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(Research Article)

A decision support system for improving customer order management in manufacturing production planning

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Abstract

Customer order management plays an important role in manufacturing production planning, particularly when companies face dynamic demand, limited production capacity, and different customer priority levels. This study aims to develop a web-based decision support system (DSS) to improve customer order management in manufacturing production planning. The proposed system is designed to support the prioritization and allocation of customer orders by considering production capacity, order status, customer segment, delivery requirements, and company rules. The analytical hierarchy process (AHP) was applied to determine the priority weights of three customer segments, namely original equipment (OE), aftermarket (AM), and general parts (GNP). The results show that OE has the highest priority weight, followed by AM and GNP. The developed system enables users to input order data, monitor production capacity, allocate orders automatically, and generate recovery plan recommendations when backorders occur. Based on historical order data, the system produced priority decisions that were consistent with the existing company policy while significantly reducing the time required for order allocation and recovery planning. The system enables the decision-making process to be completed faster and in a more structured manner than the manual approach. Therefore, the proposed DSS can improve the efficiency, consistency, and objectivity of customer order management in manufacturing production planning.

Keywords: Customer Order Management; Decision Support System; Manufacturing Production Planning; Analytical Hierarchy Process; Order Prioritization

1. Introduction

Manufacturing companies are increasingly required to improve operational efficiency, production flexibility, and decision-making accuracy in responding to dynamic customer demand [1,2]. In a competitive manufacturing environment, companies must be able to manage production capacity, production schedules, and customer priorities effectively to maintain delivery performance and customer satisfaction. Ref. [3] stated that the effectiveness of a production system is strongly influenced by the company's ability to align production planning and operational control in order to minimize deviations between production plans and actual production realization.

Customer order management plays an important role in ensuring that customer demand can be translated into feasible production plans [4,5]. In manufacturing operations, customer orders may come from different segments with different demand patterns, delivery requirements, and business priorities. Therefore, companies need a structured order management mechanism to balance customer demand with available production capacity. Ref. [6] explained that an integrated production planning and control system is required to synchronize demand management, production planning, capacity planning, and inventory control.

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In the observed production planning process, customer order prioritization was carried out manually by production planners. This manual process required planners to review forecast data, actual daily orders, production capacity, delivery deadlines, and customer priority rules before determining which orders should be processed first. Production planning and scheduling are generally concerned with determining the resources required to meet customer demand, while order acceptance and scheduling decisions become critical when capacity is limited and delivery deadlines must be considered [7,8]. However, simpler planning methods may become less effective when production decisions involve complex trade-offs between competing priorities, due dates, available capacity, and resource constraints [9]. This condition may result in subjective decisions, longer decision-making time, back orders, and delivery delays. Furthermore, Ref. [10] argued that mismatches between customer demand and production capacity may contribute to instability in the supply chain.

One of the key challenges in customer order management is determining production priority when available capacity is limited. In this situation, planners must decide which customer orders should be fulfilled first and which orders should be delayed or rescheduled. The decision becomes more complex when the company serves several customer segments, such as original equipment (OE), aftermarket (AM), and general parts (GNP), each of which has different operational characteristics and priority levels. Without a systematic decision-making approach, the prioritization process may depend heavily on the experience and judgment of individual planners.

To address this problem, a decision support system (DSS) can be used to assist decision-makers in solving semi-structured problems through the integration of data, analytical models, and user interfaces. A DSS is a computer-based system designed to support decision-making processes by providing structured information and analytical support [11]. In the context of manufacturing production planning, DSS can help planners evaluate customer orders, compare available capacity, determine production priorities, and generate recovery plan recommendations when backorders occur.

The analytical hierarchy process (AHP) is one of the methods that can be integrated into a DSS to support multi-criteria decision-making. AHP enables decision-makers to structure complex decision problems into a hierarchy consisting of goals, criteria, sub-criteria, and alternatives [12]. Through pairwise comparison, AHP produces priority weights that can be used to rank alternatives systematically. Ref. [13] also emphasized that AHP is suitable for decision-making problems involving multiple criteria and complex alternatives because it provides a consistent and measurable prioritization process. AHP has been implemented in various applications, such as in service quality [14-17], supplier selection [18,19], car selection [20], and sustainability [21-23].

Based on these considerations, this study develops a web-based DSS to improve customer order management in manufacturing production planning. The proposed system is designed to support customer order prioritization and production allocation by considering production capacity, order status, customer segment, delivery requirements, and company rules. The AHP method is applied to determine the priority weights of customer segments, while the web-based system is used to process order data, monitor production capacity, allocate orders automatically, and generate recovery plan recommendations when backorders occur.

The main contribution of this study is the development of a structured decision-making tool that supports order prioritization and recovery planning in a manufacturing production environment. Compared with manual planning, the proposed system is expected to improve the efficiency, consistency, and objectivity of customer order management. Therefore, this study aims to develop a web-based DSS for improving customer order management in manufacturing production planning, particularly in conditions involving dynamic demand, limited production capacity, and different customer priority levels.

2. Theoretical Foundation

2.1. Customer Order Management

Customer order management is an important process in manufacturing operations because it connects customer demand with production planning, capacity allocation, and delivery fulfillment. In a customer-order-driven production system, production planning must consider customer requirements, delivery lead time, and available production capacity to ensure that customer orders can be fulfilled effectively [4]. Customer order planning also supports the integration of demand forecasts and actual customer orders into the planning process, allowing companies to create more consistent and realistic production plans [5].

In manufacturing companies, customer orders may come from different segments with different characteristics, priorities, and delivery requirements. Therefore, order management is not only related to recording customer demand but also to determining how each order should be processed based on operational constraints. When customer demand changes dynamically or exceeds available production capacity, companies need to determine which orders should be prioritized and which orders should be rescheduled. Without a structured decision-making process, customer order management may become time-consuming and highly dependent on planner judgment.

Customer order management also has a close relationship with supply chain performance. Effective order management can help companies improve service levels, reduce delivery delays, and maintain customer satisfaction. Ref. [24] stated that supply chain management focuses on managing relationships and processes to deliver superior customer value at lower cost. Therefore, the ability to manage customer orders properly is essential in supporting production planning and maintaining supply chain stability.

2.2. Manufacturing Production Planning

Manufacturing production planning is a process used to determine how production resources should be allocated to meet customer demand. Production planning and control generally include demand management, forecasting, master production scheduling, material planning, capacity planning, inventory control, and production activity control [6]. These activities are required to ensure that production can be carried out according to customer requirements, available resources, and delivery schedules.

In production planning, capacity is one of the most important constraints. When customer orders are lower than or equal to available capacity, production planners can allocate orders according to the existing plan. However, when demand exceeds production capacity, planners must make priority decisions. These decisions may involve selecting customer orders to be fulfilled first, allocating production to alternative lines, rescheduling orders, or preparing recovery plans. Order acceptance and scheduling decisions become critical when companies face limited capacity and strict delivery deadlines [8].

Production planning decisions become more complex when companies serve multiple customer segments. Each customer segment may have different delivery urgency, demand stability, and business importance. As a result, production planners need to evaluate several criteria before determining production priorities. Advanced planning and scheduling approaches are often needed when production decisions involve trade-offs among due dates, resource availability, customer requirements, and production constraints [9]. This shows that production planning requires a decision-making approach that is not only fast but also consistent and objective.

2.3. Decision Support System

A Decision Support System (DSS) is a computer-based system designed to support decision-making processes, especially for semi-structured and unstructured problems. DSS helps decision-makers by integrating data, analytical models, and user interfaces to produce useful information and recommendations [11]. In manufacturing production planning, DSS can be used to assist planners in evaluating order data, analyzing production capacity, determining order priorities, and generating alternative decisions.

Ref. [25] explained that DSS supports managers and decision-makers by improving access to relevant data and analytical tools. A DSS does not replace human decision-makers but provides structured support so that decisions can be made more systematically. In the context of customer order management, DSS can reduce the dependence on manual calculations and individual judgment by applying predefined decision rules and analytical methods.

The use of DSS is relevant in production planning because planners often need to make decisions under time pressure and capacity limitations. A web-based DSS can improve accessibility and monitoring because users can input order data, review production capacity, process allocation logic, and obtain recommendations through a single system interface. In the context of this study, the DSS is developed to support customer order prioritization, automatic order allocation, and recovery plan generation when backorders occur. This design follows the need identified in the practical case, where manual order prioritization and recovery planning still require significant time and planner judgment.

2.4. Analytical Hierarchy Process

The Analytical Hierarchy Process (AHP) is a multi-criteria decision-making method introduced by [12]. AHP is used to solve complex decision problems by structuring them into a hierarchy consisting of goals, criteria, sub-criteria, and alternatives [12]. This method allows decision-makers to compare criteria and alternatives through pairwise comparisons and convert subjective judgments into priority weights.

AHP is suitable for decision-making problems that involve several criteria and alternatives. Ref. [13] explained that AHP provides a measurement approach through pairwise comparisons and relies on expert judgment to derive priority scales. In this method, each criterion is compared using a preference scale, commonly ranging from 1 to 9, where a higher value indicates a stronger level of importance. The comparison results are then processed to obtain priority weights.

Another important feature of AHP is the consistency test. The consistency ratio is used to evaluate whether the pairwise comparison judgments are logically consistent. In general, a consistency ratio value of less than or equal to 0.10 indicates that the comparison matrix is acceptable. This consistency test is important because it ensures that the resulting priority weights are reliable enough to be used as a basis for decision-making.

In this study, AHP is used to determine the priority weights of customer segments in the production planning process. The alternatives consist of original equipment (OE), aftermarket (AM), and general parts (GNP). The criteria used in the prioritization process include product quantity, delivery method, customer segment hierarchy, and compliance with company rules. The resulting priority weights are then integrated into the DSS to support automatic customer order allocation.

2.5. Customer Order Prioritization in Production Planning

Customer order prioritization is required when production capacity is not sufficient to fulfill all customer orders at the same time [26]. In this condition, production planners need to determine which customer orders should be processed first based on business priority, delivery requirements, and operational constraints. If prioritization is performed manually, the process may take longer and may produce inconsistent results, especially when order changes occur suddenly.

The integration of DSS and AHP can provide a structured approach to customer order prioritization. AHP is used to calculate customer priority weights, while DSS is used to process order data and apply the priority logic in production allocation. This combination enables the system to support decision-making in a faster and more objective manner. In addition, the DSS can generate recovery plan recommendations when backorders occur by identifying unfulfilled orders and checking available production capacity on alternative lines.

In this study, customer order prioritization is developed to support manufacturing production planning under dynamic demand and limited capacity conditions. The proposed system considers order status, customer segment, production capacity, delivery requirements, and company rules. By integrating these factors into a web-based DSS, the system is expected to improve efficiency, consistency, and objectivity of customer order management.

3. Methodology

3.1. Research Design

This study used a quantitative approach combined with system development. The quantitative approach was applied to analyze customer order data, production capacity, and priority weights using AHP. Meanwhile, system development was carried out to design and develop a web-based DSS for supporting customer order prioritization and production allocation. The research focused on improving customer order management in manufacturing production planning. The main problem addressed in this study was the manual prioritization of customer orders when production capacity was limited or when backorders occurred. Therefore, the proposed DSS was designed to assist production planners in determining customer priorities, allocating orders based on available capacity, and generating recovery plan recommendations.

3.2. Research Object

The object of this study was the customer order management process in the Production Planning and Inventory Control (PPIC) function of a manufacturing company. The process involved the management of customer orders, production capacity, order allocation, and backorder handling. Three customer segments were considered in the prioritization process: original equipment (OE), aftermarket (AM), and general parts (GNP). These customer segments have different characteristics and priority levels. OE customers generally have higher urgency because their orders are closely related to just-in-time production requirements. AM and GNP customers also need to be fulfilled, but their priority levels are determined based on company rules, delivery requirements, and available production capacity. Therefore, a structured decision-making method was required to determine customer priorities objectively.

3.3. Data Types and Sources

The data used in this study consisted of primary and secondary data. Primary data were obtained through direct observation and interviews with personnel involved in production planning activities. This data included information about the existing customer order management process, customer prioritization criteria, production capacity considerations, and company rules related to order allocation. Secondary data was obtained from company documents related to customer orders and production planning. The data included historical order data, actual daily order data, production capacity data, and monthly forecast data. This data was used as the basis for testing the system logic and comparing the proposed DSS with the existing manual process.

The system trial was conducted for one week by running the web-based DSS in parallel with the existing manual process. The system output did not directly affect actual production decisions during the trial period but was used to evaluate whether the proposed DSS could generate consistent and reliable recommendations. The data used in the trial system are summarized in Table 1.

Table 1 Data used in the system trial

Data Type	Period	Purpose
Historical order data	December 2025	To test the system logic and compare the system output with manual decisions
Actual order data	January 2026	To simulate daily order input in the web-based system
Production capacity data	December 2025–January 2026	To identify available capacity for each production line
Monthly forecast data	January 2026	To determine the Month-to-Date (MTD) limit and demand fluctuation rule

3.4. Data Collection Methods

The data collection methods used in this study consisted of observation, interviews, and documentation study. First, observation was conducted to understand the existing customer order management and production planning process. Through observation, the research identified how customer orders were received, reviewed, prioritized, and allocated by production planners. Second, interviews were conducted with personnel involved in the PPIC process, including supervisory and planning staff. The interviews were used to identify the criteria considered important in customer order prioritization, the rules applied in order allocation, and the problems faced in the existing manual system. Third, documentation study was conducted by reviewing customer order data, forecast data, production capacity data, and related planning documents. These documents were used to support the AHP calculation, system design, and system evaluation.

3.5. Analytical Hierarchy Process Method

The AHP was used to determine the priority weights of customer segments. AHP is suitable for multi-criteria decision-making because it enables decision-makers to structure complex problems into a hierarchy and compare criteria or alternatives through pairwise comparisons [12,13,16,17].

The AHP procedure in this study consisted of the following steps:

- Defining the decision goal
    - The goal of the decision process was to determine customer order priority in manufacturing production planning.
- Determining the criteria
    - The criteria used in the prioritization process were product quantity, delivery method, customer segment hierarchy, and compliance with company rules. The criteria were determined through observation and interviews with production planning personnel. These criteria represent the main factors considered when planners determine which customer orders should be prioritized, especially

when production capacity is limited. The criteria are presented in Table 2. The compliance criterion consisted of two sub-criteria: demand fluctuation and Month-to-Date (MTD) limits. Demand fluctuation was used to control order changes, while MTD was used to ensure that cumulative order fulfillment did not exceed the forecast limit. These criteria were then used as the basis for determining the priority weights of customer segments.

- Developing the hierarchy structure
  - The hierarchy consisted of the decision goal, criteria, sub-criteria, and alternatives. The alternatives were OE, AM, and GNP. The hierarchy structure is shown in Figure 1.
- Conducting pairwise comparison
  - Pairwise comparisons were carried out using Saaty's scale from 1 to 9. The comparison values were obtained based on expert judgment from production planning personnel.
- Calculating priority weights
  - The pairwise comparison matrix was processed to obtain the priority weight of each customer segment.
- Testing consistency
  - The consistency ratio was used to evaluate the consistency of the pairwise comparison. A consistency ratio value of less than or equal to 0.10 indicated that the comparison matrix was acceptable.

Table 2 Customer order prioritization criteria

No	Criteria	Description
1	Product quantity	The ability of the production system to fulfil customer orders based on the quantity requested by each customer segment
2	Delivery method	The delivery requirements and flexibility of the schedule requested by customers
3	Customer segment hierarchy	The priority order of customer segments based on company policy
4	Compliance with company rules	Compliance with demand fluctuation limits and Month-to-Date (MTD) forecast limits

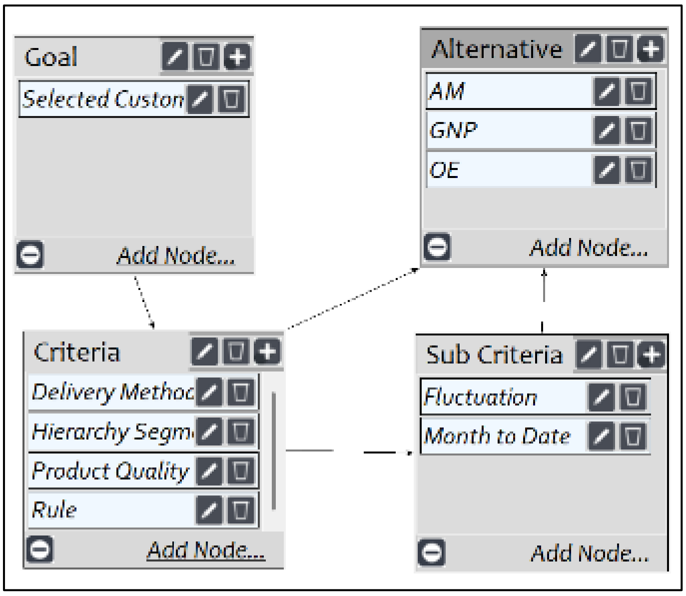


Figure 1 The hierarchy structure

The AHP results were then used as the priority logic in the DSS. Based on the AHP calculation, OE obtained the highest priority weight, followed by AM and GNP. These priority weights were integrated into the system to support automatic order allocation when production capacity was limited.

3.6. Decision Support System Development

The DSS was developed as a web-based system to support customer order prioritization, production allocation, and recovery planning. The system was designed to operate as a parallel decision-support tool, meaning that it supported the planning process but was not directly integrated with the company's main system during the trial. The system development process consisted of four main stages as follows.

- Requirement analysis

This stage identified the system's requirements based on the existing problems in customer order management. The system needed to support order input, capacity monitoring, automatic order allocation, backorder detection, recovery plan generation, and data export.

- System design

The system was designed using several design components, including Use Case diagrams, activity flow, database design, and user interface design. The main modules consisted of a dashboard, order input page, production line capacity page, planning page, and export feature.

- System development

The system was developed as a web-based DSS. Users could input customer orders manually or import order data using an Excel template. The system then processed the order data based on customer priority weights, order status, and available production capacity.

- System implementation and trial

The developed system was tested using historical order data and actual order data. The trial was conducted to evaluate whether the DSS could produce order allocation results and recovery plan recommendations that were consistent with the existing manual process.

3.7. System Logic

The DSS logic began with customer order input. The system identified each order based on customer segment, order quantity, production line, deadline, and order status. The order status was categorized into ongoing order, backorder, and next order. After the order data were entered, the system compared the total order quantity with the available production capacity. If the available capacity was sufficient, all orders were allocated according to the production plan. However, if the order quantity exceeded capacity, the system applied customer priority weights based on the AHP results. The allocation sequence followed the priority order of OE, AM, and GNP.

When back orders occurred, the system automatically identified unfulfilled orders and searched for available capacity on alternative production lines. If alternative capacity was available, the system generated a recovery plan recommendation, including the suggested production date, shift, and line allocation. If no alternative line was available, the system recommended rescheduling the order to the following period.

3.8. System Evaluation

The system was evaluated by comparing the proposed DSS with the existing manual process. The comparison focused on whether the system could generate consistent priority decisions, allocate orders accurately, reduce decision-making time, and provide recovery plan recommendations for backorders. The evaluation used five key performance indicators as shown in Table 3.

The system was tested under three scenarios: normal order conditions, orders exceeding total production capacity, and orders exceeding the main production line capacity. These scenarios were used to evaluate how the DSS responded to different production planning conditions. The results of the trial were then compared with the manual process to determine whether the proposed system could improve customer order management in manufacturing production planning.

Table 3 Key performance indicators of system evaluation

No	Key Performance Indicators (KPI)	Description
1	Customer priority selection	The order of customer segments receiving production allocation when capacity is limited
2	Order fulfilment accuracy	The percentage of fulfilled orders compared with total orders
3	Delivery delay	The difference between the promised delivery date and the actual fulfilment date
4	Order handling speed	The time required from order input to allocation or recovery plan decision
5	Recovery plan availability	The ability of the system to provide alternative production plans for unfulfilled orders

4. Results

4.1. AHP Priority Weight Results

The AHP calculation was conducted to determine the priority level of three customer segments: original equipment (OE), aftermarket (AM), and general parts (GNP). Pairwise comparisons were carried out based on expert judgment from production planning personnel. The comparison considered product quantity, delivery method, customer segment hierarchy, and compliance with company rules. The AHP results are shown in Table 4.

Table 4 AHP priority weight results

No	Customer Segment	Normalized Weight
1	OE	0.484484
2	AM	0.282147
3	GNP	0.233370

Based on the normalized weights, OE obtained the highest priority weight of 0.484484, followed by AM with 0.282147 and GNP with 0.233370. Therefore, the customer priority order generated by the AHP method was OE > AM > GNP. This result is consistent with the existing production planning policy, where OE orders are prioritized because they are closely related to just-in-time production requirements and have a significant impact on downstream customer operations.

The AHP result indicates that OE has a dominant influence in customer order prioritization. Its priority weight is almost half of the total normalized weight, meaning that OE orders should receive the first allocation when production capacity is limited. AM and GNP are then allocated based on the remaining available capacity. The consistency of the pairwise comparison was also reported to meet the acceptable threshold, with a Consistency Ratio of less than or equal to 0.10.

4.2. System Allocation Logic

The system allocation process begins when customer order data are entered into the system. Each order is classified based on customer segment, order quantity, production line, delivery deadline, and order status. The order status is divided into three categories: ongoing order, backorder, and next order. After the order data are entered, the system compares the total production load with the available capacity. If the available capacity is sufficient, all orders are allocated according to the production plan. However, if the order quantity exceeds production capacity, the system applies to the AHP priority sequence, namely OE, AM, and GNP. The allocation logic can be summarized as follows:

- The system fulfills ongoing orders and backorders first.
- OE orders receive the highest priority allocation.
- Remaining capacity is allocated to AM orders.
- If capacity is still available, GNP orders are allocated.
- If there is still remaining capacity after fulfilling ongoing and back orders, the system allocates next orders.

- If some orders cannot be fulfilled, the system generates recovery plan recommendations.

This logic enables the DSS to support production planners in making allocation decisions more systematically. The system reduces the need for manual calculation by automatically identifying capacity shortages, determining priority order, and recommending alternative actions. The logic flow is shown in Figure 2.

The logic flow describes the end-to-end process of customer order management, starting from order submission until product delivery. The process begins when the customer submits an order through the company's main order system. The order is then received by the Sales department, which classifies the customer segment into Original Equipment (OE), Aftermarket (AM), or General Parts (GNP). After the order has been confirmed, Sales forward the order data to the PPIC team for further processing.

In the PPIC Logistic stage, the system identifies the order status into three categories: ongoing order, backorder, and next order. Ongoing orders refer to orders that are already scheduled or currently being processed, back orders refer to orders that were not fulfilled in the previous period, and next orders refer to new incoming orders planned for the next production period. After classifying the order status, the system calculates material requirements based on the Bill of Materials (BOM) and compares them with available material stock. If the required materials are sufficient, the process continues to production planning. However, if the materials are not sufficient, the system applies a material allocation priority rule. The allocation is arranged by prioritizing ongoing orders first, followed by backorders, and then next orders. This rule is used to ensure that orders already in progress and delayed orders receive higher material priority before new orders are considered.

After material availability is confirmed, the process moves to the PPIC Production Planning stage. In this stage, the system identifies the production load from ongoing orders, backorders, and next orders. The system then calculates the total production load and compares it with the available production capacity. If the total load is equal to or lower than the available capacity, all orders can be planned for production. However, if the total load exceeds capacity, the system applies the customer priority rule based on the AHP result, namely OE, followed by AM, and then GNP.

The main priority of the system is to protect OE orders, including both ongoing OE orders and OE back orders. OE orders are allocated first because they have the highest priority weight and are closely related to just-in-time production requirements. After OE orders are allocated, the remaining capacity is used to allocate AM orders. If the available capacity is not sufficient to fulfill all AM orders, the system recommends emergency actions such as overtime, rescheduling, or expediting. After AM allocation is completed, the remaining capacity is recalculated and then used to allocate GNP orders. If GNP orders cannot be fully fulfilled, the system recommends adjustment through customer discussion, such as order reduction or delivery postponement. If there is still remaining capacity after fulfilling OE, AM, and GNP orders, the system allocates next orders. However, if the remaining capacity is insufficient, the unallocated next orders are carried forward to the following production period. This mechanism allows the system to manage excess demand in a structured way while maintaining the priority sequence.

After all allocation processes are completed, the system releases the final production plan. The production plan contains the allocation of orders by production line, shift, and customer segment. The plan is then sent to the production department for execution. After production is completed, the finished goods are received by the PPIC Shipping department. The shipping team then allocates finished goods based on the priority sequence of OE, AM, and GNP before delivering the products to customers according to authorization.

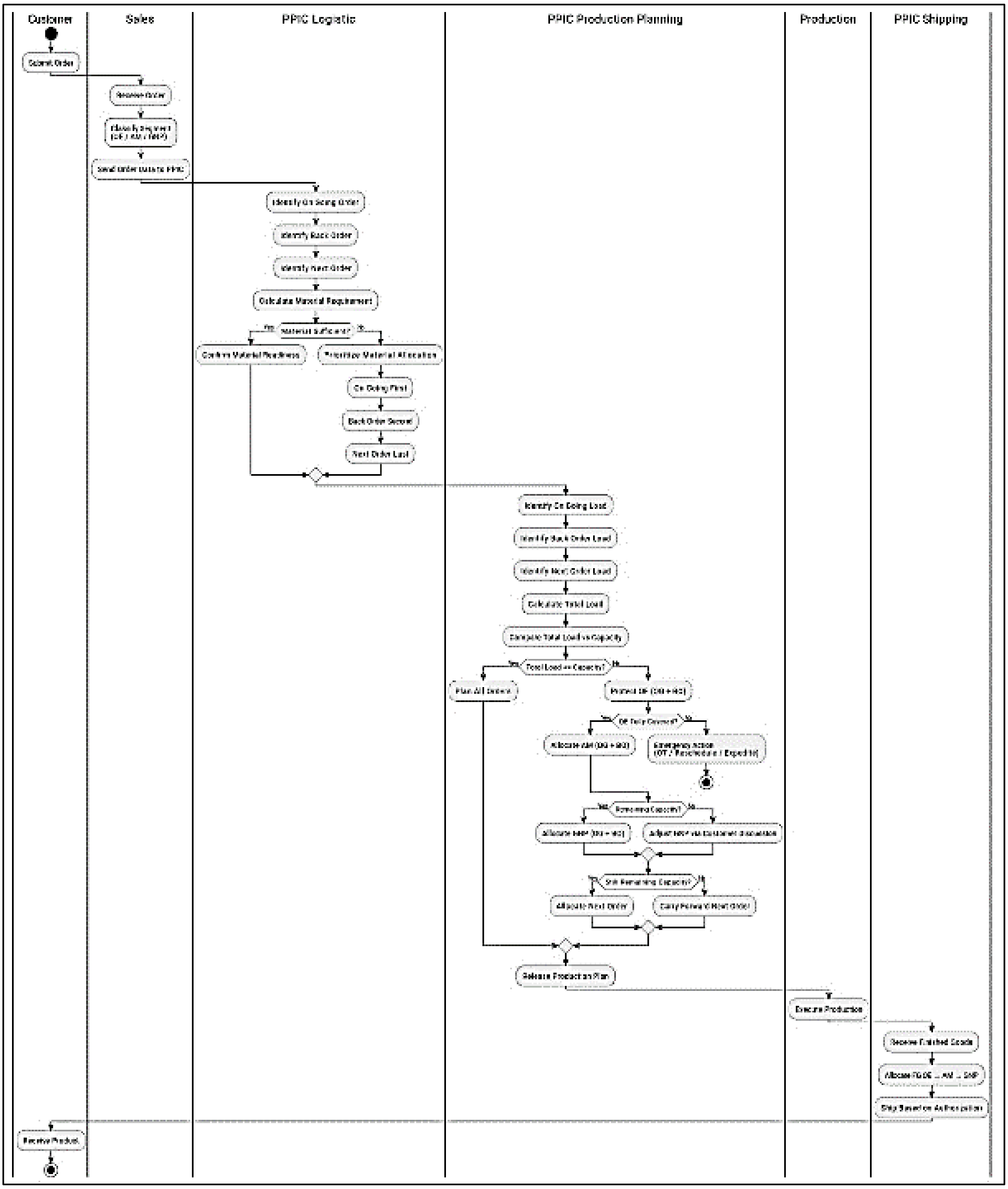


Figure 2 The logic flow

4.3. Decision Support System Output

The proposed DSS was developed as a web-based system to support customer order prioritization, order allocation, and recovery planning. The system was designed to operate as a parallel tool to the existing manual planning process. It allows users to input customer order data, monitor production line capacity, process order allocation, and generate recovery plan recommendations. The user interface of the web-based DSS is shown in Figure 3. The developed web-based DSS was designed with an integrated user interface to support the PPIC team in monitoring order conditions, managing production capacity, processing production planning, and generating decision recommendations. The interface consists of several main menus, namely Dashboard, Orders, Production Lines, Planning, Recommendation, Export Excel, and Import Data. These menus are placed in the sidebar to allow users to access each function easily.

The Dashboard serves as the main page of the system after the user logs in. This page provides a real-time summary of customer order conditions and production capacity. As shown in the dashboard interface, the system displays key order indicators, including the total number of orders, ongoing orders, back orders, and fulfilled orders. These indicators allow users to quickly understand the current order status before performing production planning.

In addition to order information, the dashboard also presents production line capacity data. Each production line is displayed with its used capacity and total available capacity. The system also shows the overall capacity utilization percentage, allowing users to identify whether the current production load is still within the available capacity or has exceeded the limit. This feature helps planners and supervisors monitor production capacity more efficiently without checking capacity data manually.

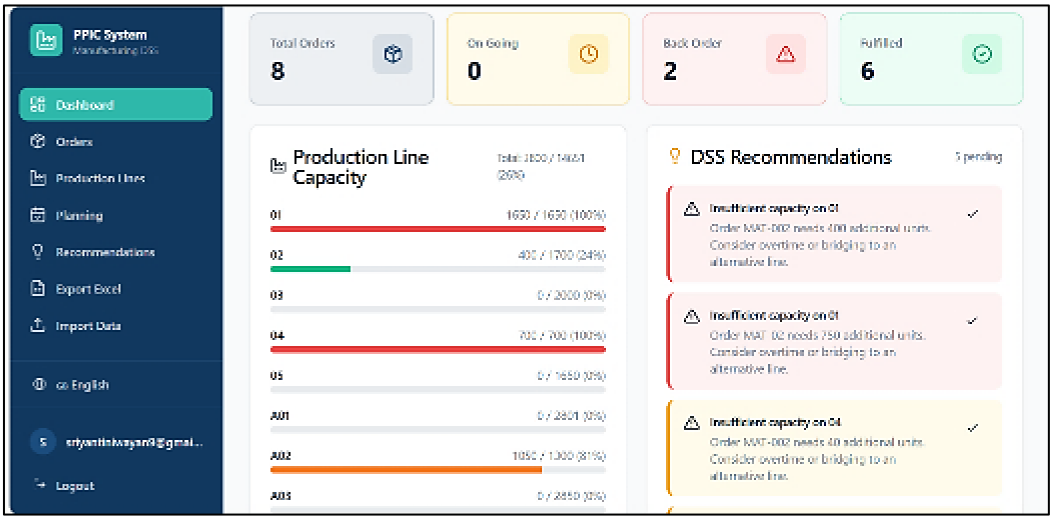
Another important feature on the dashboard is the DSS Recommendation section. This section displays system-generated alerts when a problem occurs, such as insufficient capacity on a specific production line. For example, when the system detects that a production line does not have enough capacity to fulfill an order, it provides a recommendation such as considering overtime or bridging the order to an alternative line. This feature supports faster decision-making because users can immediately identify the problem and review the suggested action.

The Orders page is used to manage customer order data. Users can input orders manually by entering information such as part name, customer segment, order quantity, production line, and delivery deadline. In addition to manual input, the system provides an Import Data feature that allows users to upload multiple orders at once using an Excel template. This function improves input efficiency, especially when a large number of orders must be processed in one planning period.

The Production Lines page is used to manage production line data and capacity information. Through this page, users can add, edit, or delete production line records and update the maximum capacity of each line. This information becomes an important input for the planning process because the system uses line capacity data to determine whether customer orders can be fulfilled or need alternative allocation.

The Planning page is the core module of the system. In this page, order data that have been entered manually or imported from Excel are processed using the system logic. The system compares total order quantity with available production capacity, applies the customer priority sequence based on the AHP result, and allocates orders according to the available capacity. If the system detects backorders or capacity shortages, it generates recommendations such as rescheduling, overtime, or bridging to another production line.

The system also provides an Export Excel feature that allows users to download planning results and DSS recommendations in spreadsheet format. This feature supports documentation, reporting, and further evaluation by supervisors or managers. With this function, users do not need to continuously access the web interface to review planning results, because the output can be saved and analyzed separately.



Insufficient capacity on 01

Order MAT-002 needs 400 additional units. Consider overtime or bridging to an alternative line.

Insufficient capacity on 01

Order MAT-002 needs 750 additional units. Consider overtime or bridging to an alternative line.

Insufficient capacity on 04

Order MAT-002 needs 40 additional units. Consider overtime or bridging to an alternative line.

Figure 3 User interface of the web-based DSS

4.4. Comparison Between Manual Process and Proposed Web-Based DSS

The proposed DSS was evaluated by comparing its output with the existing manual process. The evaluation used historical order data, actual order data, production capacity data, and monthly forecast data. The system was tested under three scenarios: normal order condition, order quantity exceeding total production capacity, and order quantity exceeding the main production line capacity. The comparison was conducted using five key performance indicators: customer priority selection, order fulfillment accuracy, delivery delay, order handling speed, and recovery plan availability.

4.4.1. Customer Priority Selection

The DSS produced the same customer priority order as the existing manual policy, namely OE > AM > GNP. This indicates that the system did not change the company's existing priority logic but transformed it into a more structured and measurable decision-making process using AHP. In the manual process, this priority order was applied based on planner judgment and company policy. In the DSS, the same priority order was generated using calculated priority weights. Therefore, the system can support decision-making while maintaining consistency with the existing planning policy.

4.4.2. Order Fulfillment Accuracy

In normal capacity conditions, both the manual process and the DSS were able to fulfill all customer orders. The order fulfillment accuracy reached 100% when production capacity was sufficient. This shows that the DSS was able to generate allocation results that were consistent with the manual process. When capacity was limited, the DSS allocated orders according to the AHP priority weights and available production capacity. The allocation result remained consistent with the manual decision because both approaches followed the same customer priority policy. However, the DSS provided the result faster and in a more structured format.

4.4.3. Delivery Delay

The average delivery delay produced by the DSS was similar to the manual process, at approximately 0.5 days. However, the difference was found in the consistency of the delay. In the manual process, delay variation depended on planner experience and the speed of manual rescheduling. In contrast, the DSS generated recommendations based on the same priority logic and capacity calculation each time. This result indicates that although the DSS did not significantly reduce the average delay, it improved the stability and predictability of the planning process. More consistent recovery recommendations can help planners respond to backorders and capacity shortages more effectively.

4.4.4. Order Handling Speed

The most significant improvement was found in order handling speed. In the manual process, planners needed to review order data, calculate available capacity, determine priority, identify backorders, and prepare recovery plans manually. This process required more time, especially when orders exceeded production capacity. The comparison of order handling speed is shown in Table 5.

Table 5 Comparison of order handling speed

No	Scenario	Manual Process	Web-Based DSS
1	Normal order condition	15-20 minutes	Less than 1 minute
2	Capacity overload	20-35 minutes	Less than 1 minute
3	Backorder and recovery planning	1-2.5 hours	2-5 minutes

The results show that the DSS significantly reduced the time required for order allocation and recovery planning. In the backorder scenario, the manual process required up to several hours because planners had to identify unfulfilled orders, check alternative production lines, calculate remaining capacity, and prepare recovery recommendations manually. With the DSS, the same process could be completed within 2–5 minutes. Overall, the DSS reduced decision-making time by approximately 95% compared with the manual process. This improvement shows that the system can support faster production planning decisions, particularly under urgent conditions involving back orders or limited capacity.

4.4.5. Recovery Plan for Backorders

Backorder handling is one of the main advantages of the proposed DSS. In the manual process, planners had to identify unfulfilled orders, open separate capacity files, check available alternative lines, calculate remaining capacity, and write recovery recommendations manually. This process was time-consuming and prone to calculation errors. The DSS improved this process by automatically detecting excess orders and searching for available capacity on alternative production lines. If an alternative line was available, the system generated a recovery plan recommendation, including the suggested production date and shift. If no alternative capacity was available, the system recommended rescheduling the order to the next period.

During the system trial, the DSS was able to generate recovery plan recommendations that were consistent with manual verification. This indicates that the system could support planners in handling back orders more accurately and efficiently.

5. Discussion

The results show that the proposed DSS can improve customer order management in manufacturing production planning in several ways. First, the system transforms customer order prioritization from a manual and judgment-based process into a structured decision-making process supported by AHP. The use of priority weights enables the system to determine customer priorities more objectively. This finding is consistent with previous studies showing that AHP can transform qualitative and quantitative decision criteria into measurable priority values for customer selection and order allocation problems [27,28].

Second, the system improves the efficiency of the planning process. In the existing manual process, planners needed to check order data, production capacity, customer segment priority, and possible back order conditions before making allocation decisions. By integrating these elements into a web-based DSS, the proposed system allows allocation decisions to be generated faster and in a more structured manner. This result is in line with Ref. [27], who found that an intelligent order allocation system could improve decision-making efficiency in order allocation problems by reducing the time required for decision generation. Similar findings were also reported by [29], who showed that a DSS for production scheduling can support production planners through dispatching priority rules, bottleneck identification, order reallocation to alternative work centers, and BOM-based checks.

Third, the DSS improves consistency in decision-making. Since the system applies the same allocation logic and priority sequence for every planning process, the resulting decisions are less dependent on individual planner judgment. This is important in production planning because manual decisions may vary depending on planner experience, data interpretation, and response time. A standardized decision model can help reduce inconsistency by organizing relevant decision attributes and supporting more systematic order allocation [27].

Fourth, the system supports backorder management through recovery plan recommendations. When capacity shortages occur, the DSS automatically identifies unfulfilled orders and recommends possible actions, such as alternative line allocation, overtime, or rescheduling. This function is aligned with the role of production scheduling DSS, which is designed to help planners respond to dynamic events such as urgent orders, bottlenecks, capacity constraints, and delayed orders [29]. In this study, the recovery plan feature is particularly important because it reduces the time required to identify alternative production options and supports faster response to back order conditions.

The results also indicate that the proposed DSS is able to maintain the existing customer priority policy while improving the speed and structure of the decision-making process. The priority order generated by the system, namely OE > AM > GNP, is consistent with the existing manual policy and the AHP priority weights obtained in this study. This indicates that the DSS does not replace managerial policy but formalizes it into a measurable and repeatable decision-making procedure. Such integration of expert judgment and analytical models is consistent with the role of DSS in supporting semi-structured decisions in manufacturing and supply chain management [30].

6. Conclusion

This study developed a web-based DSS to improve customer order management in manufacturing production planning. The proposed system was designed to support customer order prioritization, production capacity allocation, and recovery planning when backorders occur. The system integrates customer order data, production line capacity, order status, customer segment priority, and company rules into a structured decision-making process.

The AHP was applied to determine the priority weights of three customer segments: OE, AM, and GNP. The results showed that OE had the highest priority weight of 0.484484, followed by AM with 0.282147 and GNP with 0.233370. Therefore, the resulting priority sequence was OE > AM > GNP. This priority order was consistent with the existing production planning policy, indicating that the proposed DSS was able to formalize the manual priority logic into a measurable and repeatable decision-making model.

The system trial showed that the DSS could generate order allocation results that were consistent with the existing manual process. Under normal capacity conditions, the system was able to fulfill all orders, while under limited capacity conditions, it allocated orders based on the established customer priority sequence. The system also provided recovery plan recommendations by identifying unfulfilled orders and checking alternative production line capacity. The most significant improvement was found in decision-making speed. Compared with the manual process, the DSS reduced the time required for order allocation and recovery planning by approximately 95%. Manual planning required 15–35 minutes for normal and overload scenarios and up to 1–2.5 hours for backorder recovery planning, while the DSS completed the same process in less than 1 minute for order allocation and 2–5 minutes for recovery planning. This indicates that the proposed system can improve the efficiency, consistency, and objectivity of customer order management in manufacturing production planning.

However, this study has several limitations. The developed DSS still operates as a parallel system and has not been integrated with the company's main enterprise system. Therefore, order data still need to be entered manually or imported through Excel. In addition, the system trial was conducted for a limited period, so further testing is required to evaluate system performance under broader production conditions and more varied demand patterns.

Future research may focus on integrating the DSS with the company's main information system or ERP, adding real-time notification features, and conducting longer implementation trials. Further development may also include additional decision criteria, more complex production constraints, and comparison with other multi-criteria decision-making methods to improve the accuracy and flexibility of the system.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Höse K, Amaral A, Götze U, Peças P. Manufacturingcflexibility through Industry 4.0 technological concepts—impact and assessment. Global Journal of Flexible Systems Management. 2023;24(2):271–289.

[2] Weckenborg C, Schumacher P, Thies C, Spengler TS. Flexibility in manufacturing system design: A review of recent approaches from operations research. European Journal of Operational Research. 2024;315(2):413-441.

[3] Ivanov D, Dolgui A. A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. Production Planning & Control. 2021;32(9):775-788.

[4] Jodlbauer H. Customer driven production planning. International Journal of Production Economics. 2008;111(2):793-801.

[5] Stamer F, Peukert S, Lanza G. Order planning. In: Friedli T, Lanza G, Remling D, editors. Global Manufacturing Management. Cham: Springer; 2021. p. 143–153.

[6] Jacobs FR, Berry WL, Whybark DC, Vollmann TE, Vollmann T. Manufacturing planning and control for supply chain management. New York: McGraw-Hill; 2011.

[7] Guzman E, Andres B, Poler R. Models and algorithms for production planning, scheduling and sequencing problems: A holistic framework and a systematic review. Journal of Industrial Information Integration. 2022;27:100287.

[8] Slotnick SA. Order acceptance and scheduling: A taxonomy and review. European Journal of Operational Research. 2011;212(1):1-11.

[9] Gen M, Cheng R, Lin L. Advanced planning and scheduling models. In: Gen M, Cheng R, Lin L, editors. Network Models and Optimization: Multiobjective Genetic Algorithm Approach. London: Springer; 2008. p. 297–417.

[10] Lee HL, Padmanabhan V, Whang S. The bullwhip effect in supply chains. Sloan Management Review. 1997;38(3):93-102.

[11] Turban E, Sharda R, Delen D. Decision Support and Business Intelligence Systems. 9th ed. Upper Saddle River: Pearson; 2011.

[12] Saaty TL. The analytic hierarchy process. McGraw-Hill; 1980.

[13] Saaty TL. Decision making with the analytic hierarchy process. International Journal of Services Sciences. 2008;1(1):83–98.

[14] Wijayanti WR, Dewi WR, Ardi F, Fajri A, Ulkhaq MM, Akshinta PY. Combining the fuzzy AHP and TOPSIS to evaluate service quality of e-commerce website. In Proceedings of the 10th international conference on education technology and computers 2018 Oct 26 (pp. 397-402).

[15] Ulkhaq MM, Fidiyanti F, Raharjo MF, Siamiaty AD, Sulistiyani RE, Akshinta PY, Nugroho EA. Evaluating hospital service quality: A combination of the AHP and TOPSIS. In Proceedings of the 2nd International Conference on Medical and Health Informatics 2018 Jun 8 (pp. 117-124).

[16] Ulkhaq MM, Nartadhi RL, Akshinta PY. Evaluating service quality of Korean restaurants: a fuzzy analytic hierarchy approach. Industrial Engineering and Management Systems. 2016;15(1):77-91.

[17] Ulkhaq MM, Wijayanti WR, Dilaga DA, Qadarullah AA, Arfi F. Combining the analytic hierarchy process and importance-performance analysis to assess service quality of m-commerce: a case of Indonesian m-commerce. In 2021 IEEE 8th International Conference on Industrial Engineering and Applications (ICIEA) 2021 Apr 23 (pp. 6-10). IEEE.

[18] Sari DP, Wijayanti WR, Prayogo A, Ulkhaq MM, Rinawati DI. An integrated fuzzy AHP and TOPSIS model for evaluating the performance of raw material suppliers: A case study in lasem batik writing centre. In MATEC Web of Conferences 2018 Sep 21 (Vol. 204, p. 02014). EDP Sciences.

[19] Gultom KA, Ulkhaq MM. Analisis pemilihan *vendor* pelaksana kerja menggunakan metode *analytical hierarchy process* di PT X. Industrial Engineering Online Journal. 2025;14(3).

[20] Ulkhaq MM, Wijayanti WR, Zain MS, Baskara E, Leonita W. Combining the AHP and TOPSIS to evaluate car selection. In Proceedings of the 2nd International Conference on High Performance Compilation, Computing and Communications 2018 Mar 15 (pp. 112-117).

[21] Ulkhaq MM, Akshinta PY, Nartadhi RL, Susatyo Nugroho WP. Assessing sustainable rural community tourism using the AHP and TOPSIS approaches under fuzzy environment. In MATEC Web of Conferences 2016 (Vol. 68, p. 09003). EDP Sciences.

[22] Ulkhaq MM, Siamiaty AD, Handoko A, Madjid SA, ‘Sa Nu D. The fuzzy analytic hierarchy process for prioritizing the sustainable tourism attitude scale. In IOP Conference Series: Earth and Environmental Science 2019 Jan 1 (Vol. 219, No. 1, p. 012012). IOP Publishing.

[23] Pramono SN, Ulkhaq MM, Trianto R, Setiowati PR, Rasyida DR, Setyorini NA, Jauhari WA. Integrating the analytic hierarchy process and importance-performance analysis into ISO 14001 framework for assessing campus sustainability. In AIP Conference Proceedings 2017 Nov 7 (Vol. 1902, No. 1, p. 020035). AIP Publishing LLC.

[24] Christopher M. Logistics & Supply Chain Management. 5th ed. Harlow: Pearson; 2016.

[25] Power DJ. Decision Support Systems: Concepts and Resources for Managers. Westport: Quorum Books; 2002.

[26] Palakiti VP, Mohan U, Ganesan VK. Order acceptance and scheduling: overview and complexity results. International Journal of Operational Research. 2019;34(3):369-86.

[27] Leung KH, Choy KL, Lam HY. An intelligent order allocation system for effective order fulfilment under changing customer demand. In MATEC web of conferences 2019 (Vol. 255, p. 02002). EDP Sciences.

[28] Imran M, Agha MH, Ahmed W, Sarkar B, Ramzan MB. Simultaneous Customers and Supplier’s Prioritization: An AHP-Based Fuzzy Inference Decision Support System (AHP-FIDSS). International Journal of Fuzzy Systems. 2020;22(8):2625-51.

[29] Spanos AC, Gayialis SP, Kechagias EP, Papadopoulos GA. An application of a decision support system enabled by a hybrid algorithmic framework for production scheduling in an SME manufacturer. Algorithms. 2022;15(10):372.

[30] Ho W, Ma X. The state-of-the-art integrations and applications of the analytic hierarchy process. European Journal of Operational Research. 2018;267(2):399-414.