

Human Factors:



A
Performance
Test
of
the
WAVE
Vehicle

Introduction

Many stocking, transportation, and related tasks done in the retail environment can be performed manually — with the aid of ladders and trollies — or mechanically — with a powered tool such as the Wave vehicle. Each method — manual and mechanical — has measurable costs of labor time and labor effort. The field study summarized in this paper was conducted to carefully compare manual and mechanical methods of performing a sample of representative tasks in an actual retail environment, and to determine the possible benefits associated with the use of the Wave vehicle in the performance of these tasks.

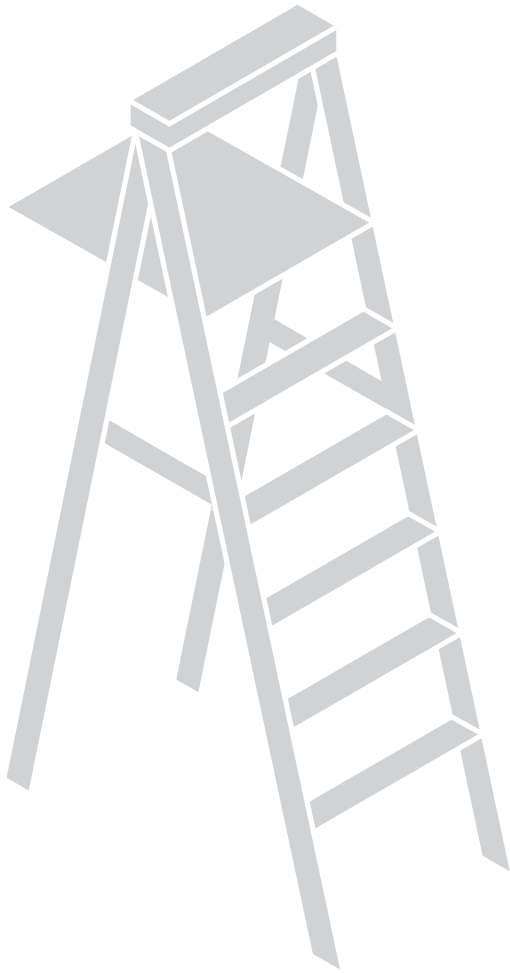
Method

The Test Setting.

The tests were conducted in a large retail store over seven days during normal store hours in the presence of customers. Four stocking tasks were identified and structured, and each was performed by up to 20 sales personnel and managers. Measures of work performed by these individuals were obtained by a team of trained observers using stop watches and data forms.

The Tasks.

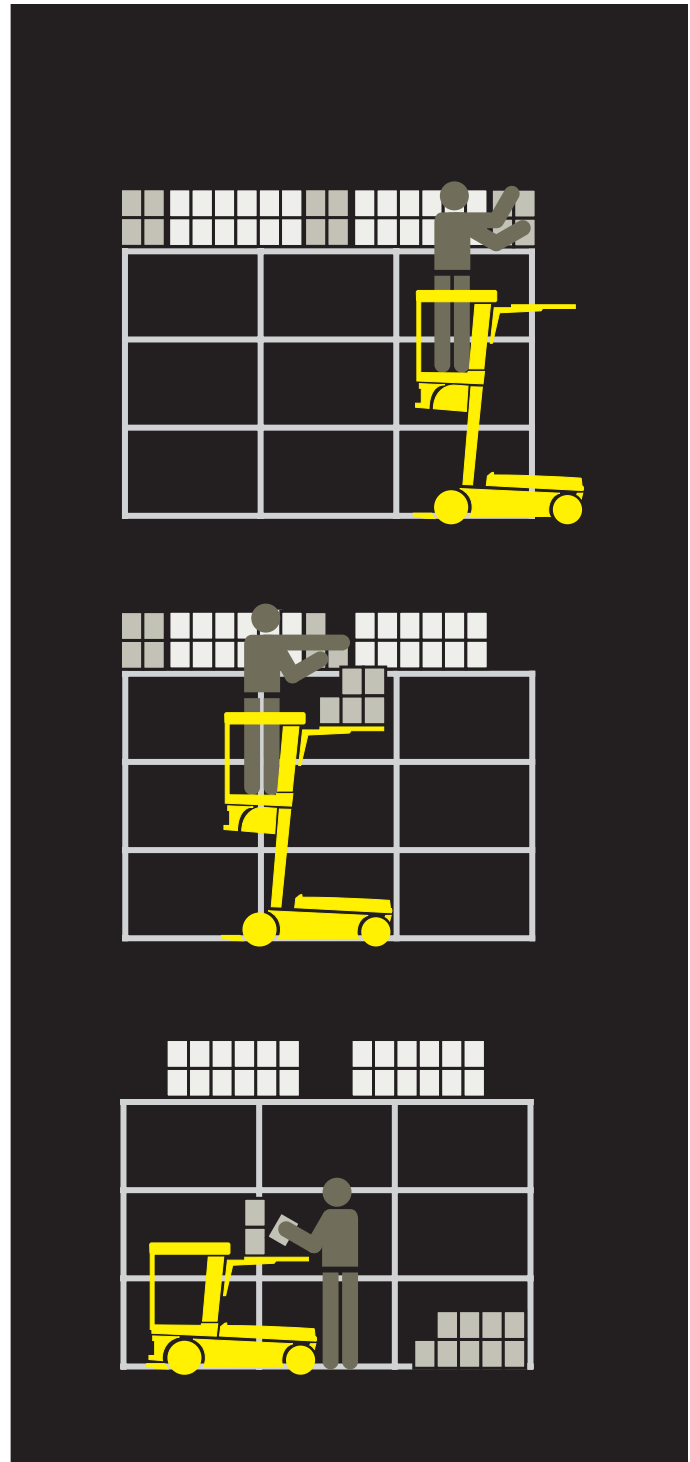
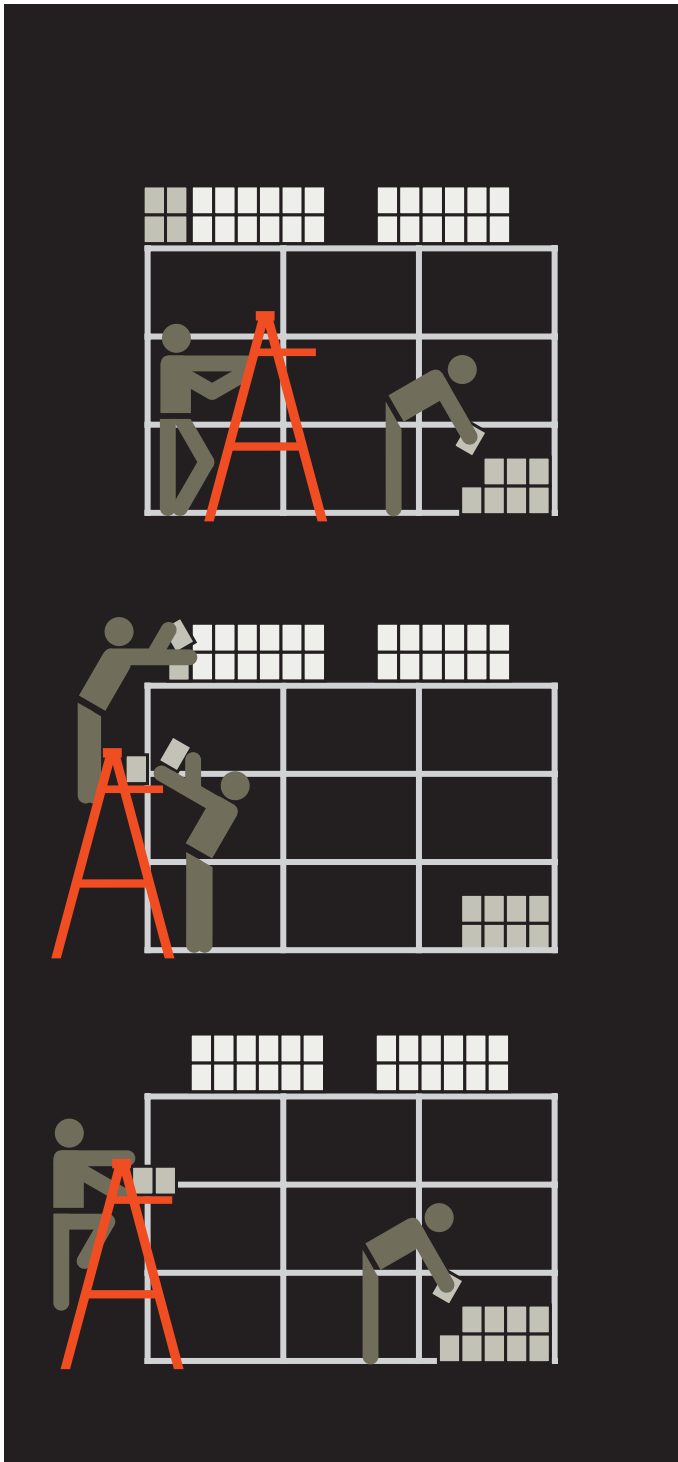
Each task was performed twice by each participant — once using the traditional manual method of the individual's choice, and once while using the vehicle. Although each task was “staged” so that it could be measured in real time, each was representative of an actual and frequently performed class of tasks performed many times in the course of a shift. The four tasks were:



Task 1:

Stock/Unstock Paint.

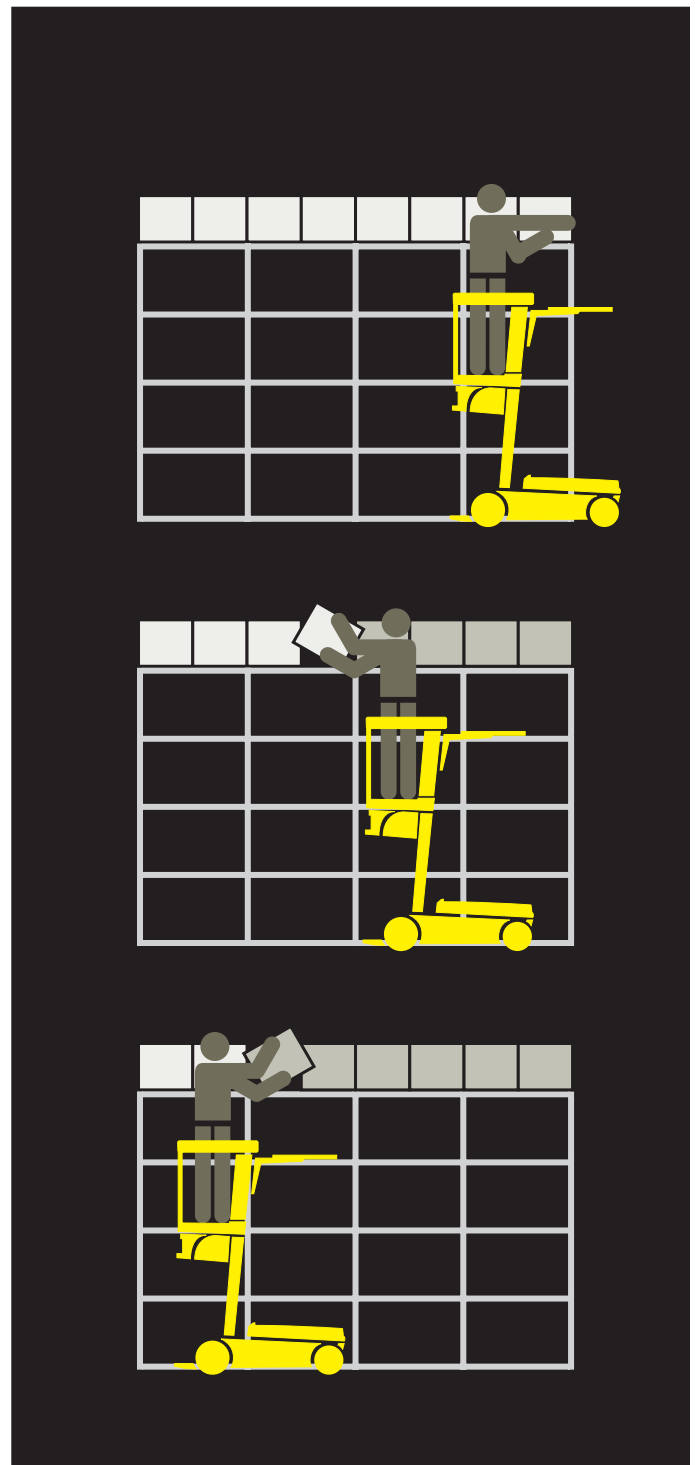
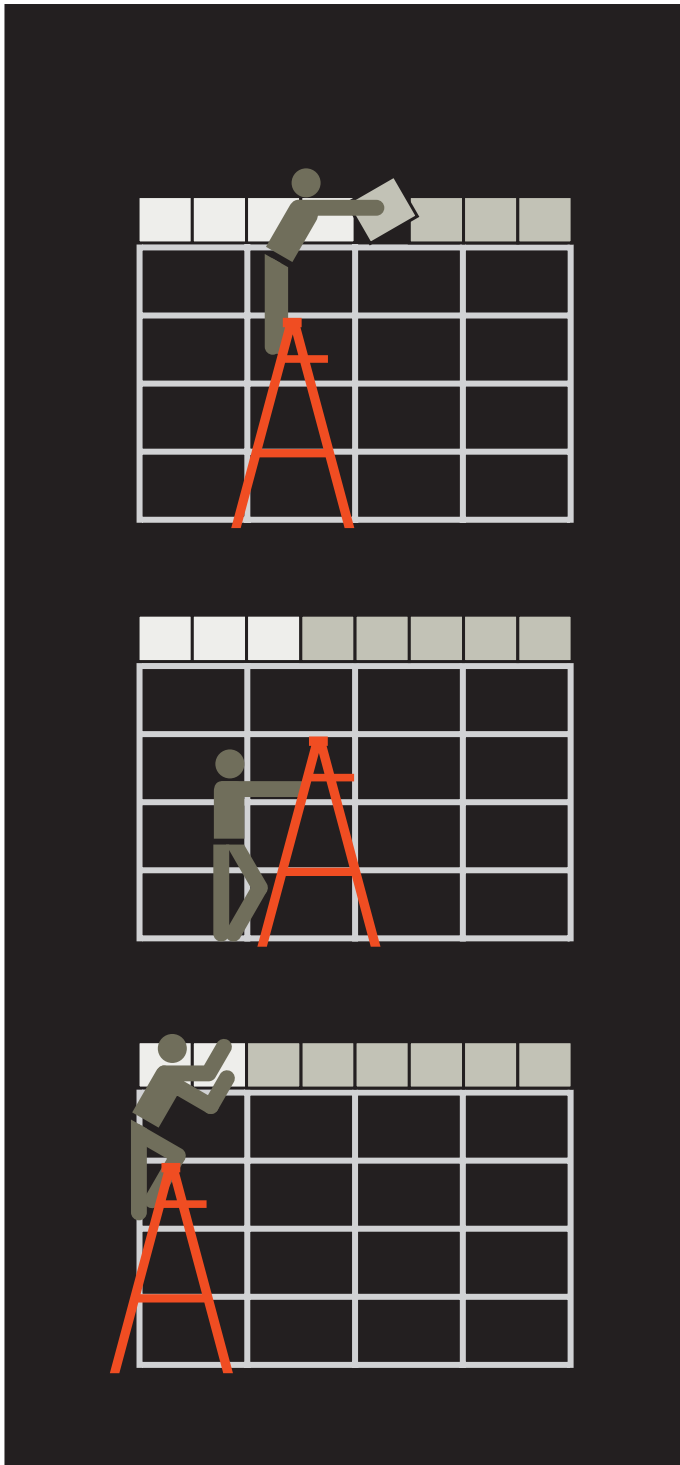
This task required each participant to stock a top shelf (94 in. high) with 12 1-gallon cans of paint initially sitting on the floor, and, conversely, lower 12 1-gallon cans of paint from the shelf to the floor. The 12 cans of paint were stacked two-high in a line on the floor opposite the shelf on which they were to be placed. The participant stacked the cans on the shelf in three groups of four separated by 6 ft., face-out and two-high, to represent the replenishment of three different colors/types of heavy items separated by a few feet. Twenty individuals performed this task.



Task 2:

Stock/Unstock Large Boxed Items.

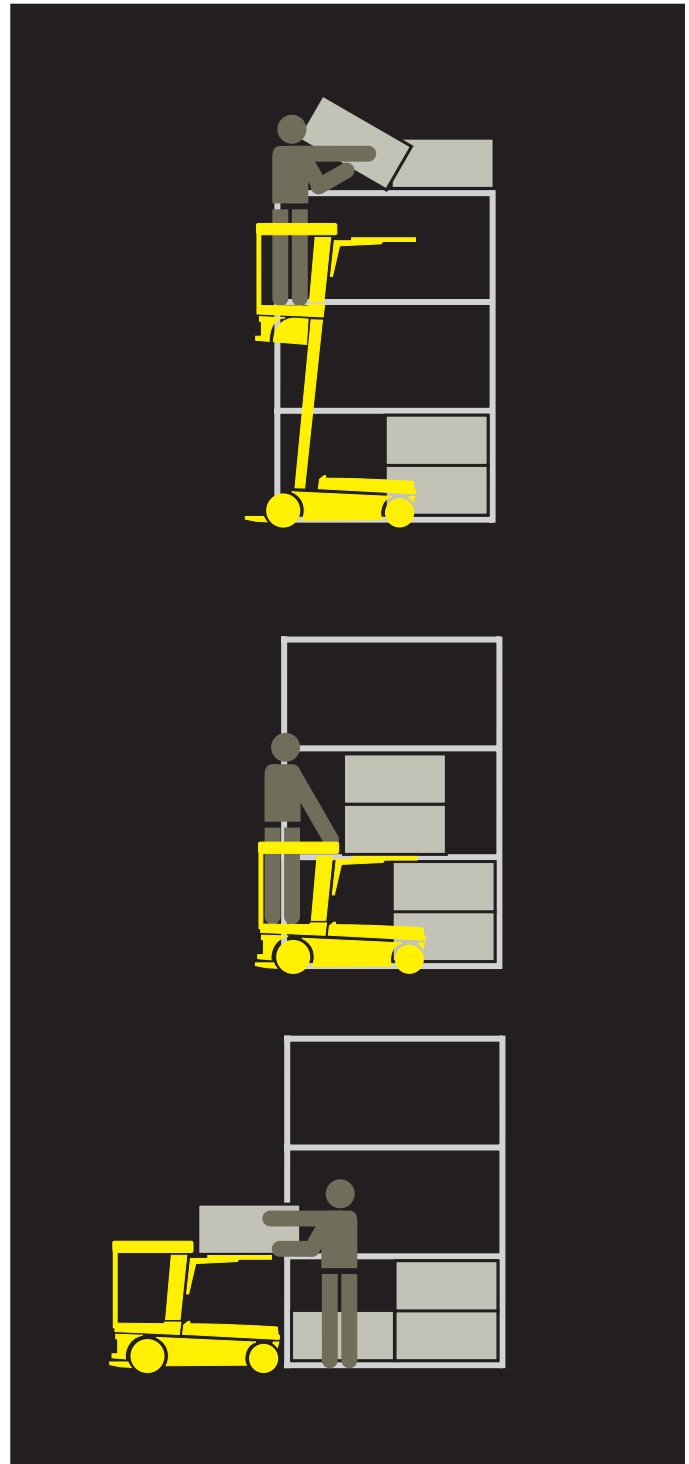
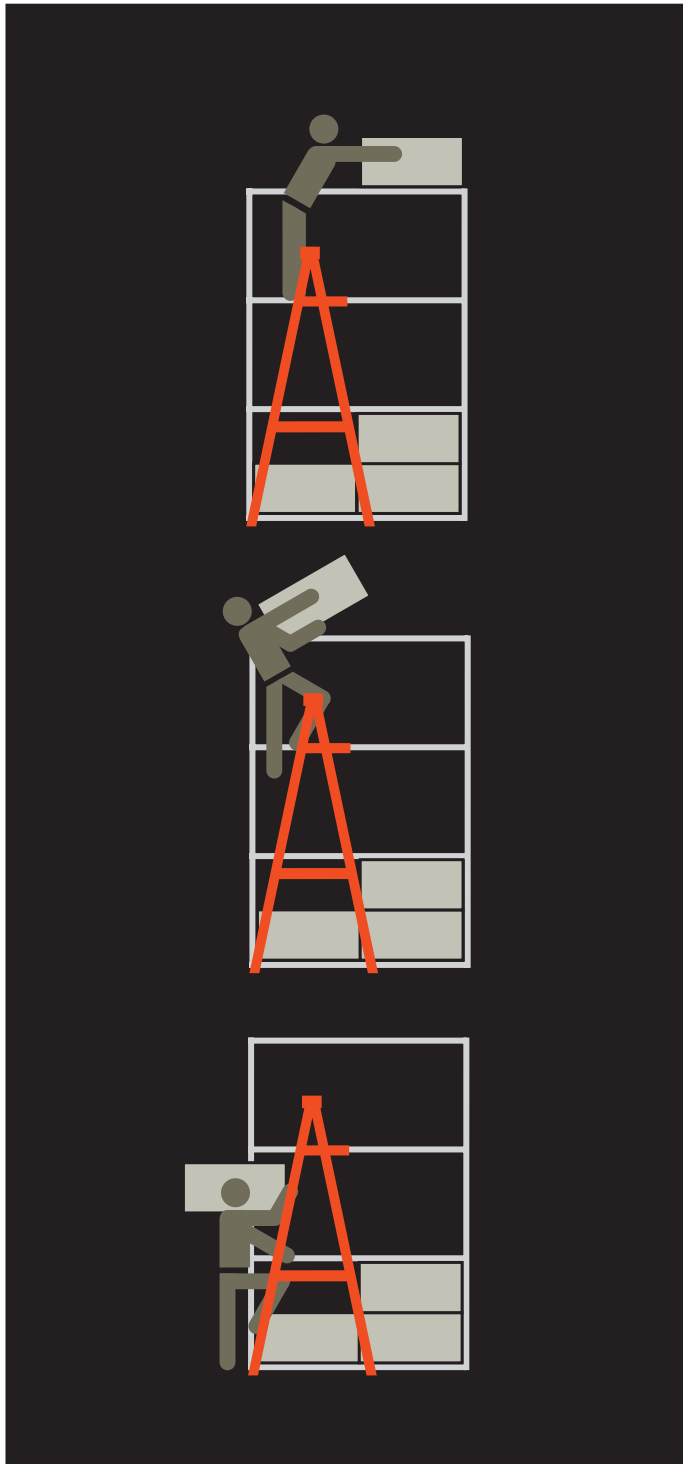
This task required each participant to lower four large boxes (30 x 14 x 14 in.), each of which contained a ride-in toy truck, from a high level and to make two adjacent stacks of the items at floor level for customer access. The boxes were all located initially at a height of 123 inches. The task was also performed in reverse. This job was representative of many tasks in which large and bulky items are brought down to customer level, or, during stocking, put up to a higher level in an attractive display. Twenty individuals performed this task.



Task 3:

Facing an Elevated Display.

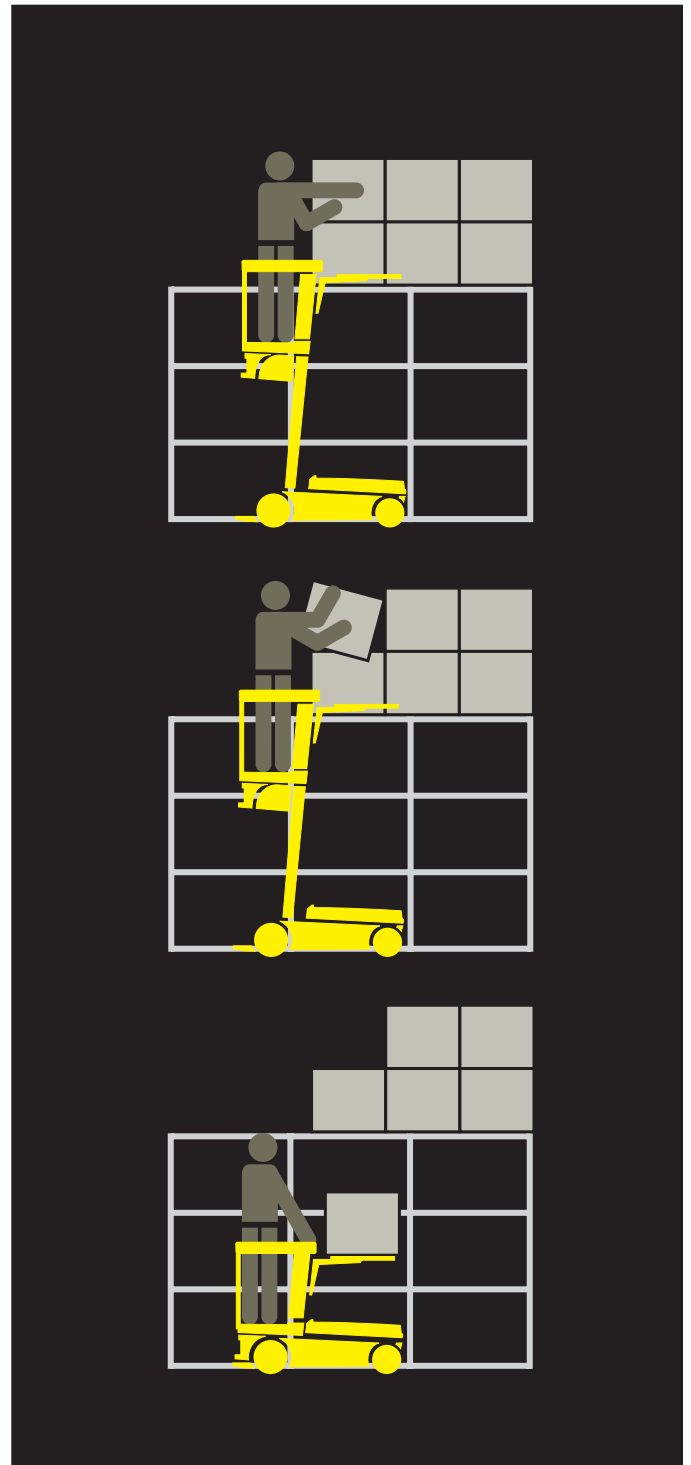
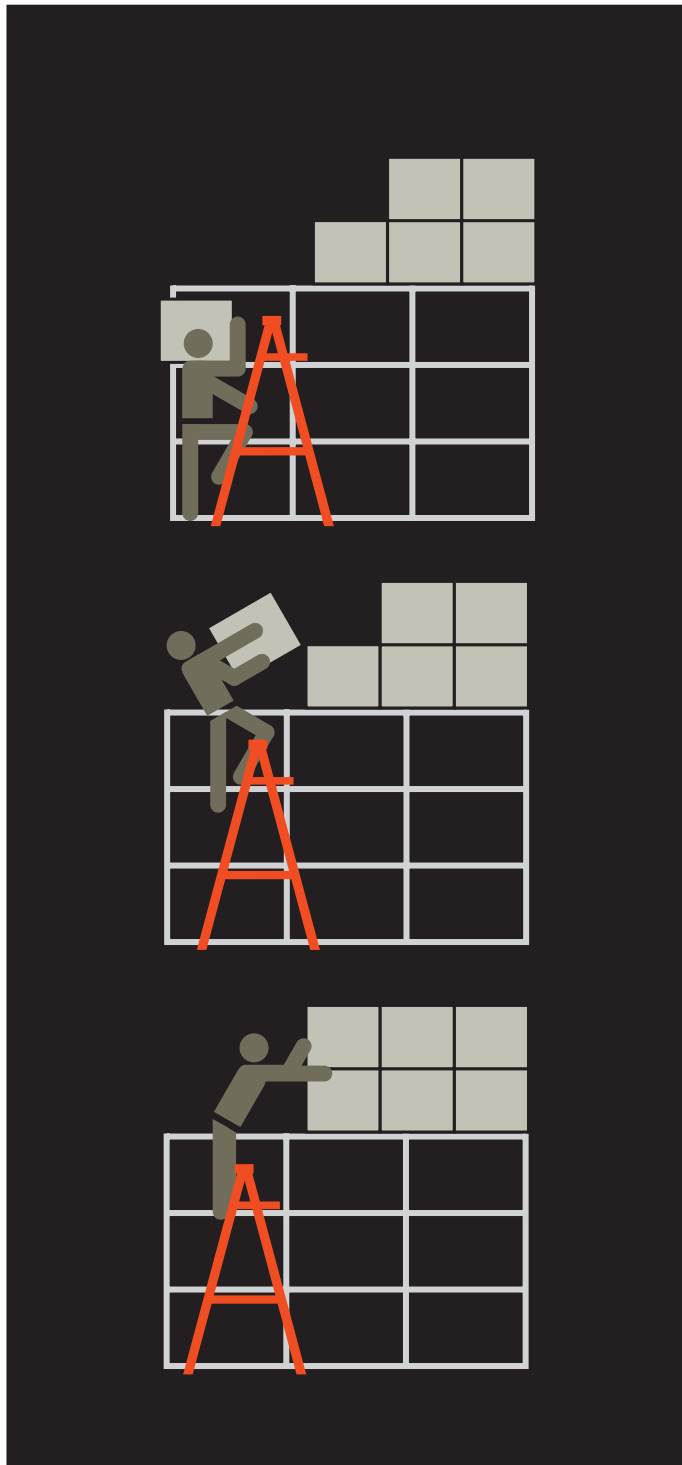
This task was representative of many tasks in which products on a shelf are straightened or rearranged. The participant had to lift and turn each of 24 plastic coolers 180 degrees so that the back side, rather than the front side, faced outward, with the resulting line of products being attractive and orderly. The row of coolers was 36 ft. long and atop a 94 inch-high shelf. The cooler handles were 110 inches above the floor. Twenty individuals performed this task.



Task 4:

Stocking a Large Television.

This task was representative of many in which a large, heavy, and possibly expensive and fragile item is moved at height or to a height. The task began with five 19 in. televisions on a 7 foot rack in a specific arrangement and one television on the ground nearby. The participant's task was to first move television "A" over to the empty spot, then move television "F" from ground level up to the new empty spot, just as would occur when stocking same-brand products together to create an attractive and logical display during restocking. This process was also studied in reverse. Nine individuals (all physically capable department managers) performed this task.



Performance Measures.

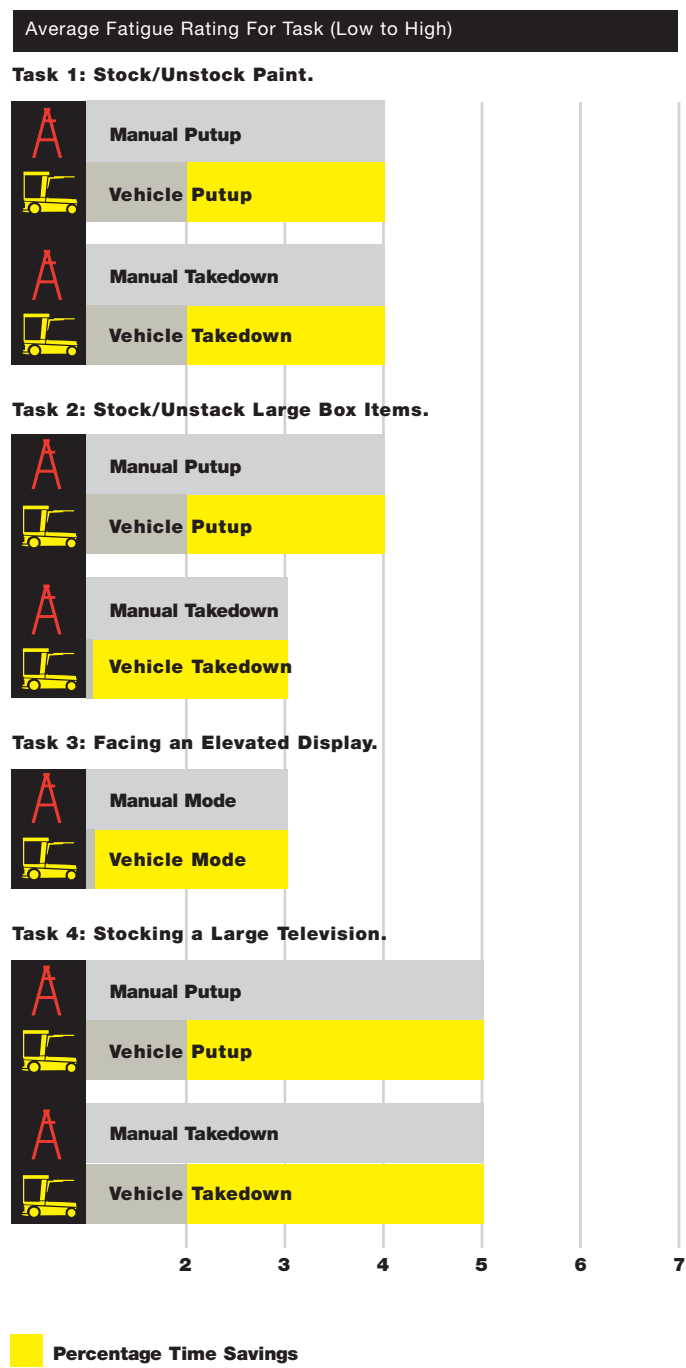
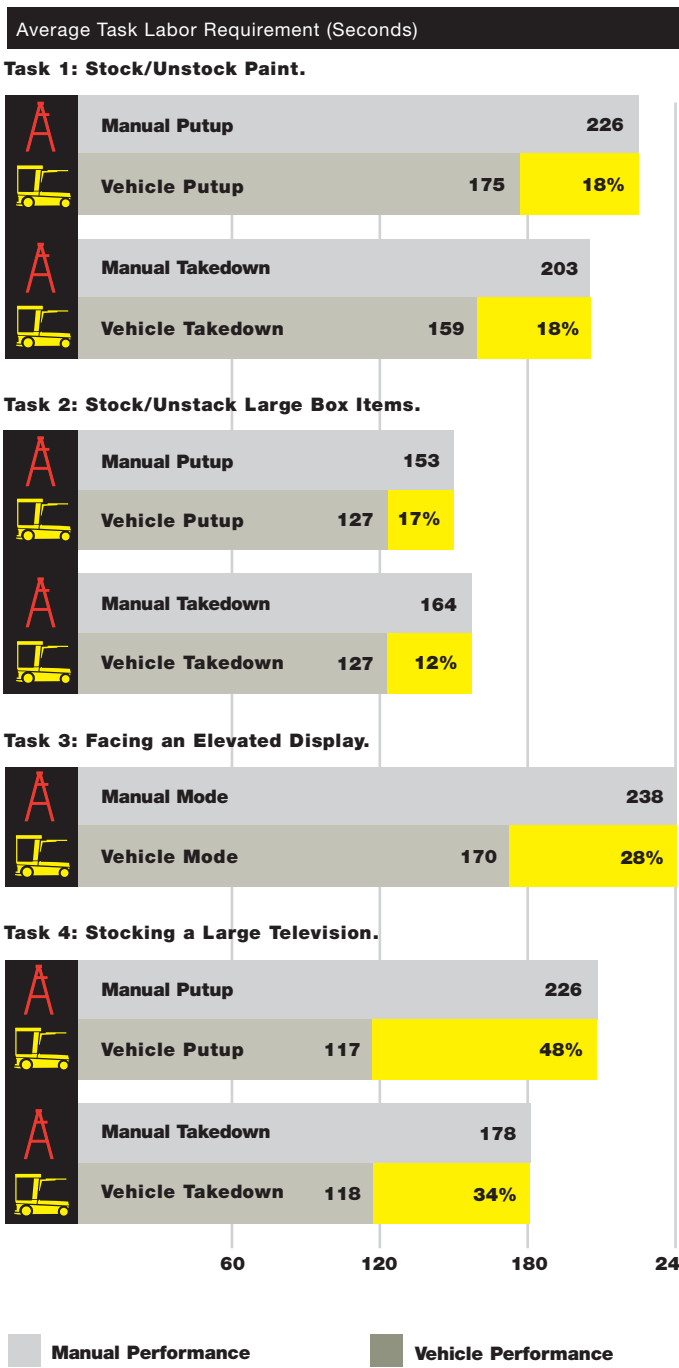
Performance on each of the four tasks was measured by trained observers using worksheets and stopwatches. Each participant was brought to the aisle where the task was set up, given an explanation, instructed to work at his or her typical and comfortable speed, and then asked to perform the task in either the “manual mode” (using his/her current standard methods) or the “vehicle mode” (with vehicle). A subjective fatigue rating (from a 7-point scale) was obtained after performing each task in each mode.

All performance measures were measures of labor time. Some participants required the assistance of another store employee when tasks were performed manually; accordingly, the time spent acquiring another employee, as well as that individual’s labor time, were included as part of the total measure of labor cost. Ladders were provided for use when tasks were performed manually.

The order of tasks, as well as the order in which tasks were performed manually or with the vehicle, were counterbalanced across participants. Each participant had previously received 45 minutes of basic instruction on the operation of the vehicle (a separate vehicle in another room) prior to performing the tasks.

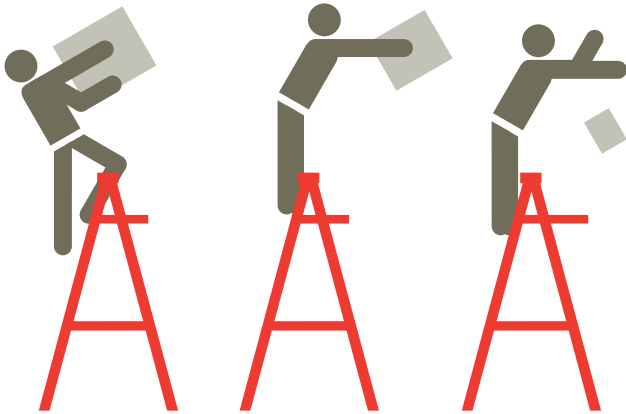
Results

The following two charts summarize the results for each of the tasks, each of which was performed in the “manual mode” and in the “vehicle mode.” The figure to the right shows the average total labor required to perform each of the tasks. The figure on the next page shows the average fatigue rating for each task for each mode. In every single case the labor requirement was lower for the “vehicle mode” than for the “manual mode,” and in every single case the “vehicle mode” was rated as being less fatiguing than the “manual mode.” The average labor savings for all of these tasks is slightly over 25 percent; the actual labor savings within a store would reflect the frequency with which these and related tasks are performed relative to all tasks that are performed. Each of these paired comparisons is statistically significant beyond the .05 level of significance (standard “t” tests for the measures of labor; appropriate nonparametric statistical techniques for the fatigue ratings). These results can therefore be considered as being highly meaningful and highly reliable.



Conclusion and Discussion

Performance is usually best when there is an appropriate match between the task to be performed and the tools used to perform the task. It is apparent that the tool used in these four tasks — the Wave vehicle — is very well suited to the requirements of these tasks, and results in the tasks being performed with significantly less labor and with considerably less effort, even with the highly limited levels of vehicle experience seen in this study.



This study did not focus specifically on health or safety issues associated with the two modes of task performance. However, it is worth noting that while performing tasks manually with ladders, some subjects dropped objects unintentionally from height, and a few subjects performed tasks, such as carrying a large television up a ladder without help from another individual, in ways that might be considered as unsound. Similar situations did not occur when subjects performed the tasks using the Wave vehicle.

Just as a bicycle would be a logical vehicle for traveling a few blocks down the street — but not for going down a flight of stairs — the tasks examined in this study were selected because they matched the intended functions of the tool — which in this case was the Wave vehicle or standard ladders, carts, and sometimes another individual. Obviously, many tasks performed throughout a shift by many employees (eg., stocking from ground level, walking down the aisle, quickly retrieving a few items just out of arms reach with the aid of a nearby step ladder, walking with a customer to a product, etc., etc.) would be performed more quickly as they are performed today than they could be performed with a powered vehicle. On the other hand, there are many tasks like those examined here, for which the vehicle is very well suited based on the observed performance advantages. The performance advantages within the total store environment may be considerable given the task completion times seen in this study, the very low level of training (on the vehicle) of the participants, and the high rate at which similar tasks appear to be performed, to say nothing of the presumed safety and physiological benefits.

