Chapter 5

Conclusion and Further Research

In this final chapter, we present and discuss the general conclusions of this research and propose some areas for further work. The major area of this thesis has been developed the inventory models for single vendor single buyer under time varying demand processes. These models are concerned the right time to place an order(deliver) and the right amount of each order(shipment) for the buyer(vendor) in order to minimize their cost and satisfy the demand.

5.1 Conclusion

We first considered the integrated inventory model for shipping a vendor's final production batch to a single buyer under linearly decreasing demand. This model discussed the two main cases that is the vendor's holding cost is less than the buyer's holding cost and vice versa. When the vendor's holding cost is less than the buyer's holding cost, the buyer wish as little stock as possible at their store and the vendor delivers a shipments only when the buyer's inventory is just about to run out. We solve this model by considering three policies ; Policy 1 (equal shipment sizes) , Policy 2 (equal shipment periods) and Policy 3 (unequal shipment sizes and unequal shipment periods). We use the Microsoft Excel Solver to obtain the result and we found that the unequal shipment sizes and unequal shipment periods policy is always superior than the other policies while the equal shipment periods is the worst policy. Sensitivity analysis is also done to the all policies to see the behavior of the total cost of each model while varying the value of some parameter such as b, P, a, h_1/h_2 and A_1/A_2. We also compared the total cost saving which is obtained by implementing Policy 3 rather than policy 1 and 2. We concluded that the best minimum policy is given by Policy 3 that is the unequal shipment sizes and unequal shipment periods.

When the vendor's holding cost is greater than the buyers, the previous model is no more suitable to be applied. Another model have to be developed in order to obtain the optimal solution. Now the vendor's wish to deliver as many as they have produce to the buyer so that the vendor can reduce their holding cost. This case also have been received a lot of attention in the literature and known as a Consignment Stock. We solved this model using three policy ; Policy 1 (equal shipment sizes) , Policy 2 (equal shipment periods) and Policy 3 (unequal shipment sizes and unequal shipment periods). We also use the Microsoft Excel Solver to obtain the result and we found that the unequal shipment sizes and unequal shipment periods is always superior to the other policies whereas the equal shipment sizes gives the same result with the equal shipment periods. Similarly, as we expected the unequal shipment sizes and unequal shipment periods are always superior than the other policy. As in the previous case, the sensitivity analysis is also done to the all policy to see the behavior of the total cost and the total cost saving while varying the value of some of the parameter as in the previous model. Again, we concluded that the best minimum policy is given by Policy 3 which is the shipment sizes and shipment periods are unequal.

In Chapter 4, we extended the previous model to n batch production policy with considering vendor's holding cost is greater than the buyer's or vice versa. For both cases, the policies where the cycle time is either equal or unequal. We solved this policy with the equal shipment sizes and unequal shipment sizes and found that the result is inline with our expectation where the unequal cycle times and unequal shipment sizes, (Policy 2(b)) gives the best optimal policy. The analysis shows that the total cost for the this policy always superior than the other policy.

5.2 Further research

There are several areas where there is potential for more analysis in the future. We recommend and suggest that further development should be undertaken in the following areas :

- In this research, we have discussed the final batch and n batch of the production cycle for the both cases $h_1 < h_2$ and $h_1 > h_2$ under time varying demand rate. All these model considered a single vendor and a single buyer. However, this type of model maybe restrictive in practice in respect of selling an item to more than one buyer or ordering an item to more than one vendor. Therefore our proposed model can be extended to the case of single vendor-multi buyer or multi vendor-single buyer or multi vendor-multi buyer. It will involve adding more parameters to the model and the mathematical formulation will be more complicated.

- In reality, most of the parameters describing real problems are continually changing with time. Then, assumption of the deterministic demand process is no longer realistic. The consideration of the stochastic demand process will be more challenging. Recently, Zavanella, Zanoni, Mazzoldi and Jaber [57] proposed a joint economic lot size model with price and environmental sensitive demand. The sensitive demand is also another good idea to be extended to our proposed research in this thesis.

- The production rate, P considered here is assumed to be constant. However, in practical problems, this would not always hold where it can be varied. Similarly, if P becomes varied, the total inventory at the vendor and the total of the system will not be simply calculated. Recently, Zanoni, Bettoni and Glock, [54] consider the energy implication in batch sizing with controllable production rates in a two-stages production system. It will be more interesting to put this idea into consideration of our proposed model in this thesis.

- The assumption of a finite planning horizon, H also can be infinite. If this is applied, these models will have only a single batch because of the repetition.

- The other case such as recovery process during production which has been discussed recently by Hishamuddin, Sarker and Essam [31] may also be considered.

- All the inventory models presented in this thesis have been concerned with the management of the inventory of a single product at a single geographical location. However, it is important to recognize that many inventory system must deal simultaneously with many product and more than one location.

- In this research we proposed a two-level integrated manufacturing system. Recently, Omar [38] proposed a just-in-time three-level integrated manufacturing system for linearly time-varying demand process. It is possible to modify our model to three-level, for example by adding the consideration of manufacturing raw material or a repairing a used item at the vendor under time-varying demand process as proposed by Omar and Yeo [39].

- Finally, there is a great deal of scope for investigating how there models could be used in practice. Of course that practical models would be more complex, but the method we have discussed may be of considerable value as a starting point for "real-life" inventory management.