TEXAS STATE UNIVERSITY

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I3 Design and Implementation of Parts Transportation Cart to Improve Process Efficiency

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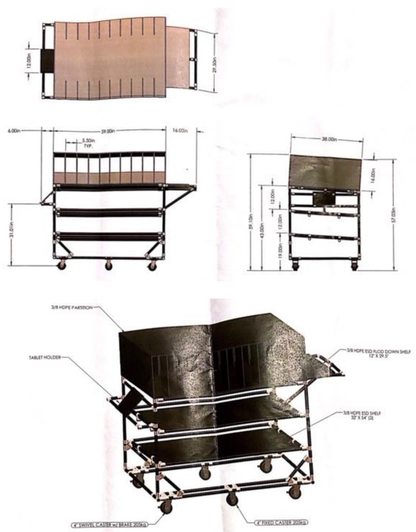
signify

Abstract

The purpose of this project is to reduce processing time through transportation of parts by building an efficient cart. The project methods used involve ergonomics for the development of the new design and time studies for the evaluation of the improvement of flow time. The project describes how through the use of different materials and cart design the reconstruction of the cart can produce the desired results. The goal was to focus on a design that was light, easy to move, and flexible in its design. The deliverables of our project were to produce a cart able to hold 40 housing parts and maintain ergonomic principles. A detailed evaluation of design and future options to improve the cart are provided within the study. The new cart can be used in a more efficient manner than its original design.



AutoCAD images of original cart design made by Signify that we redesigned. (Above and below)

Introduction / Background

- Signify Co. is a major LED lighting company responsible for providing a wide variety of light fixtures
- Average time for each order was beyond the desirable timeframe so Signify wants to reduce this period
- Analyzing data allowed us to conclude that the most time was wasted transferring parts from paint line to assembly line
- One employee takes an order from paint assembly and manually moves the loaded pallet throughout the process until it is ready to be assembled using a lot of extra labor and time
- The solution would be to design a cart that will reduce the amount of time on each order and also reduce employee labor
- A cart focusing on Signify's 3 Pillars of Sustainability: Economic, Environmental, and Social Responsibility
- We will also focus on making sure our cart is ergonomically friendly, cost efficient, and versatile

Methodology

The methods we used to design and evaluate our transportation cart entailed the values of ergonomic factors, the amount of housing parts able to be carried, and the overall cart weight.

Our team used ergonomics as one of our criteria to improve the transportation cart. We planned to maintain different aspects of the cart, such as the height and placement of the handle, in order keep the cart safe for the worker to maneuver. We also ensured that each level of the cart qualifies with NIOSH lifting standards in order for the operator to safely load and unload the parts.

Above shows operator placing housings on new design.

We designed our cart to be able to safely hold and secure our goal of 40 housing parts. Each of these housing parts weighs roughly 11.4 pounds each, therefore it is essential to the vitality of our project that we are able to design a cart that is both strong and sturdy.

In addition to creating a stronger cart, one of our goals is to reduce the weight of the overall cart by both removing unnecessary parts as well as substituting materials in different areas. The cart currently uses Trilogic materials that, while sturdy, are heavy and lead to a difficult experience for the operator.

Design of Experiments

In the design of experiment one input was an ergonomic standpoint to the operator/loader of the cart. The average weight of a part was 10 pounds and the maximum weight was 11.4 pounds(weight of one housing casting). The loader would pick a piece from inside a pallet and then place it into either the middle or top level on the cart next to it. The top and middle layer of the cart have both a lifting index below one from NIOSH calculations. In the table to the right each recommended weight limit(RWL) are above 11.4 pounds, showing the safety of the lift.

Origin	Destination									
	LC	DM	HM	VM	AM	FM	CM		RWL	LI
Pallet to	51	1	0.83	0.85	1	0.45	0.95		15.4	0.6
Top	51	1	0.83	0.93	0.71	0.45	0.95		11.9	0.8
Pallet to	51	0.9	0.83	0.85	1	0.45	0.95		13.8	0.7
Middle	51	0.9	0.83	0.99	0.71	0.45	1		12.1	0.8

The table above shows NIOSH calculation on lifting index, as well as the recommended weight limit and proves that the process is safe for the operator.

One very important implementation to the new cart is the netting. The netting was introduced in the design to replace the trilogic pallet. The netting is much lighter and cheaper then the trilogic and therefore a better choice. The netting on the top level needs to extend across the top level and replace all the trilogic panels in the future, and be secured to strengthen the load. Each netted section on the top level needs to be able to support 120 pounds(10 housing pieces).

On average about 150 housing units a day are produced from this location. In this case with an average of 15 units for the original cart, our cart can hold up to forty pieces. The new design will lower the amount of carts used by more than fifty percent in the facility.

The picture to the right shows a clear view of the different layers and how the netting replaced the trilogic composite.

Conclusions and Future Work

Conclusions:

- New cart is about 40 pounds lighter from switching to netting and taking off the box from the original top design.
- With NIOSH calculations in lifting, both the middle and the top shelf have a lifting index of 0.8, which is less than one and therefore what we want.
- With the extension of 7 inches in length to the cart, its size would permit the allowance 40 housing pieces to be transported at one time.
- Input of pockets gives more available space for smaller products while still being able to the level for bigger products.
- Total production of the housing per day is about 150 units, with the new cart we can go from 10 to 4 carts for this order.
- Being able to take the top off when not needed greatly reduces the weight of the cart and opens the top level for part placement.
- The new carts bottom level is a place to transport cardboard/boxes with an order.

Future Work:

- Install a step at one end of cart.
- Install a flag pole for soft mode.
- Increase the angle by 3% in middle layer.
- Install handle to other end for operator.
- Install a tablet sleeve and a scan gun holder to the handle.
- Install wall protection to top layer for protection and security in movement.
- Stitch in the fabric across to replace Velcro and make a tighter stronger hold. Do this to the whole top level.

Summary of Results

- We stripped our cart of the heavy top layer made from trilogic and wood, and the middle panel was moved to the bottom.
- Heavy material was replaced by light netting greatly reducing the weight of the cart.
- When the cart is extended by 7 inches and the netting is put in, then it will be able to sustain 4 rows of 5 units on both the top and middle layers of the cart for one order.
- With 150 units processed a day, it takes about ten carts to get this done. The new design can use 4 carts and hold 160 units, this in turn reduced the amount of time the operator takes walking between orders for carts.
- The bottom level is a panel for space to place cardboard to transport with its orders. The middle layer now has a pocket to place smaller components along with larger ones to keep orders together.
- The ergonomic design of the cart and its heights comply with a safe lifting index. The operators will not strain themselves when loading the cart.
- These results of the new updates to the cart are that it can hold more product while being lighter and the netting is much cheaper then the trilogic as well.
- The cart will now hold the right quantity of units for orders and help the operator due his job safely and efficiently.

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