the development of an action plan in order to determine the patterns or on the contrary the possible links between the execution of the previously identified tasks.

What is the order priority strategy most used by industrial companies?

In some projects, the project manager may have room for maneuver to organize the tasks, that is to say, he can anticipate several potential scenarios concerning the organization of the tasks. Depending on the evolution of the project, it is possible to choose one scenario for organizing the tasks rather than another.

In order to organize the tasks, it is necessary to list the previous tasks for each elementary task, based on the information collected in the field, and to choose only the most recent tasks. The calendar must facilitate the determination of the organization of the tasks of the project.

Priority stragies are the parameters and criteria on which the decision to execute an order or a command among several in processing is based. Whether in a production workshop or in the context of a project, a limited quantity of resources is used to accomplish a series of operations that are not always associated with the same range. When a task is completed on a workstation, the operator refers to a priority criterion to choose the next task among those waiting. In other words, it is necessary to determine the order of operations within a workshop or a workstation based on a single rule.

The application of priority strategies by project companies is not intended to optimize, but rather to offer "acceptable" solutions based on criteria similar to the manager's objectives.

Priority strategies enable efficient project organization and implementation within the schedule, which in turn influences the scheduling outcome. It is therefore advisable to select the strategies to be applied in order to best achieve the objectives set for planning (compliance with delivery dates, maximum machine capacity, etc.).

Order management is part of project management, particularly for industrial projects. It is the process of recording, tracking, and fulfilling customer orders. This process begins when an order is placed and ends when the customer receives their package. An order management

system is a computer software system used in several industries for entering and processing orders. Ideal order fulfillment involves delivering the goods to the customer, as promised at the time of sale, according to their wishes.

However, company managers inevitably find themselves in critical or pressured periods faced with a difficult choice of order priority.

2. Literature review

2.1.Project SCHEDULING: Concept and importance

In the context of project management and collaborative work, organizing teamwork in every organisation, requires a precise understanding of the overall task sequence and the use of powerful organizational tools.

While planning involves dividing an activity or project into tasks, predicting the start and end times for each task, and identifying prior work, task scheduling involves placing tasks in a logical order while respecting prior work. The goal is to achieve optimal organization while taking into account constraints (human, material, and financial resources, and deadlines).

Furthermore, a task is a basic entity that includes a start and/or end date, and whose completion requires a certain duration and the use of material, human, and financial resources.

Every project is subject to uncertainty in several aspects, such as the availability of resources and the certain duration of tasks. Until now, to address uncertainty, attention has focused on project scheduling, for which a probable duration is assigned to the different tasks.

Project scheduling aims to coordinate the execution of various project activities over time, taking into account resource constraints, dependencies, and ultimately the required duration for each activity.

It is therefore a set of tasks that must be organized over time., and scheduling facilitate project organization, thus increasing its efficiency in terms of cost and time, while allowing for an accurate assessment of the resources essential to its completion. Scheduling then aims to structure external tasks, such as maintenance, subcontracted work, and procurement from various suppliers.

2.2.Priority order strategies in project order scheduling

2.2.1. Order scheduling

The order scheduling process involves analyzing, predicting, and prioritizing future demand using historical data, market trends, and forecasts. This process determines the quantity of products to be manufactured and prioritizes tasks according to the deadline agreed upon with the customer.

Order planning and scheduling aims to optimize resource allocation, minimize costs, and maximize efficiency. By adopting an effective method for prioritizing orders for the customer, companies can avoid excess or shortage inventory, which in turn reduces the costs associated with storage and inventory management.

In addition to resource management, order scheduling also involves coordinating interdepartmental activities. Different departments within the company, such as production, logistics, and sales, must work together to ensure that products are manufactured, packaged, and delivered according to the required deadlines and specifications.

Technology plays a fundamental role in this process. Many companies use specialized systems and software to make order planning and scheduling more efficient and accurate. These tools enable real-time data analysis, rapid adjustment of plans in response to changes in demand or resource availability, and a clear and detailed view of the entire production and delivery chain.

In short, order scheduling is a strategic process that involves the planning, coordination, and allocation of resources to effectively meet market demand, meet established deadlines, and minimize costs. It is a key element in managing a manufacturing company's operations and logistics, contributing to its success and competitiveness in the market.

Once the required quantities have been established, the necessary resources, such as labor, raw materials, equipment, and time, are organized and allocated to ensure that established delivery times can be met. The company must then choose which criteria will prioritize its orders.

2.2.2. ORDER scheduling priority strategies

In every types of scheduling, whether project, production or order sche most well-known scheduling strategies are :

- ***Priority strategy : FIFO or FCFS***

(First come, first served) in French FCFS (First Entry, First Exit) : The FIFO or FSCFS scheduling algorithm assigns priority to tasks and orders based on their expected arrival order. It adheres to the simple principle that the first task or request received is processed first. Priority is given to operations/orders in the order of arrival.

This implies that commands are executed in the order they are received, regardless of their complexity or the time they are expected to take to complete.

The Advantages of *FCFS* can be *s*implicity so that FCFS is simple to use and does not require complex calculations or estimations. The approach is easy to implement and has a low computational cost. We can also add Fairness sot that FCFS treats all tasks or requests equally, based solely on their arrival time. This eliminates bias or favoritism and ensures fairness in task

scheduling.

Concerning limitations of *FCFS :* we can mention, lack of Prioritization, so that FCFS does not prioritize tasks and orders based on their importance or urgency. Critical or time-sensitive tasks may experience delays, leading to potential inefficiencies. And also Waiting Time so that FCFS can result in longer waiting times, especially for tasks that require significant processing time. This can lead to potential bottlenecks and delays for subsequent tasks. *We can add also* resource Utilization so that FCFS does not consider task requirements or resource utilization. Tasks with high resource demands are not prioritized over those with lower requirements, which can lead to inefficient resource allocation.

§ ***Priority strategy : TOM or SPT***

Smith proposed the optimal SPT (Shortest Processing Time) rule as a scheduling priority strategy. This recurring rule, which we will refer to as the weighted TOM rule (also known as Smith's rule), consists of sequencing tasks in ascending order of operating times. This rule can be very poor for variants of this same criterion due to the waiting times for long-running operations,

We consider Shortest Processing Time (SPT), a simplification of SRPT that skips the update (Amico 2019).

The Shortest Turnaround Time (SPT) algorithm is a technique used in task organization and management. It assigns tasks based on their turnaround times, giving priority to the shortest tasks. This method minimizes the overall wait time for all tasks. When managing multiple projects, the SPT algorithm can be implemented by tackling the fastest project first, then moving on to the next fastest, and so on. For example, if you have a large project that takes four days to complete and a smaller one that takes one day to complete, your priority would be to complete the smaller project first. This reduces the total wait time for your customers, resulting in greater efficiency and increased customer satisfaction.which can be very significant.

The SPT Take advantage of the activity time predictions to estimate the waiting time of activity (Rose 2001).

The most important limitation of this strategy are :

- ✓ Delays in determining processing times : Determining task processing times is too time-consuming; it is also possible that the only way to know a task's processing time is to execute it.
- ✓ Biased processing time estimates: Processing time estimates can be biased; this creates an incentive for resources to distort their perception of processing times, as shorter tasks

are processed earlier.

- ✓ Fairness : The SPT raises concerns about fairness: it does not treat all tasks equally. This is the main challenge for the SPT.

Shortest processing time (SPT) refers to a scheduling technique used to minimize the total execution time of tasks by prioritizing those that require the least time.

- § ***Priority strategy : LPT***

In French, TFL (Longest Manufacturing Time) : priority is given to operations and orders with the longest manufacturing time (decreasing order of operating time). So this is a priority rule that assigns the highest priority to tasks with the longest processing time.

Longest Processing Time (LPT) rule proposed by Graham in 1969. LPT requires to sort jobs in non-ascending order (Croce & Scatamacchia 2018).

The longest processing time rule ranks jobs according to their processing times, from longest to shortest. As soon as a machine becomes available, the most important job available at that time will begin processing. This algorithm is a heuristic used to determine the minimum makespan of a schedule. It prioritizes the longest jobs first to prevent an important job from being "highlighted" at the end of the schedule, which would significantly lengthen the completion time of the last job.

- § ***Priority strategy EDD (Earliest Due Date) :***

Priority is given to operations and orders with the closest promised end date (Processing in ascending order of delivery time).

An algorithm is developed for sequencing on a single processor in order to minimize maximum lateness, subject to ready times and due dates (Bratley and al.,1975)

EDD (Earliest Due Date) is a scheduling algorithm aimed at minimizing the maximum delay. Jackson's rule states that an algorithm that executes a set of n independent tasks in an order based on their non-decreasing deadlines is optimal for minimizing the maximum delay. Sustainable development education is not a priority.

- § ***Priority strategy : PCO (Prefered Customer Order)***

A preferred customer is a buyer (purchasing organization) that enjoys more favorable treatment than other customers from a supplier, with regard to product quality and availability, support during the procurement process, delivery and/or price.

Customer and order prioritization is prioritizing the orders according to features of customers and orders (Aslan 2021).

These advantages are made possible by a privileged allocation of resources and time (Steinle

and Schiele, 2008). They are structured around a strong link between buyers and suppliers, equipped with organizational tools.

Becoming a valued and preferred customer requires a structuredand complex approach. It involves transforming processes and operations, as well as shifting the approach commonly used by buyers and other staff. In reality, it's the buyer who must "sell" the organization, although it's usually up to the potential supplier to do this for their own organization.

§ ***Priority strategy : Critical Ratio (CR)***

The critical ratio is a type of calculation used by companies in the production and manufacturing sectors to determine whether a given task is meeting its scheduled deadlines. It is a distribution rule that prioritizes the order in which orders are processed.

Critical Ratio scheduling has been implemented in job shops that manufacture component parts for stock replenishment as well as direct customer (Graves 1977).

The critical ratio defines a priority index number to determine the allocation of resources, usually within a warehouse or factory. To calculate this number, the time remaining before the order's due date is divided by the anticipated processing time. The resulting number is the critical ratio. A critical ratio less than 1.0 means a task is late, while one greater than 1.0 means it is ahead of schedule.

Benefits of Using the Critical Ratio :

Prioritization : The Critical Ratio clearly identifies tasks that are behind schedule, allowing project managers to focus on the most urgent activities first.

Decision Making : By understanding the urgency of each task, project managers can make informed decisions regarding resource allocation, task reassignment, and potential risk mitigation strategies.

Improved Communication : The Critical Ratio serves as a common language for discussing the status of project tasks, promoting better communication between team members and stakeholders.

The Critical Ratio is a valuable tool for project managers looking to optimize time and resources. It provides a clear and quantifiable measure of task urgency, enabling effective prioritization, informed decision-making, and ultimately, a greater likelihood of project success.

By using the Critical Ratio, project teams can effectively navigate the complexities of planning and scheduling, ensuring they stay on track and deliver on time and within budget.the task is on schedule.

3. Research hypothesis

Based on our research question, we can distinguish the following hypotheses :

H1 : *The FIFO order priority strategy is the most used by industrial companies*

H2 : *The SPT order priority strategy is the most used by industrial companies*

H3 : *The LPT order priority strategy is the most used by industrial companies*

H4 : *The EDD order priority strategy is the most used by industrial companies*

H5 : *The PCO order priority strategy is the most used by industrial companies*

H6 : *The CR order priority strategy is the most used by industrial companies*

4. Research methodology

In order to answer our research question, we conducted telephone interviews with more than 10 SME'S national and multinational industrial companies located in Morocco in the cities of Tetouan, Tangier, and Casablanca. Since qualitative studies explore phenomena in depth through non-numerical data such as interviews, we adopted a qualitative approach based on interviews with specific companies (industrial domain).

Our interview was unstructured, based on specific questions that provide an answer to the problem. Our data Our data has been analyzed according to the observation of the strategy most affirmed by the companies of each sector.

5. Discussion and result

Based on the survey we conducted through telephone interviews with industrial companies specializing in textile and upholstery manufacturing, and labeling and industrial equipment companies , as well as the wiring and automotive industries, we concluded that the most widely adopted strategy in the clothing and upholstery sector , and and labeling and industrial equipment companies is the EDD strategy, which consists of prioritizing orders. While in the wiring and automotive sector, the most widely adopted strategy is the FCFS strategy.

This results can be explained by the fact that the textile and upholstery industry brings together all the activities of design, manufacturing and marketing of clothing and furnitur with a well-organized and scheduled manufacturing process based on precise types of implantation which contribute to a better minimization of operational pressure. This industry has a large number of professions throughout a manufacturing chain made up of fabric and knitwear manufacturers, finished product manufacturers, and distributors, who transform fibrous raw materials into semi-finished or fully manufactured products. Manufacturers of natural and synthetic fibers intervene upstream, and therefore outside this chain.

Any well-known, specific type of implementation with a determined production line and a

multitude of machines and materials can help eliminate the uncertainty between prioritizing short tasks (SPT) or long tasks (LPT) but instead focus on the deadline agreed with the customer.

In the automotive sector, the primary objective of wiring harness design is to minimize component costs while maintaining high product reliability by developing rapid assembly and ensuring that their performance is aligned with that of the vehicle.

The automotive and wiring harness industry encompasses all companies and activities involved in the design, manufacturing, marketing, and sale of motor vehicles. This vast industry is not limited to the production of passenger cars, but also includes commercial vehicles, as well as trucks and buses. Defined by its scale and complexity, the automotive industry incorporates sophisticated and globalized production chains. From assembly plants to dealerships and after-sales services, each stage of the value chain plays a decisive role in meeting the growing mobility needs of populations.

With the emergence of new technologies and environmental concerns, the automotive industry is undergoing a profound transformation. The advent of electric vehicles, autonomous vehicles, and shared mobility solutions is reinventing the automotive landscape and opening the way to new economic and societal opportunities. Technological innovations, sustainable development, and changes in consumer behavior are all challenges and opportunities shaping the future of this dynamic industry.

The automotive sector is characterized by a significant concentration and centralization of assembly and production activities, even though supply sources and distribution channels are dispersed. Indeed, automotive logistics is a complex and elevated distribution network in which all stages must be well connected and supported by a strong, well-equipped, and broadly organized production hub for the manufacture of a wide range of production quantities. This may explain why industrial companies in this sector do not need to implement time-dependent prioritization strategies such as SPT and LPT, and therefore, the FIFO (first-come, first-served) strategy is the appropriate strategy for their customer relationships.

6 CONCLUSION

In any type of project, planning and scheduling tasks or orders involves thinking through and organizing everything necessary to complete the work as quickly and completely as possible. It covers everything from defining the objective, scope of work, tasks, quantity, and resources to budgeting and setting deadlines. All of this must be done from the very beginning of the project to ensure smooth completion.

This is one of the stages of the project management cycle, which covers the process from project inception to completion. In industrial companies, it is a key step in the supply chain process, more specifically in the logistics process, which includes the production and distribution links. It involves defining and prioritizing tasks, allocating costs, volume, and scheduling work according to the quantity and deadline set by the client. This process is necessary to ensure the project is completed on time and within budget. Even something as mundane as breakfast sometimes requires some planning, prioritizing tasks, and determining quantities based on a set time.

In essence, project scheduling indicates what needs to be done, what resources need to be used, and when the project must be completed. It is, therefore, a precise plan that describes the start and end dates, as well as the steps that must be followed to ensure the project is completed on time.

In the industrial sector, industrial project management is essentially no different, and in both project styles, the objectives of that specific project must be defined and how to proceed according to quantities and deadlines.

Order planning and scheduling is a fundamental activity in the operations and logistics management of an industrial company. It involves the detailed planning and coordination of the production and delivery of products or services to efficiently meet market demand and current and potential customers.

A well-managed order schedule is a key element of effective inventory management in today's economy. An industrial company must focus on monitoring data, streamlining orders, and maintaining the perfect balance between supply and demand, thus ensuring optimal results.

Customer order management is essential to the success of industrial companies. A well-organized system allows for the monitoring of the entire process, from customer order placement to product delivery. When everything runs efficiently, not only is customer satisfaction achieved, but resources are also optimized, delivery times are shortened, and a smooth, easy, and transparent purchasing experience is guaranteed.

Order management is essential to ensure that every purchase reaches the customer quickly and efficiently. It all starts with the receipt of the order: the system verifies it, ensures product availability, and confirms payment. The order then moves to processing, where it is carefully packaged and a shipping label is generated.

An effective order management system is based on several pillars, however, choosing a prioritization strategy is one of the most important. This allows you to focus on the most effective strategy that meets customer requirements.

The results showed us the most widely used strategy in the industrial sector, However, we invite future researchers in the field of scheduling to explore other areas, particularly services.

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