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**Article**

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# Research on Improvement of Hotel Supply Chain Resource Management Decision in the Era of Big Data

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## ABSTRACT

Hotel supply chain management (SCM) refers to the material service that takes a hotel as the core object. At present, the main method is centralized SCM, which uses integer programming or mixed integer programming to establish and solve the allocation management of various resources among hotels in the supply chain. In this article, based on ant colony algorithm (ACA), the hotel SCM mode is studied and optimized. The research shows that the convergence path is A-S4-M3-L3-D1-R1-T. Therefore, the optimal partner combination meeting the requirements of the supply chain is S4, M3, L3, D1 and R1. The experiment shows that the max-min ACA is effective to solve the problem of partner selection in hotel supply chain. By using enterprise management technology, information technology, network technology and SCM technology under ACA, the effective rules and control of information flow, logistics, capital flow, business flow and value flow in the whole supply chain can be achieved, and the maximum benefit of the whole hotel supply chain can be realized.

## KEYWORDS

Ant colony algorithm, Hotel supply chain, Management mode, multi-modal multimedia information, online product decision analysis, Resource management

## RESEARCH ON IMPROVEMENT OF HOTEL SUPPLY CHAIN RESOURCE MANAGEMENT DECISION IN THE ERA OF BIG DATA

Chinese hotels have significant limitations in terms of internal systems, business models, and related management concepts, compared to some famous foreign hotels (Tortorella et al., 2019). In the fierce competition environment of the global market, the traditional "vertical integration" mode of production and management can no longer make enterprises respond to market demand quickly. In this case, people will naturally extend resources to other places, with the help of hotel resources, to achieve the purpose of quickly responding to market demand, so the idea of "horizontal integration" rises, and a new mode of production and management emerges as the times require (Al-Aomar & Hussain, 2019). Hotel supply chain management (SCM) refers to the material services formed with a hotel as the core object. At present, the main method is centralized SCM, which uses integer programming or mixed

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integer programming to establish and solve the allocation management of various resources among hotels in the supply chain. The object of supply chain quality management is each node enterprise in the supply chain. E a platform for quality information communication, building a whole supply chain quality assurance system, and achieving effective quality coordination ensure the continuous and stable quality assurance capability of the whole supply chain to enhance its competitiveness (Sari & Suslu, 2018). With the deepening of the concept of SCM, the development of hotels has gradually developed from the previous "vertical integration" mode to "horizontal integration." It is urgent for hotel development to return to its core business and enhance its competitive advantage.

This paper introduces the ant colony algorithm (ACA) into the hotel SCM mode for optimization, simulates the strategy of ant colony path optimization, and works out a unified material demand, production, and distribution plan through the trade-off between local cost and global cost, so as to unify and coordinate the control of various business departments (Zhang & Ye, 2018). Ant colony optimization algorithm is a new type of simulated evolutionary algorithm (Turken et al.,2020). It is an artificial ACA first proposed by Italian scholars and others on the basis of studying the collective behavior of real ant colonies in nature. Ant algorithm, inspired by the behavior of ants in nature, is a new bionic evolutionary algorithm for solving research on supply chain strategic alliances, partnership, and collaboration (Bhavya & Elango, 2023). A series of management methods for supply chain to improve performance, reduce costs, and other aspects have also been proposed and gradually applied. Because ants can go through a relatively short path in a short time, and more pheromones can be accumulated on the shorter path in the same time, a large number of ants will concentrate on choosing the shorter path after a certain time. The ACA is the way to solve the optimization problem by simulating this group behavior of ant colony (Abou Kamar, 2021).

The quality management of hotel supply chain based on ACA is to establish a standardized and competitive supply chain quality management system, and comprehensively manage the whole life cycle of product quality formation, so as to ensure that the best quality products are finally provided. The ACA chooses the best path through the trade-off between local information and global information, which can well unify the decision of each local best path into the decision of the global best path (Roespinoedji et al., 2019). The quality management of hotel supply chain based on ACA has expanded the scope of quality management from within the hotel. In the optimization process, subgroups with larger similarity coefficients tend to choose subgroups with smaller similarity coefficients for information exchange to maintain the diversity of solutions. In this way, a dynamic balance between diversity and convergence of solutions can be achieved in each ant subpopulation, enabling the algorithm not only to have a fast global convergence speed, but also to have high-quality solutions and efficiency. Moreover, its important role is that it changes the environment around the current path that ants pass through, and also changes the historical information stored by the entire ant colony like a function. The traditional mode of hotel SCM is to calculate the whole order according to the order processing sequence. By calculating the processing route of each order under each processing sequence, it is possible to find the processing sequence by comparing the results (Alreahi et al., 2023).

In this paper, the author optimizes the hotel SCM mode based on ACA. The implementation of SCM is a powerful means to improve the hotel system management ability (Li et al., 2014). The establishment process of the supply chain is actually an evaluation and selection process of upstream and downstream enterprises in the industry. Selecting enterprises as partners in the supply chain is the most important basis for strengthening the SCM. Enterprises need to comprehensively assess partners in terms of product delivery time, supply quality, aftersales service, and product price. During optimization, the subgroups with larger similarity coefficients tend to choose the subgroups with smaller coefficients for information exchange every certain number of iterations to maintain the diversity of solutions. This allows to achieve a dynamic balance between the diversity and convergence of solutions in each ant subpopulation, so that the algorithm not only has a fast global convergence rate, but also has high-quality solutions and efficiency. Of course, the overall service level of the hotel based on the ACA depends on the coordination and continuity of the combined products, and also depends on the service level of the components of the combined products, that is, each subsystem. To ensure the service quality of each service subsystem, it is necessary to analyze the composition of the quality elements (Mollaei, 2017).

This paper includes five parts. The first part of the introduction introduces the background and research significance of the topic selection in this paper. The second part offers an overview of the main research achievements and their shortcomings by an analysis of the current status of supply chain research both domestically and internationally. The third part introduces the theories of hotel supply chain and SCM, and proposes an optimization strategy for hotel SCM mode based on ACA. The fourth part includes empirical analysis on the selection of supply chain partners. Simulating the selection process of supply chain partners in MATLAB environment, the author found the optimal partner combination for constructing the supply chain. Empirical evidence shows that introducing the maximum-minimum ACA into the field of supply chain partner selection is feasible and provides effective support for decision-makers in supply chain partner selection. The fifth part is a summary of the entire paper and the content that needs further in-depth research in the field of hotel SCM.

## RELATED WORK

Panicker et al. (2018) proposed that the implementation of SCM is the need for hotels to adapt to changes in the world economic environment. Today's society belongs to the service society, and the development of the service economy is changing with each passing day, so the competition in the hotel industry is becoming increasingly fierce. Rao (2018) studied the optimal pricing decisions of hotels under different modes and the choice of cooperation modes with online travel agencies (OTA) in consideration of consumers' channel preferences and online channel acceptance. Zhao et al. (2017) stated that it should be put on the agenda to meet the personalized needs of customers, utilize the external resources of the hotel, and engage in hotel management in a new way. SCM is a new management method based on the rational integration of internal and external resources, and it is the management of the overall coordination of the enterprise's supplier network, the core enterprise and the enterprise's sales network. Shanshan et al.(2023) showed that the value of the hotel was increased, so they have high requirements for hotel service level, product quality, supply speed, and service attitude. According to Dzalbs and Kalganova (2020), it is necessary to establish inventory to ensure the delivery rate of products, and it is necessary to establish an inventory control strategy to ensure the delivery rate. In SCM, material demand, production, and distribution plan, as decision variables, are important means to control inventory and ensure delivery rate. Xu et al. (2017) analyzed the optimal decision-making and income of hotels in wholesale mode and agency mode, and obtained the optimal conditions of wholesale mode and agency mode for hotels. However, Xu et al. (2017) ignored the influence of heterogeneous customers' choice behavior on decision-making. Based on the hotel supply chain structure, Meathawiroon (2023) found that it is the difficulty of this research to establish an optimal decision model and method that can unify all business divisions and coordinate planning, taking into account the links and cost factors between each business division and the whole enterprise. Chen et al. (2021) pointed out that the choice behavior of homogeneous customers generally occurs when there are many competing enterprises selling the same product or one enterprise selling several alternative products. Heterogeneous customers' choice behavior shows that different customers have different value evaluation of the same product or service. However, with the wide application of this strategy, consumers become smarter and smarter. They will compare the different prices implemented by online channels and offline channels and choose the best buying strategy. Wan et al. (2020) proposed to provide personalized service for hotel customers with the help of network and information technology, which is one of the main functions of hotel SCM, and also the purpose of hotel application of new technology and new management theory. Yuyan et al. (2023) established pricing decision models for telecom supply chain operators under different game structures, analyzed the impact of network externalities and other factors on hotel profits, studied the impact of different network externalities on optimal decisions, and gave corresponding cooperation suggestions.

By organizing and analyzing the current research status, the author concluded that the main focus of current research is on the concept, operation methods, coordination mechanisms, benefit allocation, and risk factors of traditional supply chains. There is still a lack of relatively in-depth research on supply chains. According to the survey, many enterprises, especially small and medium-sized enterprises, do not have scientific partner selection methods when implementing SCM. To date, domestic and foreign scholars have conducted some research on the selection methods of supply chain partners, but there is a lack of specificity, and further in-depth research is needed. The methods commonly used for selecting supply chain partners include Analytic Hierarchy Process method, fuzzy comprehensive evaluation method, and neural network method. Although they have certain applicability, new methods need to be added and supplemented. The research significance of this paper is to help confused enterprises overcome the misconceptions in SCM, and to provide scientific and effective methods for selecting supply chain partners to help enterprises make scientific and reasonable decisions in their daily business activities.

## RESEARCH METHOD

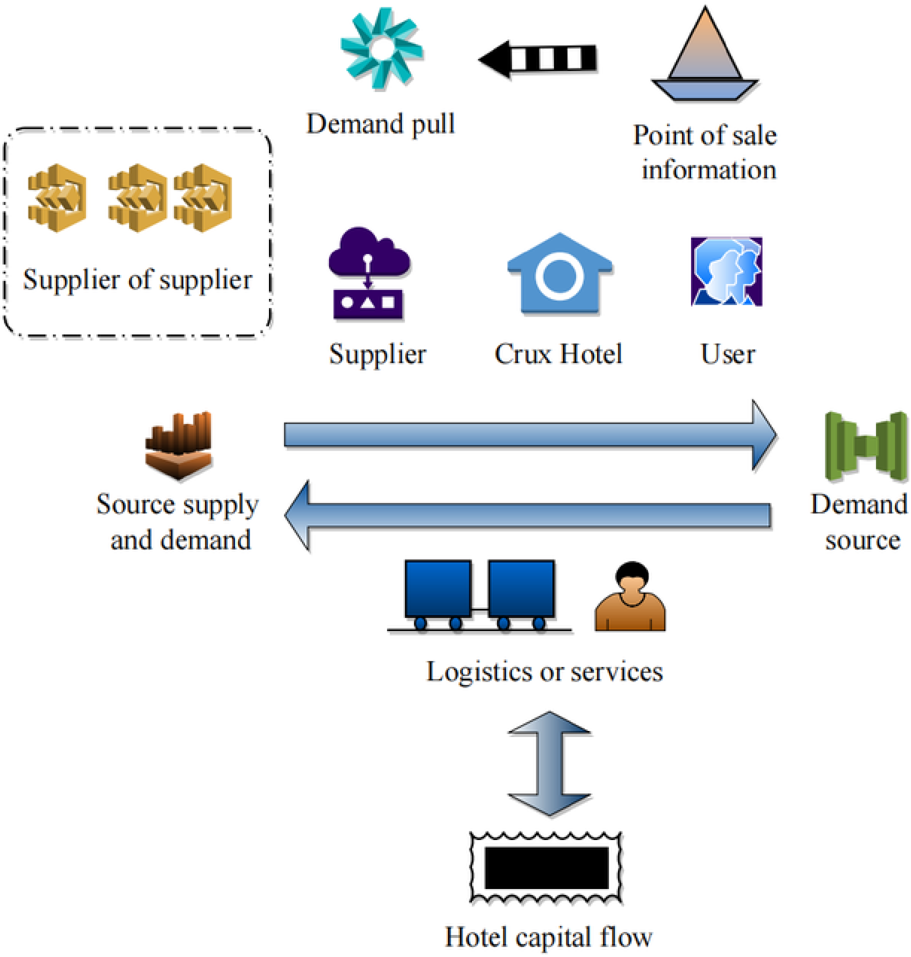
### Hotel Supply Chain and Supply Chain Management

With the development of science and technology and economy, the market competition around new products are becoming increasingly fierce. Besides, with the development of technology and the diversification of demand, the life cycle of products has been shortened, and enterprises are facing more and more pressure and increasingly severe environment. Under the SCM mode, the focus of management mainly focuses on the solution of the internal problems of the hotel, and the total quality management is carried out in the hotel in isolation, but the attention to external parties and processes is lacking, and the connection between upstream and downstream is ignored (Nugroho et al., 2020). It can be said that there is no smooth chain quality chain that links all the nodes in the supply chain. Suppliers, manufacturers, distributors, and final customers are separated by independent and closed "quality black boxes," and the quality relationship between the supply chain nodes is only based on order constraints and acceptance constraints. The SCM mode puts forward higher requirements for the management ability of hotels at each node in the supply chain. Although the original management methods and quality tools have achieved certain practical results, there is no substantial change in quickly meeting customer needs. People finally realize that the problem is not the specific tools and management methods, but that the traditional management ideas can no longer fully meet the new competitive situation (Díaz et al., 2021).

Hotels sell rooms through online and offline channels, but, in the hotel industry, on the basis of considering consumers' choice behavior, the problems of channel and mode selection have not been systematically compared and analyzed. Therefore, on the basis of fully considering the selection of heterogeneous customers, the quality of hotel hardware is the material foundation for meeting customer needs (Tsai et al.,2021). The quality of hardware depends on whether its functionality can meet customer needs. This requires backend service departments such as equipment and facility maintenance, production departments, and procurement departments to closely cooperate with changes in hotel service capabilities from the perspective of maximizing hotel revenue (Arifin et al., 2019). Hotel supply chain is a hotel structure model with a wider scope, which includes a core hotel and all affiliated enterprises to form an extensive enterprise network organization. The supply chain is also an optimized value-added chain. Figure 1 shows its structure diagram.

As hotel supply chain is a functional network system composed of a wide range of node enterprises, it must be effectively integrated. SCM is a management function aimed at ensuring the efficient operation and collaborative work of various links in the supply chain by reasonably coordinating

Figure 1. Schematic diagram of hotel supply chain structure




logistics, information flow, capital flow, value flow, and business flow. In the hotel industry, supply chain management specifically refers to the management of materials and services centered around hotels to meet customer needs and provide a high-quality hotel experience. At present, the main method is centralized, which uses integer programming or mixed integer programming to establish and solve the allocation management of various resources among hotels in the supply chain.

In today's increasingly globalized society, customer demand changes rapidly, products are updated rapidly, and the division of labor in industrial chains of various industries is becoming more and more detailed. Research on supply chain strategic alliances, partnership, and collaboration also gradually appears in various literature journals. However, a basic prerequisite in the fierce competition environment of the global market, the traditional vertical integration mode of production and management can no longer make enterprises respond to market demand quickly. In this case, people will naturally extend resources to other places, with the help of hotel resources to achieve the purpose of quickly responding to market demand, so the idea of horizontal integration rises, and a new mode of production and management SCM emerges as the times require waste. The production and delivery cycle are getting shorter and shorter, which requires hotels to meet the increasingly vigorous demand for flexible production and personalized production. This traditional closed and black box quality management model can no longer meet the current demand for integrated and rapid response SCM.

## Optimization Strategy of Hotel Supply Chain Management Mode Based on Ant Colony Algorithm

In this paper, the author optimizes the hotel SCM mode based on ACA. The implementation of SCM is a powerful means to improve the hotel system management ability. The hotel is a comprehensive service enterprise integrating accommodation, catering, entertainment, and other functions. All the daily activities of customers from the moment of check-in, such as food, accommodation, travel, shopping and travel, are part of the hotel's service products. Therefore, based on the ACA, the author studied and optimized the hotel SCM mode, and put forward the following strategies.

### *Reducing Costs to Maximize Profits*

In the hotel SCM, reducing the hotel cost and maximizing the hotel profit is the first goal, at present. Aiming at the of course, the overall service level of the hotel based on the ACA depends on the coordination and continuity of the combined products, and also depends on the service level of the components of the combined products, that is, each subsystem. To ensure the service quality of each service subsystem, it is necessary to analyze the composition of the quality elements. The application of SCM can integrate all departments of the hotel into a business process system by controlling the logistics, service flow, information flow, and capital flow of the hotel (Pratyameteetham & Atthirawong, 2017). In this environment, the modern hotel industry, whether from its facilities and equipment or from its service products and management, has followed the changes of the times, showing three major trends, namely, hardware intelligence, business networking, and personalized service.

Conforming to the development trend of the industry, hotels should widely apply new technologies and constantly carry out technological innovation and service innovation to meet the changing and diversified needs. At certain intervals, according to the evolution degree of its own solution, according to the instructions sent by the core manufacturer ant group, hotels exchange their solution information and complete cooperation and competition(Zhang & Zhang, 2022). The evolution degree of each supplier's population solution is reflected by the similarity coefficient. At the same time, the cooperation between departments should be based on ensuring the smooth and efficient operation of daily business processes, so that the hotel's business system and service system can be organically integrated and coordinated through a reasonable SCM system to improve the effectiveness of the management system (Rao, 2020). Theoretically, the management of operation system is the basis of hotel management. On this basis, it is possible for the hotel industry to comprehensively apply other related discipline theories, such as strategic management theory, human resource management theory, and revenue management theory. The hotel can achieve the following benefits in many aspects: The total SCM cost is reduced, the hotel's on-time delivery rate is increased, the inventory is reduced, the order fulfillment lead time is shortened, and the hotel's net profit is increased. Either way, the pheromone concentration cannot be updated at any time. The establishment process of the supply chain is actually an evaluation and selection process of upstream and downstream enterprises in the industry. Selecting enterprises as partners in the supply chain is the most important basis for strengthening the SCM. Enterprises need to comprehensively assess partners in terms of product delivery time, supply quality, aftersales service, and product price. Every certain time, according to the evolution degree of its own solution, according to the core manufacturing instructions, exchange their own solution information to maximize the hotel profits.

### *Managing and Optimizing the Supply Chain*

Ants are a kind of social insects whose individual structure and behavior are very simple. Individual ants can do very few actions, most of which are to transmit information. However, the colony composed of these simple individuals, ant colony, can effectively search for food, and, in the process of searching for food, form an effective path to send food to the ant nest (Ding et al., 2022). At present, the multicolony ACA and the information exchange between subgroups lack certain guidance; in addition, they cannot choose the information exchange object according to their own evolutionary characteristics, and cannot adaptively control the introduction of information from other subgroups to update the search information of their own group, which is easy to form premature or stagnation (Hussain et al., 2019). In ACA, the way ants communicate and cooperate is the pheromone of the current path. In the process of sports, the transfer direction is decided according to the number of pheromones on each side, and every time people visit a hotel, they will take the hotel as a partner to complete the corresponding tasks. $p_{ij}^{k}$ indicates the probability of transferring to hotel $e_{ij}$ and $e_{pq}$ at $t$ time:

$$p_{ij}^{k} = \frac{\left[\tau_{ij}\left(t\right)\right]}{\sum_{u=1}^{m_p}\left[\tau_{ij}\right]} \tag{1}$$

The parameter $\alpha, \beta$ are used to control the relative importance of familiarity and connection cost, respectively.

Familiarity between hotels gradually decreases, and the parameter $p$ indicates the degree of decreasing familiarity, $p \in \left(0,1\right)$, completing a cycle, and the familiarity on each side is adjusted according to Equation 2:

$$\tau_{ij}\left(t+1\right) \leftarrow p \bullet \tau_{ij}\left(t\right) \tag{2}$$

$\Delta\tau_{ij}^{k}$ indicates the increment of familiarity between hotels $e_{ij}, e_{pq}$ in the cycle of $k$:

$$\Delta\tau_{ij}^{k} = \begin{cases} \dfrac{1}{Z\left(S_k\right)} \\ 0 \end{cases} \tag{3}$$

$S_k$ is the formed supply chain and $Z\left(S_k\right)$ is its objective function value. The expression is as follows:

$$\min Z\left(S_k\right) = W_1 T + W_2 P \tag{4}$$

in which, $W_1 + W_2 = 1$.

$T, P$ is calculated as follows:

$$T = \sum_{i=1}^{m\Sigma} \frac{t_{e_{ij}}}{t_{max}} \tag{5}$$

$$P = \sum_{i=1}^{m\Sigma} \frac{P_{e_{ij}}}{P_{max}} \tag{6}$$

Then, it is possible to calculate the flag bit $Y$ of whether the task is completed, and the expression is as follows:

$$Y = \sum_{i=1}^{m\sum\left(1-\sum_{j=1}^{m_i}\right)} \frac{t_{e_{ij}}}{t_{max}} \tag{7}$$

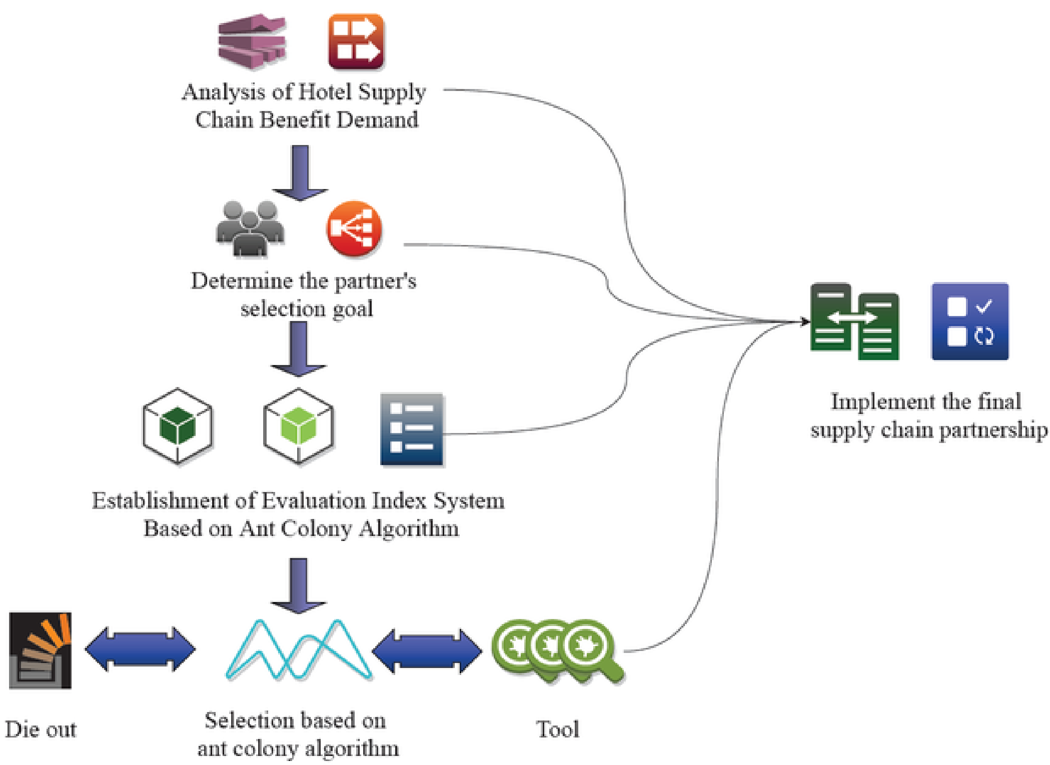
The values of $\tau, P, Y$ in the set can be obtained from Equations 1-3 and 7.

Based on ACA, Figure 2 shows the optimization process of SCM mode after analyzing the overall demand and benefit of hotel supply chain.

According to the optimization results of the supplier ant colony, the information exchange scheme between the supplier ant colony is set to guide the supplier ant colony to search along the direction of business efficiency. The other is supplier ant colony, which is distributed in different supplier computing nodes in the supply chain to optimize different resource combination schemes. The similarity degree between ant colony paths of the two populations is described by matrix inner product. The mathematical formula is as follows:

$$S_{colony(i,j)=\frac{matrix_i * matrix_j}{matrix_i * matrix_j}} \tag{8}$$

**Figure 2. Flowchart of SCM Mode optimization based on ACA analysis**



where $matrix_i * matrix_j = tr\left(\left(matrix_i\right) * matrix_j\right)$ represents the inner product of the traversal path matrix of two ant colonies; $tr\left(\right)$ represents the sum of the main diagonal elements of the matrix.

$$matrix_i = matrix_i, matrix_i \tag{9}$$

When subgroup $i$ chooses subgroup $j$ as the object of information exchange, there are:

$$j = argmax\left(S_{colony\left(i,j\right)}\right) \tag{10}$$

Among them, $h$ is the number of subgroups, which avoids the blindness of random selection.

After every $w$ iteration, the researcher can decide whether to exchange with the external population according to the exchange probability:

$$Interval = 1 - S_{colotny\left(i\right)} \tag{11}$$

After the information exchange object $j$ of the subant colony $i$ is determined, the subant colony $j$ exchanges with the subant colony $i$.

$$Solution = Solution_{colony\left(j\right)}^{best} \tag{12}$$

where $Solution$ represents the worst solution of the subant colony up to now; $Solution_{colony\left(j\right)}^{best}$ represents the best solution of mosquito swarm so far.

The implementation process of ACA is as follows:

1. Initialize ant colonies with random solutions for resource combination scheme.
2. While stopping criterion is not met:
   a. For each ant colony:
      i. Update ant's position based on pheromone concentration and heuristic information.
      ii. Evaluate solution quality of ant's current position.
      iii. Update pheromone concentration based on ant's solution quality.
      iv. Record the best and worst solutions found by the ant colony.
   b. For each subgroup of ant colonies:
      i. Determine similarity degree between ant colony paths of the subgroup and the external population using matrix inner product formula.
      ii. Choose another subgroup to exchange information with based on a selection probability formula.
      iii. Exchange information between the selected subgroups using the best and worst solutions found by the ant colonies.
   c. Decide whether to update pheromone concentration based on the stopping criterion.
3. Return the best solution found by the ant colonies.

## RESULT ANALYSIS AND DISCUSSION

In this section, the author analyzes the influence of factors such as hotel service capacity $K$, customers' acceptance level of network channels $\theta^H$ and $\theta^L$, customers' market share $\alpha$, and commission rate $r$ in agency mode on hotel profits in different modes through some numerical experiments, and discusses under what circumstances hotels should cooperate with OTA. Other parameters are assigned as follows: $\theta^H = 1.5$ and $\theta^L = 0.8$. At the same time, in order to analyze the influence of commission rate on hotel decision-making through comparison, the commission rate is $r = 0.2$ and $r = 0.1$, respectively; Figure 3 and Figure 4 show the experimental results.

Figure 3 shows that, when the hotel's service capacity $K$ is relatively low, the limited rooms can only meet the customers' needs of the hotel stores. Meanwhile, the marginal profit of the rooms directly sold by the hotel is higher than that of the rooms sold (Figure 3).

**Figure 3. The situation of high commission efficiency**

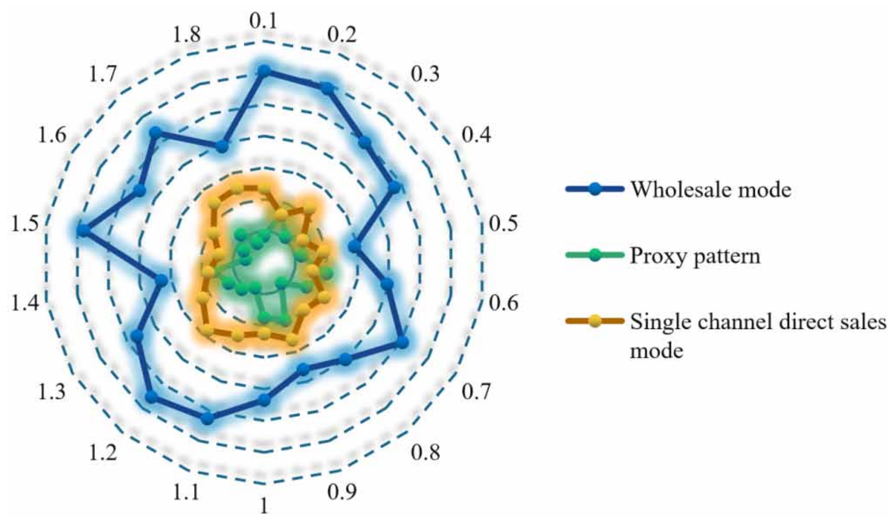



**Figure 4. The situation of low commission efficiency**

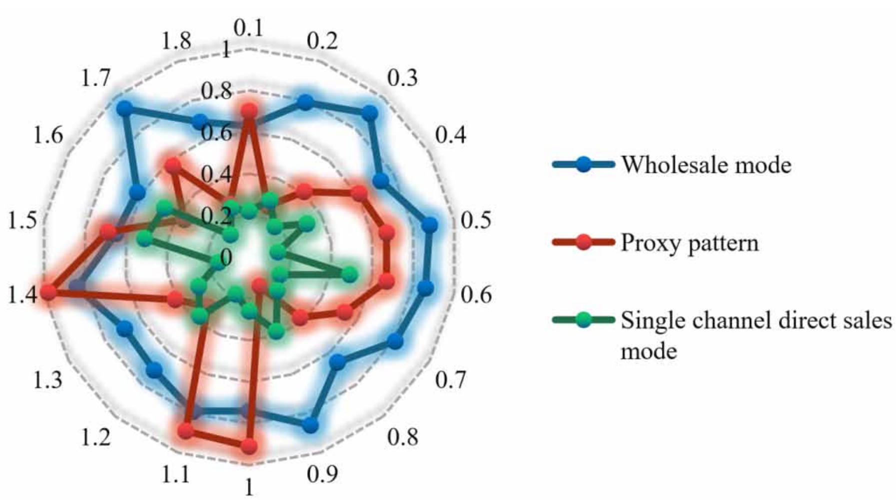


Figure 4 shows that, when the hotel service capacity $K$ is relatively low, the hotel will give up cooperation with OTA. The comparison between Figure 3 and Figure 4 evidences that, when the commission rate is low, the researcher has to analyze the joint impact of $K$ and customers' acceptance level of network channels $\theta^H$ on hotel decision-making. Other parameters are assigned as follows: $\alpha = 0.5$, $\theta^L = 0.8$, and $r = 0.2$ (Figure 5).

Figure 5 shows that, when the hotel service capacity $K$ is relatively low, the hotel will give up OTA cooperation at this time. Then, the researcher analyze the joint influence of customers' acceptance level of network channels and their market share on hotel decision-making when hotel service capacity is fixed. Other parameters are assigned as follows: $k = 0.4$, $\theta^L = 0.8$, and $r = 0.2$ (Figure 6).

Figure 6 shows that, when customers' acceptance level of network channel $\theta^H$ is low or customers' market share $\alpha$ is small, the hotel will give up cooperation with OTA. When customers' acceptance level of network channel $\theta^H$ is low, OTA must set a lower online sales price to attract more customers. However, in the case of limited hotel service capacity, hotels joining network channel can not only increase profits, but also bring competition to their direct sales channels, thus reducing their total profits.

Finally, the author used the ACA of the supply chain partner selection model to evaluate and select the above supply chain partners. The author determined the flow particles selected by the supply chain partners and established an evaluation index system, preliminarily screen potential partners that met the requirements of the supply chain, collected production data in partners through various channels and methods, and established enterprise attraction table and hotel professional ability evaluation data, respectively (Table 1). On the basis of the evaluation index system of candidate partners established, the author calculated the attraction between upstream and downstream hotels in

**Figure 5. Joint influence of acceptance level of hotel service capability network channels on hotel decision-making**

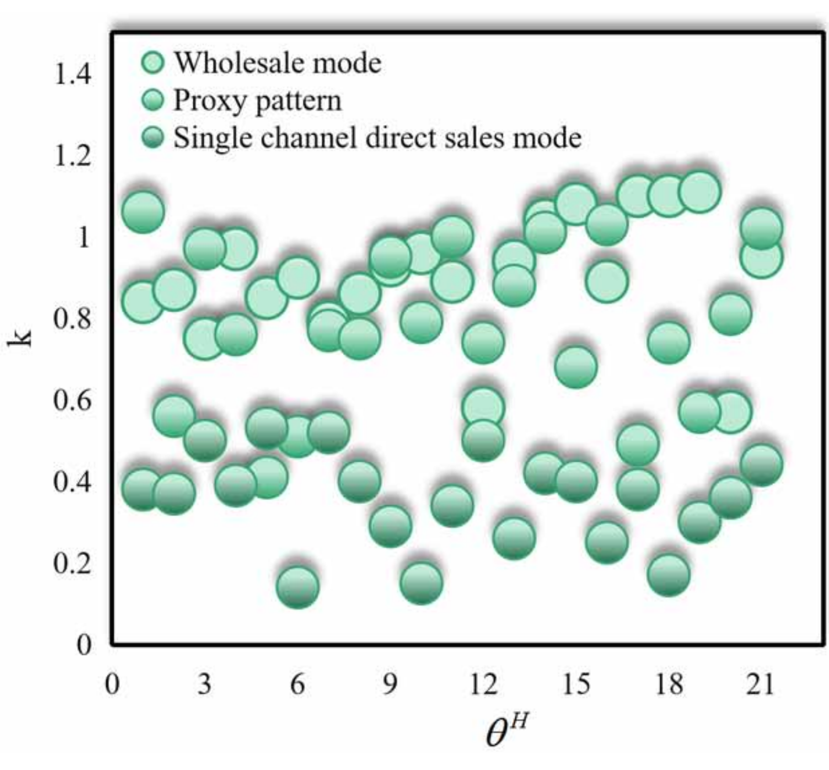


**Figure 6. The joint influence of customers' acceptance level of network channels and their market share on hotel decisions**

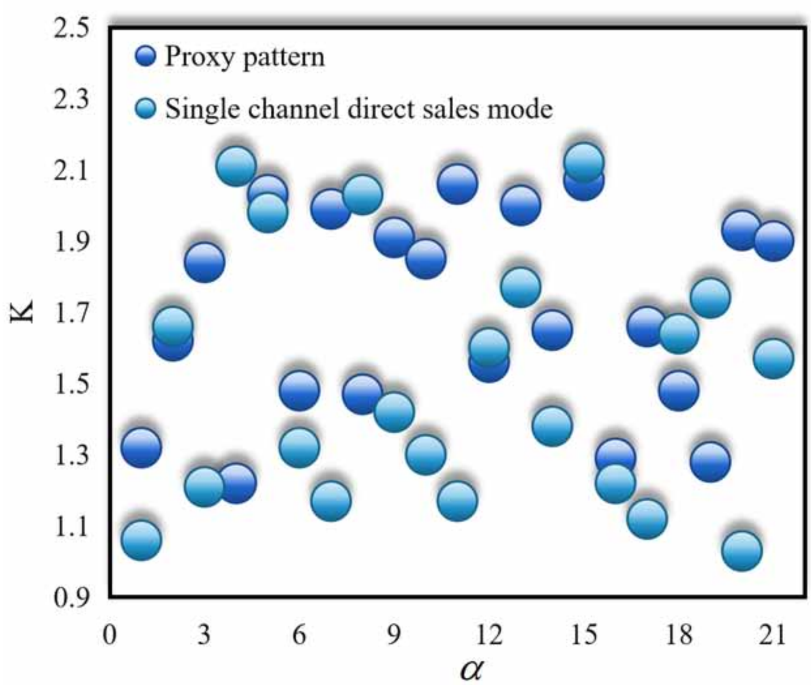



**Table 1. Familiarity between hotels**

| Candidate enterprises | M1 | M2 | M3 | M4 |
|---|---|---|---|---|
| S1 | 3 | 9 | 9 | 2 |
| S2 | 3 | 6 | 3 | 9 |
| Candidate enterprises | L1 | L2 | L3 | L4 |
| M1 | 10 | 4 | 8 | 8 |
| M2 | 4 | 7 | 4 | 10 |

the supply chain, and then determined the final partner by using the maximum and minimum ACA. The author evaluated each candidate hotel according to the above-mentioned indicator factors, and calculated the attractiveness of each candidate partner (Table 2).

The goal of partner selection is to use a supply chain partner selection model based on the maximum and minimum ACA to achieve the optimal overall performance of the supply chain consisting of logistics service providers (L), suppliers (S), manufacturers (M), distributors (D), and retailers (R). In this paper, the author categorized the number of candidate partners for the above tasks as 4, 4, 4, 5, and 4, respectively.

MATLAB is used for algorithm simulation (Velani et al., 2023). After analysis and processing, the problem of partner selection in the hotel supply chain has become a path optimization problem that takes node A as the starting point and node T as the end point, and requires searching for the shortest path from A to T. The parameters of the ACA are $\alpha = 1$ and $\beta = 1$, and the number of ants is $m = n = 21$ and $p = 0.7$. After 251 iterations of the algorithm, the calculated value converges to 3.12, and Figure 7 shows the experimental results.

**Table 2. Attraction between candidate partner hotels**

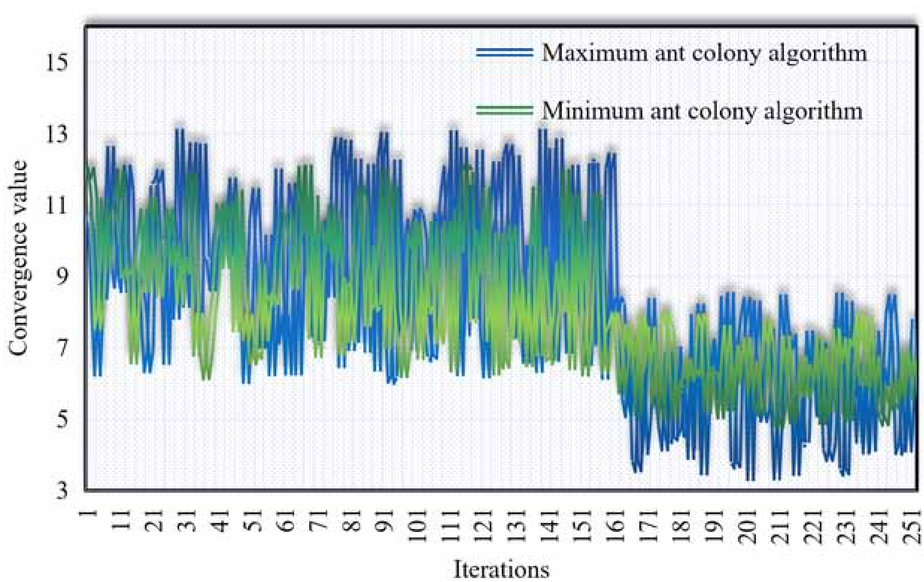
| Candidate enterprises | M1 | M2 | M3 | M4 |
|---|---|---|---|---|
| S1 | 0.63 | 0.80 | 0.80 | 0.60 |
| S2 | 0.60 | 0.68 | 0.60 | 0.77 |
| Candidate enterprises | L1 | L2 | L3 | L4 |
| M1 | 0.85 | 0.70 | 0.80 | 0.80 |
| M2 | 0.72 | 0.79 | 0.72 | 0.87 |

Figure 7 shows the evolution process of the optimal solution. The convergence path is A-S4-M3-L3-D1-R1-T. Therefore, the optimal partner combination to meet the requirements of the supply chain is selected as S4, M3, L3, D1 and R1. The experiment shows that the max-min ACA is effective in solving the partner selection problem of hotel supply chain.

## CONCLUSION

Hotel SCM is a very complex distributed combinatorial optimization problem, and it is difficult to achieve good results with general methods. In this study, the author investigated the hotel SCM model based on ACA and optimized it. The research showed that the convergence path is A-S4-M3-L3-D1-R1-T. Therefore, the author selected the optimal partner combination meeting the requirements of the supply chain as S4, M3, L3, D1 and R1. The experiment shows that the max-min ACA is effective in solving the partner selection problem of hotel supply chain. This paper based on ACA optimization of hotel SCM mode and strategy, including meeting customer needs, building a quality management system platform, and establishing supply channels. Hotels should transform their core competitiveness into as many material forms as possible, such as core products and final products, so that their core competitiveness can be fully diffused, which can not only further strengthen the core competitiveness

**Figure 7. Evolution process of optimal solution**



of hotels, but also obtain huge profits. Because the hotel capacity is relatively fixed for a certain period of time, the hotel industry is a typical capacity constrained service industry. Therefore, it is necessary to consider customer selection behavior and limited hotel service capabilities when analyzing the SCM models of hotels and OTA based on ACA in this paper. This is a guarantee for the effective implementation of hotel SCM and has certain reference significance for the establishment and use of new management models based on hotel supply chain.

## DATA AVAILABILITY

The Figures and Tables used to support the findings of this study are included in the paper.

## CONFLICTS OF INTEREST

The authors declares that they have no conflicts of interest.

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## REFERENCES

Abou Kamar, M. (2021). Transforming hotel supply chain using intelligent decision support system: Prospects and challenges. *Journal of Association of Arab Universities for Tourism and Hospitality*, *20*(2), 216–246. doi:10.21608/jaauth.2021.63136.1136

Al-Aomar, R., & Hussain, M. (2019). Exploration and prioritization of lean techniques in a hotel supply chain. *International Journal of Lean Six Sigma*, *10*(1), 375–396. doi:10.1108/IJLSS-10-2017-0119

Alreahi, M., Bujdosó, Z., Dávid, L. D., & Gyenge, B. (2023). Green supply chain management in hotel industry: A systematic review. *Sustainability (Basel)*, *15*(7), 5622. doi:10.3390/su15075622

Arifin, M., Ibrahim, A., & Nur, M. (2019). Integration of supply chain management and tourism: An empirical study from the hotel industry of Indonesia. *Management Science Letters*, *9*(2), 261–270. doi:10.5267/j.msl.2018.11.013

Bhavya, R., & Elango, L. (2023). Ant-Inspired Metaheuristic Algorithms for Combinatorial Optimization Problems in Water Resources Management. *Water (Basel)*, *15*(9), 1712. doi:10.3390/w15091712

Chen, M. H., Wei, H., Wei, M., Huang, H., & Su, C. H. J. (2021). Modeling a green supply chain in the hotel industry: An evolutionary game theory approach. *International Journal of Hospitality Management*, *92*(1), 102716. doi:10.1016/j.ijhm.2020.102716

Díaz, L. E. C., Abreu, A. A., Estevez, P. G., & Pires, S. R. (2021). An empirical study on supply chain management practices within the hotel segment in Spain using an artificial intelligence technique. *International Journal of Services and Operations Management*, *39*(1), 62–80. doi:10.1504/IJSOM.2021.115185

Ding, Z., Jiang, S., Xu, X., & Han, Y. (2022). An Internet of things based scalable framework for disaster data management. *Journal of Safety Science and Resilience*, *3*(2), 136–152. doi:10.1016/j.jnlssr.2021.10.005

Dzalbs, I., & Kalganova, T. (2020). Accelerating supply chains with ant colony optimization across a range of hardware solutions. *Computers & Industrial Engineering*, *147*(2), 106610. doi:10.1016/j.cie.2020.106610 PMID:32834426

Hussain, M., Al-Aomar, R., & Melhem, H. (2019). Assessment of lean-green practices on the sustainable performance of hotel supply chains. *International Journal of Contemporary Hospitality Management*, *31*(6), 2448–2467. doi:10.1108/IJCHM-05-2018-0380

Li, N., Su, Z., Bi, Z., Tian, C., Ren, Z., & Gong, G. (2014). A supportive architecture for CFD-based design optimisation. *Enterprise Information Systems*, *8*(2), 246–278. doi:10.1080/17517575.2013.843203

Meathawiroon, C. (2023). The Importance of Green Supply Chain Management on Supply Chain Performance and Sustainable Supply Chain Management in the Hotel Industry. *Journal of Economics & Management Strategy*, *10*(1), 185–202.

Mollaei, M., Mohaghar, A., & Asgharizadeh, E. (2017). The effect of external service quality on customer's loyalty in hotel's industry supply chain (case study: Parsian Hotels). *Journal of Industrial Strategic Management*, *2*(3), 25–36.

Nugroho, A., Zane, M. D., & Sihite, J. (2020). The influence of supply chain strategy in hoteling industry and intention to book hotel traveloka. *International Journal of Supply Chain Management*, *9*(3), 462.

Panicker, V. V., Reddy, M. V., & Sridharan, R. (2018). Development of an ant colony optimisation-based heuristic for a location-routing problem in a two-stage supply chain. *International Journal of Value Chain Management*, *9*(1), 38–69. doi:10.1504/IJVCM.2018.091109

Pratyameteetham, T., & Atthirawong, W. (2017). Green supply chain management performance within the Thai hotel industry: A structural equation model. *Journal for Global Business Advancement*, *10*(4), 440–460. doi:10.1504/JGBA.2017.086520

Rao, P. H. (2020). Green supply chain management in Hotel Azure: A case in sustainability. *Journal of Supply Chain Management Systems*, *9*(2&3), 28.

Rao, T. S. (2018). An ant colony TSP to evaluate the performance of supply chain network. *Materials Today: Proceedings*, *5*(5), 13177–13180. doi:10.1016/j.matpr.2018.02.308

Roespinoedji, R., Mulyati, Y., Istambul, R., & Mutalib, N. A. (2019). How the hotel website management influence hotel supply chain management and tourism industry. *International Journal of Supply Chain Management*, *8*(1), 231.

Sari, K., & Suslu, M. (2018). A modeling approach for evaluating green performance of a hotel supply chain. *Technological Forecasting and Social Change*, *137*(1), 53–60. doi:10.1016/j.techfore.2018.06.041

Shanshan, Z., Ahmad, A., & Heng, X. (2023). Analysis of Management Strategies for Urban Hotels in China Under the Sustainable Development Goals of Low-Carbon Tourism. *International Journal of Professional Business Review*, *8*(8), e02995–e02995. doi:10.26668/businessreview/2023.v8i8.2995

Tortorella, G. L., Rosa, M., Caiado, R., Nascimento, D., & Sawhney, R. S. (2019). Assessment of lean implementation in hotels' supply chain. *Production*, *29*(2), e20190044. doi:10.1590/0103-6513.20190044

Tsai, C. W., Chen, M. Y., Piccialli, F., Qiu, T., Jung, J. J., Hung, P. C., & Zeadally, S. (2021). IEEE Access special section editorial: Data mining for Internet of things. *IEEE Access : Practical Innovations, Open Solutions*, *9*(3), 90418–90427. doi:10.1109/ACCESS.2021.3090137

Turken, N., Cannataro, V., Geda, A., & Dixit, A. (2020). Nature inspired supply chain solutions: Definitions, analogies, and future research directions. *International Journal of Production Research*, *2020*(5), 1–27. doi:10.1080/00207543.2020.1778206

Velani, A. F., Narwane, V. S., & Gardas, B. B. (2023). Contribution of Internet of things in water supply chain management: A bibliometric and content analysis. *Journal of Modelling in Management*, *18*(2), 549–577. doi:10.1108/JM2-04-2021-0090

Wan, X., Jiang, B., Li, Q., & Hou, X. (2020). Dual-channel environmental hotel supply chain network equilibrium decision under altruism preference and demand uncertainty. *Journal of Cleaner Production*, *271*(1), 122595. doi:10.1016/j.jclepro.2020.122595

Xu, S., Liu, Y., & Chen, M. (2017). Optimization of partial collaborative transportation scheduling in supply chain management with 3PL using ACO. *Expert Systems with Applications*, *71*(1), 173–191. doi:10.1016/j.eswa.2016.11.016

Yuyan, W. A. N. G., Dexia, W. A. N. G., Yulin, S. U. N., Zongchao, L. I. U., Zhenlong, Y. A. N. G., & Qiang, H. A. N. (2023). Pricing Decision of the Bundled Mobile Phone Supply Chain Based on Diseconomies of Scale and Network Externalities. *Journal of Systems Science and Mathematical Sciences*, *43*(3), 577.

Zhang, L., & Ye, F. (2018). Mechanisms of collaboration in the hotel supply chain: Two-stage ordering contract and option contract. *Journal of Systems Science and Complexity*, *31*(3), 750–772. doi:10.1007/s11424-017-6101-0

Zhang, L., & Zhang, R. (2022). Research on UAV cloud control system based on ant colony algorithm. *Journal of Systems Engineering and Electronics*, *33*(4), 805–811. doi:10.23919/JSEE.2022.000080

Zhao, J., Lin, J., & Zhao, X. (2017). Ant colony algorithm and multi-agent-based production scheduling optimization model. *Malaysian E-Commerce Journal*, *1*(1), 1–6. doi:10.26480/mecj.01.2017.01.06

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