

Tourism Service Auction Market for Saudi Arabia



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1 Introduction

1.1 *Tourism in Saudi Arabia*

Saudi Arabia is a large country in terms of geographical area and contains a vast number of tourist places and attractions; there are five places registered so far in UNESCO as historical and tourist destinations [1]. According to the Saudi Vision 2030, the Saudi government will work to establish heritage tourism places and take care of them through the goals stipulated in the vision; additionally, this project aims to double the number of heritage sites registered by UNESCO [2]. Moreover, the kingdom has established commissions to support tourism. For example, the royal commission for AIUla will be responsible for delivering infrastructure in AIUla and completing responsible tourism development projects to make AIUla a world-class tourist destination [3].

Previously, travel to Saudi Arabia for the purpose of tourism was difficult due to visa restrictions. Currently, Saudi Arabia is opening its national tourism industry to tourists who wish to come to Saudi Arabia. For current and future tourist destinations in Saudi Arabia, such as AIUla and Neum (respectively), this movement is in line with the Kingdom's Vision 2030 and aims to both attract tourists and simplify the process of obtaining a tourist visa. Given this wide-open opportunity for tourism in Saudi Arabia, it is clear that there is a strong case for the development and introduction of an electronic market for tourism in Saudi Arabia. The utilization of an electronic market would improve the buying and selling process between tourists

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and the agents who act as providers of services. This electronic service market will improve communication between the tourist and the service provider (agent) while increasing overall efficiency. Both sides would be able to trade services by using trading software and communication networks.

An electronic market for the tourism services between sellers (service providers) and buyers (tourists) is proposed in this paper. For instance, a tourist often has a list of desired activities for their trip. Each agency has its own list of services they provide; a single agency might not cover all the activities that tourists desire, so a consortium of agencies may be more able to fulfill the entire list of activities desired by the tourist.

2 Literature Review

2.1 Background of E-marketplaces

In recent years, as Internet technology has grown, traders have begun utilizing the Internet as a means of selling goods and services [4, 5]. This electronic form of trading is known as the electronic market, “online trading,” “e-marketplaces,” or “electronic commerce” [6]. As e-marketplaces expand, many benefits of utilizing the Internet in trade have been noted [7, 8]. These benefits include Internet assistance for organizations and delivery services [8]. Additionally, the Internet aids in the exchange of management information and provides support for strategy implementation. The structure of the e-marketplace varies based on business models and the industry of focus [9].

2.2 Consortium

A consortium refers to two or more members collaborating together, as a buyer or a seller, to achieve a common objective within the marketplace [10, 11]. Moreover, Ivanovic et al. [12] presented the explanation of a consortium as a contractual relationship meant to benefit all participants within an investment project. The definition of a consortium within a local government is the arranged compilation of the needs of multiple local government organizations to optimize the purchasing power and available resources of the government [13]. Documentation and management are crucial processes necessary for the development of a consortium [12]; additionally, membership fees, consulting fees, and transaction fees make up the bulk of consortium income in an e-marketplace [14]. On the other hand, consortiums in e-marketplace serve different functions for both buyers and sellers. Consortiums benefit buyers by reducing the cost of products when compared with large sellers online [14]. For example, an agent does not need to provide a lot of services;

whenever an agent needs a service that they do not provide, they may outsource this service via a consortium. In reference to sellers, consortiums increase the sales of their products [14].

2.3 *Clearing House*

The establishment of rules and regulations, as well as the enforcement of contracts, is the responsibility of the clearinghouse [15]. In the market, buyers and sellers must have accounts with the clearinghouse before accessing the services provided [16]. The clearinghouse serves as a substitute for direct counterparty relationships between buyers and sellers by acting as an intermediary [15, 16]. Additionally, a clearinghouse takes on the role of a counterparty to both sides within the market [15].

As mentioned above, it ensures that all parties in the marketplace perform their duties equitably as directed by their contracts [16]; however, the clearinghouse can only provide these services to those who already have an account with the clearinghouse [15]. An agent may encounter many potential problems, such as an out-of-order bus or bad weather; despite these potential complications, agents must provide their service to their best efforts.

However, in this case, the clearinghouse function is different from the traditional clearinghouse function. The proposed clearinghouse will deal with intangible services, not products, and work to guarantee the services are provided. Additionally, the clearinghouse will work to enforce rules. In this model, these potential problems are excluded due to the model complexity.

2.4 *Set Cover Problem*

A set cover problem is defined as, “a set of sets whose union has all members of the union of all sets. The set cover problem is to find a minimum size set” [17]. A set cover problem is classified as one of Karp’s 21 NP-complete problems and is recognized as a typical problem in computer science [18]. Therefore, a heuristic algorithm is utilized in this proposal. The definition of set cover problems can best be explained using a set of elements. For example, the universe U is given n elements and a collection of subsets of U , $S_1 \dots S_k$, with positive costs specified, the minimum set cover problem is to find the minimum cost of elements of the sets whose union is U [19].

Solving set cover problems presents several possible complications, such as set redundancy and infeasibility of solutions [20, 21]; for these reasons, set cover problems are heavily considered to be NP-Hard. To solve set cover problems, a heuristic algorithm is utilized to produce possible solutions that would generate favorable outcomes in practice. Set cover problems have been applied for various purposes,

such as crew scheduling on railways and extended transit issues with transportation companies [22]. Despite the possible difficulties of set cover problems, there are countless instances in which the problem-solving process has yielded practical and effective solutions. In this paper, there is a set of trips and the consideration of the lowest costs during pairing; the set of services provided by the agents that includes all requested services from the activity list of the tourist is used as set cover.

3 The Proposed Tourism Service Auction Market

The proposed electronic market for tourism works as follows: a tourist submits his or her wanted activity list to the electronic market; then, the market system tries to match this list with the collection of lists of service providers. If a service provider cannot provide the requested service, a consortium of services from many different service providers will be formed with the lowest service price. The service fee transaction will be guaranteed by a clearinghouse. The tourist should have an account with an adequate amount of money, and tourist agents must make sure the promised services will be provided. This electronic market for tourism is depicted in Fig. 1.

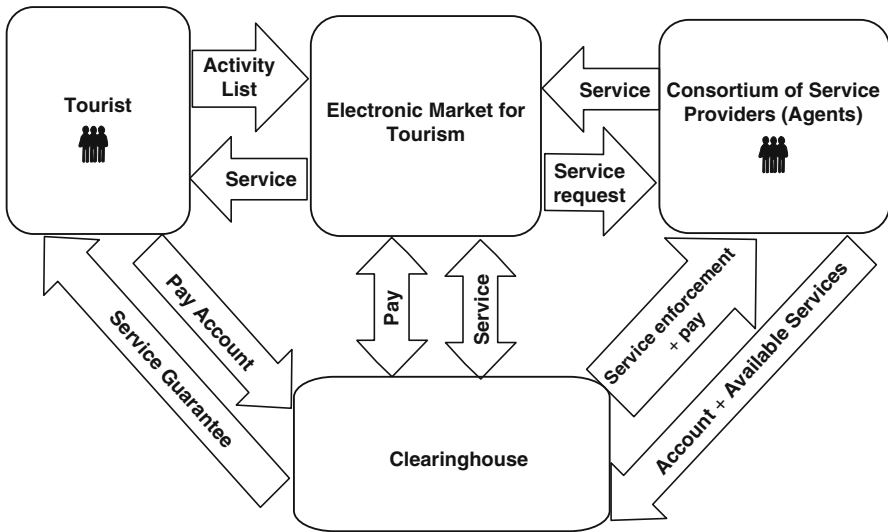


Fig. 1 The proposed electronic market for tourism in Saudi Arabia

3.1 Market Model (Math Model)

An automated, electronic, agent-based auction is applied to a tourist activity service market. A tourist has a wanted list of activities. There are many tourists $\{t_1, \dots, t_m\}$ with tourist activity lists (TA). The tourist j will have $TA_j = \{a_1, \dots, a_n\}$. There are many tourist agencies $\{a_1, \dots, a_q\}$ with service activities (SA). The agent i will have service provider activity list $SA_i = \{a_n, \dots, a_m\}$. This market first aims to match the tourist's activity list with the agents' activity list. If an agent can cover all the activities of tourist j and the cost is minimum, then that agent will win the service for the tourist j . If there is no single agent that can cover the tourist j 's activity list, then there will be a consortium of agents for the service of tourist j . For each activity on the list of desired activities of the tourist, tourist agents will compete in the auction. A consortium will be formed for this given tourist activity list. This consortium will cover all the activities in the tourist's activity list at a minimum price.

Matching Set

1. Tourist Set $T = \{t_1, \dots, t_m\}$

TA_j : tourist (t_j) j^{th} Activity list. $TA_j = \{a_1, \dots, a_m\}$

2. Agent Set $A = \{a_1, \dots, a_n\}$

It is the agent i 's activity list $SA_i = \{(a_{in}, p_{in}), \dots, (a_{im}, p_{im})\}$ where a_{in} stands for the agent i 's activity n and its price is p_n .

3. Consortium $\bigcup_{k \in A} C_k = TA_j$ (set cover)

The consortium is a union of a minimum set of agents' selected activity list and it covers TA_j

where

$C_K = \{(a_{k,p}, p_{k,p}) \mid k \in A, a_{k,p} \in TA_k, p_{k,p} = \min(p_m, p) \text{ for all } m \in A \text{ and } a_{k,p} \in TA_j\}$

Note: $a_{k,p}$ represents agent k 's activity list p and $p_{k,p}$ represents the price of agent k 's activity p .

C_K is a consortium of activities of service a_k providers.

Example:

There is a tourist John, and he has a list of activities,

TA "John" = $\{a_1, a_2, a_3, a_4, a_5\}$

There are three agents:

$A = \{S_1, S_2, S_3\}$

Each agent has a service list with prices:

$SA_1 = \{(a_1, 10), (a_2, 20)\}$, $SA_2 = \{(a_1, 20), (a_4, 10), (a_3, 10)\}$, $SA_3 = \{(a_4, 20), (a_5, 10)\}$

The service consortium for John can be selected as follows:

$C_{\text{John}} = \{(a_{11}, 10), (a_{12}, 20), (a_{23}, 10), (a_{24}, 10), (a_{35}, 10)\}$

Each activity is selected at the minimum price from different agents, and this list will cover John's activity list.

4 Implementation

4.1 Java Model

This paper uses Java as a modeling tool and a heuristic algorithm for the tourism service auction market. Figure 2 shows the use of Java for the proposed auction market with agents, and the consortium is coded by using Java programming. Moreover, Fig. 3 displays a sample run of the example in our math model.

4.2 Implementation Results

There were a total of 20 runs with randomized data. An example of creating tourist agents and their services is demonstrated in Fig. 4, and tourists' wanted activities are listed in Fig. 5. In these examples, the proposed heuristic algorithm successfully made consortia for the tourists' activity requirement list. As a sample, results for two tourists' activities lists and service matchings are displayed in Fig. 6.

5 Conclusion

In this paper, a model for an electronic tourism service auction market for Saudi Arabia has been proposed, as this will lead to a more efficient tourism support mechanism in Saudi Arabia. In this electronic tourism auction market, a mathematical model is proposed and implemented with a heuristic algorithm in Java. Based upon random tourist and agent service auction trading, this model was

Fig. 2 Heuristic algorithm for the tourism service auction market

```
function match (Tourst_Activity,List of activities of agents)
{
  foreach Agent
    look for activities requested by a tourist
    If current agent can cover all the activities
      Form the tourist with minimum
      Return the Agent and its activities
    Else
      Apply consortium to find all sets of Tourist Activities
      (TA) with price_check
      function price_check
        select an activity of an agent
        with minimum price
        Return the selected Agent, its activities with price
  }
}
```

There are three agents {1,2,3}

Each agent has a service list with prices:

Agent 1 has Activities:
Activity no. 1 with price: 10,
Activity no. 2 with price: 20,

Agent 2 has Activities:
Activity no. 1 with price: 20,
Activity no. 4 with price: 10,
Activity no. 3 with price: 10,

Agent 3 has Activities:
Activity no. 4 with price: 20,
Activity no. 5 with price: 10,

There is a tourist John and he has a list of activities:
John wants Activities: 1, 2, 3, 4, 5,

The services consortium from different agents for John can be selected as follows:

John Activity No 1 match Agent1
John Activity No 2 match Agent1
John Activity No 3 match Agent2
John Activity No 4 match Agent2
John Activity No 5 match Agent3

Each activity is selected at the minimum price from different agents, and this list will cover John's activity list and the package total price for John is: 60

Fig. 3 A sample run of the example in Sect. 3.1

Fig. 4 Agents, their activities, and prices

The Agents (service provider) are:

Agent 1 has Activities:
Activity no. 19 with price: 44,
Activity no. 14 with price: 54,
Activity no. 18 with price: 48,
Activity no. 5 with price: 57,
Activity no. 9 with price: 48,

Agent 2 has Activities:
Activity no. 18 with price: 42,
Activity no. 19 with price: 52,
Activity no. 1 with price: 49,
Activity no. 2 with price: 58,
Activity no. 12 with price: 46,

Agent 3 has Activities:
Activity no. 20 with price: 50,
Activity no. 8 with price: 53,
Activity no. 16 with price: 49,
Activity no. 13 with price: 46,
Activity no. 12 with price: 51,

executed successfully and demonstrated the performance of basic functionalities of the tourism service market. The proposed model selects activities with minimum prices for a tourist's list of desired activities through agent consortia. The results

Fig. 5 A sample case of ten tourists' requested activities

The Tourists desired activities are:
 Tourist 1 wants Activities: 5, 7, 19, 8, 6, 1,
 Tourist 2 wants Activities: 16, 8, 9, 20, 10, 2,
 Tourist 3 wants Activities: 2, 11, 7, 8, 20, 18,
 Tourist 4 wants Activities: 5, 4, 8, 16, 18, 7,
 Tourist 5 wants Activities: 7, 4, 14, 15, 13, 1,
 Tourist 6 wants Activities: 16, 1, 7, 8, 18, 19,
 Tourist 7 wants Activities: 11, 4, 19, 20, 1, 12,
 Tourist 8 wants Activities: 10, 14, 3, 17, 5, 15,
 Tourist 9 wants Activities: 14, 4, 16, 18, 3, 8,
 Tourist 10 wants Activities: 12, 16, 6, 17, 13, 14,

The results of desired activities for tourists with minimum prices for a tourist's list through agent consortium:

Tourist 1 :
 Activity number 5 Match Agent 11 and the price is: 40
 Activity number 7 Match Agent 9 and the price is: 43
 Activity number 19 Match Agent 1 and the price is: 44
 Activity number 8 Match Agent 10 and the price is: 42
 Activity number 6 Match Agent 9 and the price is: 41
 Activity number 1 Match Agent 17 and the price is: 42

The package total price for Tourist 1 is: 252

Tourist 2 :
 Activity number 16 Match Agent 14 and the price is: 43
 Activity number 8 Match Agent 10 and the price is: 42
 Activity number 9 Match Agent 16 and the price is: 40
 Activity number 20 Match Agent 12 and the price is: 46
 Activity number 10 Match Agent 8 and the price is: 43
 Activity number 2 Match Agent 13 and the price is: 40

The package total price for Tourist 2 is: 254

Fig. 6 A Sample results for two tourists' activity lists

of the model also demonstrate the usefulness of agent consortia for fulfilling the tourist's list of desired activities at a minimum price from various service providers. As demands for tourism services in Saudi Arabia increase under the 2030 Vision, an effective electronic market model will contribute to its cause. Overall, the proposed model demonstrates a feasible solution for the tourism services in Saudi Arabia, which utilizes an electronic auction market with consortia.

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