Optimal work method in a flowers' distribution center to achieve on time delivery

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Abstrat

The study investigates the issue of reducing the working hours in flowers' distribution center (about 25% of the total working hours in the farm) while performing the activities needed to prepare customer orders prior to delivery.
The farm under study is located in the central part of Israel, consists of 5 hectares (1.4 ha of greenhouses and 3.6 ha of screen houses) and employing 45 workers. It grows a large variety of cut flowers packed in four sizes of pots. In addition, it grows various types of green ornamentals delivered in bundles of 50 stems. The annual yield of the farm in 2010 was 8.6 million branches delivered to nurseries and local municipalities. The major types (about 30%) were Vinca, Antirrhinum and Petunia. The activity starts everyday at noon time aiming to end before dark. The marketing department prepares the pick lists according to customers' orders promised for the next morning.
The objective of the study was to improve the work processes of: flowers' picking (various quantities for different orders) from screen houses and greenhouses located all over the farm, transporting the product to the distribution center, orders preparation in the distribution center and trucks' loading to be ready for distribution.
Direct time studies were conducted to verify the time standards of the various involved processes.
A computer simulation model was developed using the Arena. The model inputs are the pick lists of the orders to be delivered containing flower types and the related quantities. The simulation inputs were the picking methods and the number of workers in the related work teams. The simulation outputs (performance measurements) were: Daily picking hours, daily waiting hours, average worker walking hors, number of packages and the total time to accomplish the task (makespan).
Five alternatives were tested where each alternative tested a predefined work method. The current method (moving in series from one location to next one) was the reference. Other alternatives employed teams of workers working in parallel in various picking locations in the farm.
Results show that the best alternative reduced the total time needed to accomplish the task with 16%. This alternative involves two teams working in parallel.

Key words: Flowers, Packing House, Work Methods, On Time Delivery, simulation.

1. Introduction

Flower production in Israel is grown on 5,000 ha and results in an annual export of one billion flowers with total revenue of about 120 million US Dollars.There are about 800 farmers competing in the market where each farmer usually grows up to 15 flower types. One of the basic farm processes is preparing customer orders to be delivered usually the next morning. This process becomes very complicated as a function of the variety of flowers grown in the farm and the number of orders to prepare. In order to satisfy customers demand nobody would like to postpone a delivery thus, minimizing process times (Minimum Makespan) is critical. The process starts with the creation of pick lists for each customer, continue with the picking process in various locations of the farm, arranging on carts and loading on the trucks.

Broekmeulen (1998) presents a tactical decision model that improves the effectiveness of the operations of a distribution center for vegetables and fruits. Order picking has long been identified as the most labour-intensive and costly activity for almost every warehouse; the cost of order picking is estimated to be as much as 55% of the total warehouse operating expense (de Koster et al., 2007). Any underperformance in order picking can lead to unsatisfactory service and high operational cost for the warehouse, and consequently for the whole supply chain. In order to operate efficiently, the order-picking process needs to be robustly designed and optimally controlled. Many firms increase the efficiency of their warehouses by using zone picking. Zone picking requires that a worker only pick those stock-keeping units (SKUs) stored within their picking zone. The paper examines the configuration or shape of these picking zones by simulating a bin-shelving warehouse to measure picker travel where SKUs are assigned storage locations either using random or volume-based storage (Petersen, 2002). Class-based storage (CBS) partitions stock-keeping units (SKUs) into storage classes by demand and randomly assigns storage locations within each storage class area. This study compares the performance implications of CBS to both random and volume-based storage (VBS) for a manual order picking warehouse. The simulation results show that CBS provides savings in picker travel over random storage and offers performance that approaches VBS (Petersen et al., 2004) An analytical model was proposed to estimate the picking efficiency as a function of wavelength. The model, which has been tested by simulations, includes an algorithm to estimate the expected overlapping of order lines (Marchet, et al., 2011).

2. Material and methods

2.1. Farm data

The farm under study is a private owned business established in the central part of the country in 1983. The total growing area is 5 ha with 1.4 ha of greenhouses and 3.6 ha of screenhouses. There are 45 workers on a daily basis employed in various processes according to customer orders to be delivered. The farm grows about 1,300 crop types through the year.

Figure 1 presents the sales distribution in 2010.

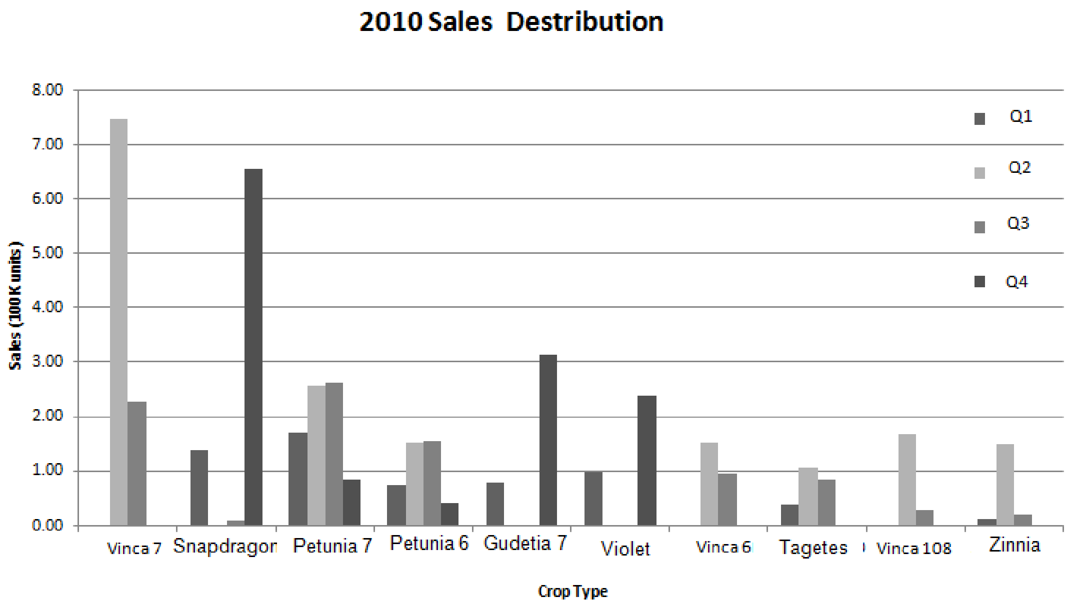

FIGURE 1: sales distribution in 2010.

2.2. Work processes

Figure 2 illustrates the flow chart of the picking/collecting work cycle.

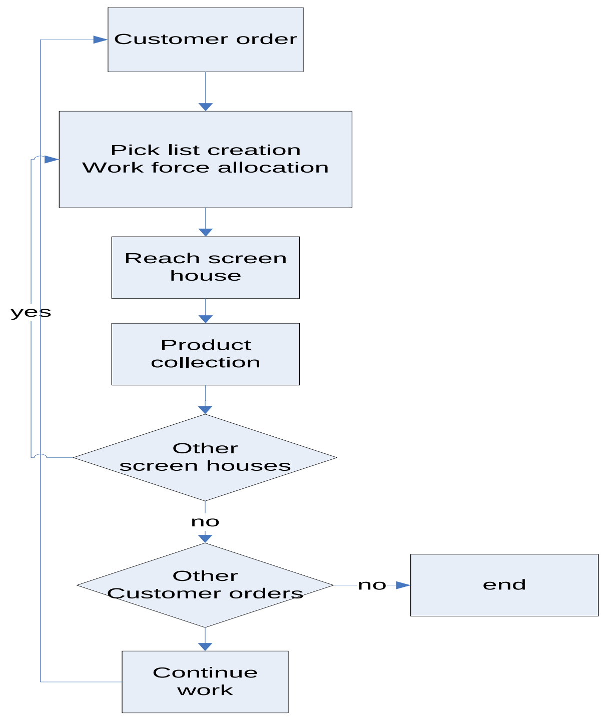

FIGURE 2: Picking/collecting work processes.

2.3. Work study and time measurement**.**

In this research, work studies were performed by means of direct measurements and work sampling techniques (Meyers and Stewart, 2001). Time measurements were made using work study software developed for handheld computers (Bechar et al., 2005). Time studies and work measurements were conducted during the Picking/Collecting processes and the processes at the distribution center (DC).

2.4. Simulation.

A simulation model using the Arena system was developed. Five alternatives were run where the independent variables are: work metod (sequential/parallel), number of work teams(1-11) and number of workers in a team (1-12). Alternative 1 (present work method): Work method- Sequential, one team with 12 workers; Alternative 2: Work method- Parallel, 11 teams, one team of 2 workers and the rest one worker each; Alternative 3: Work method- Parallel, 10 teams, one team of three workers and nine teams of one worker; Alternative 4: Work method- Parallel, one team of two workers and 10 teams of one worker; Alternative 5: Work method: Paraller, two teams of six workers each. The performance measurements were: Mean daily picking hours, Mean daily idle hours, Mean daily walking hours, Mean number of flower cases per day.

3. Results.

Table 1 presents time study results for the picking process and Table 2 for the packing process in the distribution center.

TABLE 1: Picking/Collection Process

Work Element	Mean Time [sec]	Percent of Cycle Time [%]
Case Prep.	12.93	12.5
Crop Prep.	3.6	65.7
Case Handling	12.88	16.2
Load/Unload Case	1.3	5.6

TABLE 2: Packing process in distribution center

Elements	Mean Time [sec]
Case Handling	55
Order Handling	24
Other	25

Figure 3 presents the distribution of work categories.

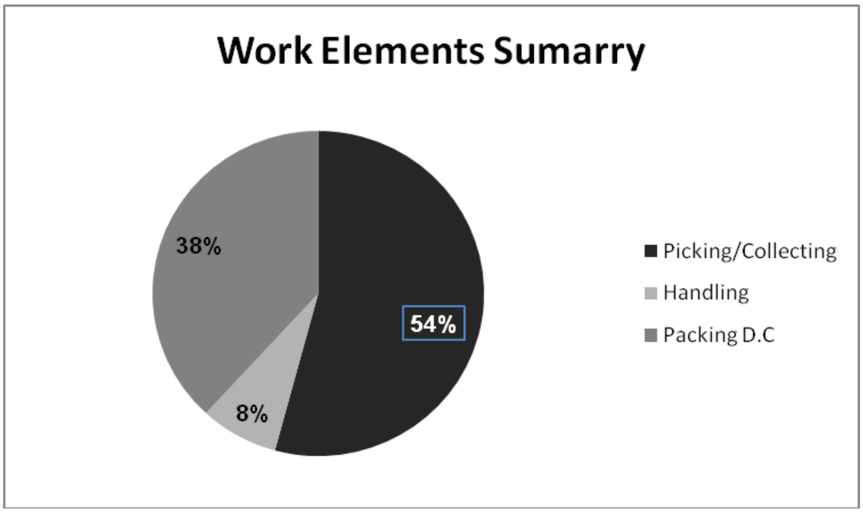

FIGURE 3: Distribution of work categories

Figure 4 presents the simulation findings for the mean daily working hours in three work disciplines: Productive hours (picking), Walking hours and Idle hours (workers stay with no work in a screen house). Observing the findings it is clear that the present work method creates large idle times and is inferior to the other alternatives. Three alternatives (2, 3, 4) create similar work and wait time. Alternative 5 creates higher walking time. In order to decide which alternative to implement, an alternative evaluation was conducted with the following criteria: Mean daily picking hours, Mean daily walking hours, Cases per hour and mean daily idle time. The recommended alternative to implement is alternative 4.

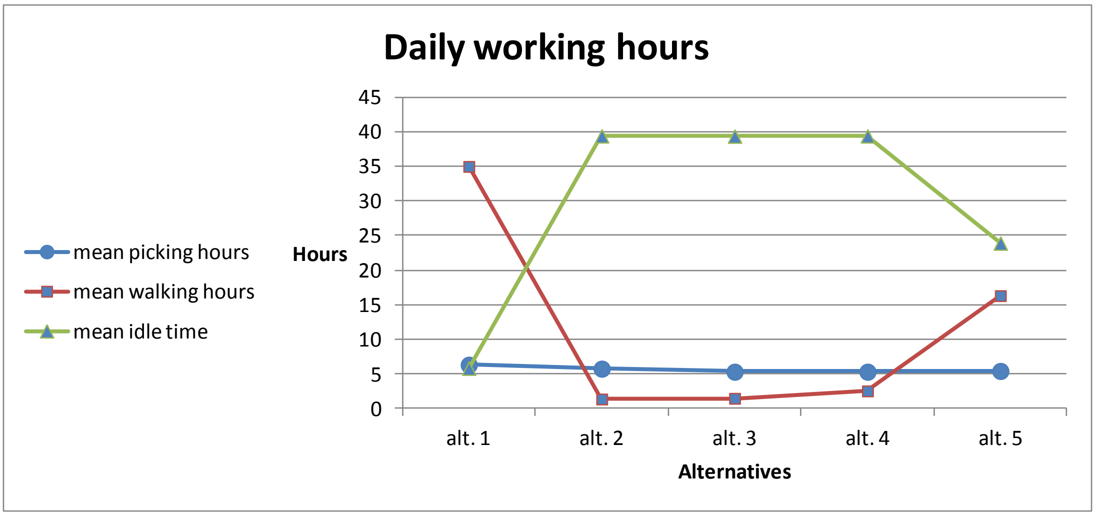

FIGURE 4: daily working hours.

4. Summary and Conclusions

The objectives of this study were to minimize the total time (Makespan) needed to fulfil the requirements of customer orders on time delivery. A simulation model using the Arena package was developed and five alternatives were tested. Two work methods were tested, working sequentialy and parallel. Also, various combinations of number of work teams and number of workers in a team were tested. The chosen alternative (alternative 4) is the easiest alternative to be implemented, employeeing the parallel work method with 11 working teams, on team with two workers and the rest with one worker each. The two workers team starts his job in the largest screenhouse and the other 10 teams work in the other scraeen houses(10 screen houses). When a worker finishes his work he will join the team which works in the largest screenhouse and help to finish the picking process. It turns to be that alternative 4 is very easy to control and there is no need for additional managing hours.

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