

Revenue Management – State of the Art

2.1 Introduction

Previous chapter introduced the importance of managing revenue properly which is not addressed properly and the proposed methodology. This chapter presents a detailed study on work done already in the area of revenue management in various business processes. Broadly three categories identified. Namely, Agent models for supply chain management, negotiation methods in agent oriented markets and multi agent models in online market places. Even though no agent models available developed for tour operation, supply chain management studied because it somewhat closely resembles the business process of tour operation.

2.2 Supply Chain Management (SCM) – Agents in action

Supply chain management is one of the hottest topics in relation to evaluate multi agent models. Sara Saberi and Charalampos [18] have proposed a multi agent based approach for SCM. They have identified 3 levels of agents, namely, Supplier, Distributor and Retailer which perform individually to achieve own goals and work collaborative achieve overall system goal. One other main feature they have incorporated in their approach is the negotiation, where, if retailer agent fails to supply the customer demand, it opens a negotiation mechanism with customer to get a new order price. There, Economic Order Quantity (EOQ) [12], method of negotiation is used. Two other key agents in the system, Forecaster and Controller agents have been incorporated to specify both static and dynamic characteristics of various supply chain characteristics. However, in the paper, it is not mentioned how Forecaster agent performs his job which is crucial to the performance of the overall system. Nevertheless, two researchers have proved that, use of Multi-Agent technology in SCM or a similar business model definitely improves the overall performance of the system while reducing the bullwhip effect.

One another popular environment for testing multi agent based models for SCM is TAC-SCM environment [5]. David Pardoe and Peter Stone [17] discuss in detail predicting changes in product prices in SCM. They have used additive regression with decision stumps. Actually, in their approach, Agents not only perform the predictions, but also adapt to the market on how other competing agents react orders from customers. Other agent behaviors are learnt from logs obtained from previous games and data for predicting product prices are also obtained from history. Even though, their approach has been successful in the above mentioned simulated game environment, the prediction algorithm or the learning mechanism doesn't cater for unobserved changes that would rise in a real market environment. A new direction to TAC-SCM provided by Yevgeniya et.al [22] by proposing a demand oriented approach for SCM which is claimed to be first such system. According to the literature, their approach has performed well in the TAC-SCM competition. However, generally, when it comes to travel and tourism industry, factors like committed inventory, current sales velocity also influences pricing and demand.

Even though there are number of researches being carried out to model supply chain management, the full spectrum of business challenges not addressed together. Those include, competitor prices for the products, inventory commitments, correct demand forecasts, causal factors, current sales velocities ...etc

2.3 Agent Negotiation in competitive environments

When it comes to agent oriented market places or business process models, how agents negotiate plays a crucial role. That is because; success of the approach solely depends on capability of agents to make the appropriate decision at the right time. This is vital when it comes to revenue management since, e.g. accepting or rejecting a particular customer order request directly impacts on the overall revenue of the organization. Re contracting/negotiation and de-commitment plays a vital role in succeeding in online business due to the fact that number of attributes influencing generating revenue. Unforeseen cancellations are only one aspect. Such situations If not properly addressed, would make the system malfunction and not to achieve its design goals.

The problem of contracting and reconfiguration in competitive environments is studied in detail by Biba, et al. in their paper [3]. Authors emphasize the fact that standard MAS (Multi Agent System) techniques would not cater the goals of entrepreneurs who would have inner components cooperating with each other, where in the internal context, there is an overall goal while, when it comes to external context, MAS with self interested agents are required. In achieving contracting and reconfiguration, Biba and Vokrinek have studied several standard contracting and contract maintenance protocols. Those are, Contract-Net Protocol (CNP), multi stage negotiation protocol [2] and Acquaintance model [9]. Those protocols are analyzed to propose an algorithm for setting contract price in leveled commitment contracts [19], [7]. After evaluating above protocols, authors propose a simple acquaintance model that enables only tracking the history of contracts for each customer that the provider interacts with. However, their contract setting algorithms are somewhat stationary and it is required to have more complex non stationary models for contract setting to be more adaptive in handling customer behaviors.

A novel approach called negotiation centre approach studied and presented by Zoltan et al [23] after studying several negotiation methods available. Instead of agents performing the negotiation, authors propose to have a centralized negotiation place called a negotiation centre. However, there is an issue in having a negotiation centre. That is, agents would have to rely and trust the negotiation centre to make the fair negotiation for them. This can be a problem in a highly competitive market environment where agent autonomy plays a key role. But as, authors propose, their approach suits well for mobile agents although still it can be a problem with communicating with the negotiation centre when the network traffic is blocked.

Even though it is not evident from the literature, which negotiation approach suites the most for complex business processes, approaches mentioned in this section need to be further studied and evaluated to find out the most appropriate one.

2.4 Online Market places and Multi Agent Systems

Online business processes are becoming popular ever than before. This is mainly because, from customer's point of view, more details being available online with a

greater comparison among products. On the other hand, service providers encounter less cost in putting the inventory online, but face huge market competition. However, there is a growing trend to model business processes as agent systems and this section reviews literature in that area.

Joan Morris et al [14] have presented some interesting dynamic approaches for sellers to optimize revenues in an auction market place. Their system is called Sardine, which, according to them, is an effort to consider the seller side of an auction market where most of other approaches exist for consumer side of the same market. System is presented in air line industry even though they claim the approach can be applied to other domains as well. Goal of the seller side of Sardine is to make an intelligent dynamic decision to accept or reject the bid while maximizing revenues and seat sales. Constraints to the seller are finite number of goods, finite amount of time and changing perceived value of the goods. Few of the important assumptions made in the system are, constant demand over time, buyer being committed to buy the winning bid (no cancellations allowed) and not to consider costs of the airline. The two strategies for the seller are varying the reserve price for a seat and varying the number of seats released to reserve per day. Even though changing reserve prices provided increasing revenues except in one case, seat releasing strategy has been failed. According to their findings, they have concluded that tracking demand on short sighted buyer observances are does not provide enough information to make an intelligent strategy. They also have emphasized the importance of historical behaviors to consider.

Adaptive pricing mechanism for distributed workflow enactment has been studied by Hrishikesh et al [10]. They have mainly considered distributed workflow enactment in new job requests each composed of a workflow, deadline and a payment. The work by the authors concluded with test results showing that adaptive pricing mechanism effects greatly to increase company profit. However, the conducted research addresses the issue of choosing work flows, there are some areas which need to be improved in this system for that to be more effective revenue management system. Few of them are, evolving with the market changes, adaptive forecasting mechanisms to predict

future sales/jobs more accurately and making agents more utility based (this is also pointed out as a future work by authors).

It is true, the fact that there are growing number of researches being carried out in the area of agent oriented online market places as mentioned above. However, they have a different scope or need to be extended to support full dynamic nature of the market and to address the complexity.

2.5 Problem in brief

Revenue management is becoming increasingly difficult task for the businesses facing very high competition, dynamic market and selling their products over the internet. That is due to dynamic nature of the market and subtle changes in demand for their products. Conventional approaches involve considerable amount of human intervention and hence unable to grasp opportunities emerge from the market to generate additional revenue

2.6 Summary

This chapter presented in detail, current literature related to agent oriented revenue management and business process management. It was evident that there is no readily available system or mechanism to model the complexity in tour operation business process. Even though the supply chain management process goes closely with tour operation, there are number of differences in terms of resources being managed and number of intermediate entities communicating with each other. Some of the agent negotiation methods also studied since they play a vital in agent communication and negotiation. Internet market place models currently developed presented next since; tour operation also has an online side of the business. Finally, problem to be solved presented in brief as, managing revenues in complex business processes remaining still unsolved.

Next chapter presents the technological findings in developing a solution to the problem found in this chapter.