ABSTRACT

Coordination among supply chain members is essential for better supply chain performance. An effective method to improve supply chain coordination is to implement proper coordination mechanisms. The primary objective of this research is to study the performance of a multi-level supply chain while using selected coordination mechanisms separately, and in combination, under lost sale and back order cases. The coordination mechanisms used in this study are price discount, delay in payment and different types of information sharing. Mathematical modelling and simulation modelling are used in this study to analyse the performance of the supply chain using these mechanisms.

Initially, a three level supply chain consisting of a supplier, a manufacturer and a retailer has been used to study the combined effect of price discount and delay in payment on the performance (profit) of supply chain using mathematical modelling. This study showed that implementation of individual mechanisms improves the performance of the supply chain compared to ‘no coordination’. When more than one mechanism is used in combination, performance in most cases further improved.

The three level supply chain considered in mathematical modelling was then extended to a three level network supply chain consisting of a four retailers, two wholesalers, and a manufacturer with an infinite part supplier. The performance of this network supply chain was analysed under both lost sale and backorder cases using simulation modelling with the same mechanisms: ‘price discount and delay in payment’ used in mathematical modelling. This study also showed that the performance of the supply chain is significantly improved while using combination of mechanisms as obtained earlier. In this study, it is found that the effect (increase in profit) of ‘delay in payment’ and combination of ‘price discount’ & ‘delay in payment’ on SC profit is relatively high in the case of lost sale. Sensitivity analysis showed that order cost of the retailer plays a major role in
the performance of the supply chain as it decides the order quantity of the other players in the supply chain in this study. Sensitivity analysis also showed that there is a proportional change in supply chain profit with change in rate of return of any player. In the case of price discount, elasticity of demand is an important factor to improve the performance of the supply chain. It is also found that the change in permissible delay in payment given by the seller to the buyer affects the SC profit more than the delay in payment availed by the buyer from the seller.

In continuation of the above, a study on the performance of a four level supply chain consisting of a manufacturer, a wholesaler, a distributor and a retailer with ‘information sharing’ as coordination mechanism, under lost sale and backorder cases, using a simulation game with live players has been conducted. In this study, best performance is obtained in the case of sharing ‘demand and supply chain performance’ compared to other seven types of information sharing including traditional method. This study also revealed that effect of information sharing on supply chain performance is relatively high in the case of lost sale than backorder. The in depth analysis in this part of the study showed that lack of information sharing need not always be resulting in bullwhip effect. Instead of bullwhip effect, lack of information sharing produced a huge hike in lost sales cost or backorder cost in this study which is also not favorable for the supply chain.

Overall analysis provided the extent of improvement in supply chain performance under different cases. Sensitivity analysis revealed useful insights about the decision variables of supply chain and it will be useful for the supply chain management practitioners to take appropriate decisions.

**Keywords:** Supply chain, Coordination, Lost sale, Backorder, Price discount, Delay in payment, Information sharing, Mathematical modelling, Simulation modelling, Sensitivity analysis, Profit/Cost.