Executive Summary

Plasticraft is a manufacturer of molded plastic taxi top lights, made for the purpose of wholesale distribution to commercial taxi companies. The current owners purchased the company in September of 2003 following a long period of declining sales. The new owners feel that by minimizing costs and offering they're product at a competitive price point they can resurface as a top competitor in the molded taxi light market. Although small, the profit potential of this market is impressive, due to the lack of serious competition and rise in demand for public transportation.

Our report will outline the production operations of Plasticraft to identify areas that they are performing well and those that we feel could be improved. The focal point of our report will be the production times of the various workstations and recommendations for the possible reduction of those times. We will also address inventory management, from raw materials to WIP, and finally finished goods. The lay-out of the production facility will be analyzed to determine areas that create waste and recommendations for its subsequent elimination. We will conclude our report with recommendations for the future strategy of Plasticraft with regards to technological innovation, waste elimination and overall operational efficiency.

Company Overview

Plasticraft manufactures the plastic lights commonly seen adorning the top of Taxi Cabs in major cities across the globe. The Company was started in 1954 as the only supplier of plastic taxi-cab lights in the *world*. With an international customer base, it wasn't long before competition emerged overseas. Shipping costs made it difficult to compete with European suppliers so Plasticraft has since focused its attention on domestic customers.

Operations Strategy

Plasticraft operates a low cost production facility. The emphasis on cost minimization was apparent from our first visit to the production site. At the time of our first visit to the production facility there were no customer orders being produced, this contributed to the condition of the shop floor which was clean with minimal debris strewn about the work areas. Raw materials are stored neatly in racks on one side of the building and there were zero WIP or finished goods inventory in the facility.

The high degree of visibility through out the facility contributes to Plasticrafts JIT philosophy.

Since the company changed ownership, re-ordering raw materials hadn't been necessary because the previous owner had stockpiled to take advantage of economies of scale with regards to ordering and shipping costs. As we prepared our report management was in the process of contacting suppliers to create supplier relationships that would be structured to best serve the end customer. To do this Plasticraft management set some expectations that the previous owner had not. First, raw material lead time needed to be reduced by ½ or from 2 to 1 week. This will allow Plasticraft a higher degree of responsiveness with respect to changes in customer demand. It also aligns with they're strategy of minimizing costs by not over ordering and ending up with an abundance of obsolete raw materials.

The elimination of waste is also a key part of the Plasticraft strategy. Management attempts to identify waste in all areas of the production process because they feel that in order to minimize they first need to identify. We will go farther into this discussion in the JIT section of this report. By focusing on cost minimization Plasticraft positions its-self ahead of the competition, which is evident in a price comparison. It is possible that the competition is selling at an extremely high margin, but because we do not know the competitions cost structure we cannot report with a high degree of certainty the reason behind the approximate 30% price difference.

Products

Product offerings at Plasticraft consist of five unique taxi lights. The uniqueness of the products is in their design. The size, shape, and style differ depending on the model. Most taxi companies use consistent models across their fleet, and others maintain consistency among geographic area. In this scenario all taxis in the Seattle area may have the same model while taxis from the same company in Orlando may use another model. Three of the lights are available with optional lenses, which are amber in color and mount to the top of the light. All five of the models are available with optional custom vinyl lettering. Detailing the lights with custom lettering is labor intensive therefore Plasticraft cannot sell the lights at a high enough price to maintain margins with the increased labor costs. Plasticraft management is willing to give the customer a 10% discount if they supply and install their own lettering.

Customers

Plasticraft's customer base includes major taxi cab companies across the country and into Canada. Yellow Cab is currently the highest volume customer. A long time client, Yellow Cab places frequent orders for local and national branches. Far West also purchases most of they're lights from Plasticraft. There are a number of smaller accounts but none purchase with the frequency or the volume of Yellow or Far West. Plasticraft has serviced these accounts for years and has not signed on any new customers since the sale in September of 2003.

Part of Plasticrafts business strategy is to seek out new customers and build a substantial base of clientele. They also plan to identify the competition and wage a competitive war on the national level to grow they're share of the taxi light market. By offering they're products at 30% below the competition Plasticraft is confident that they can win customers over as long as they can get they're product in front of the consumer when they are ready to purchase. The four P's are evident in Plasticrafts strategy, competitive Price, the right Product in the right Place, and Promotion. Currently the two promotions Plasticraft offers are 10% price reductions for either ordering lights without lettering, or placing orders of 20 or more units. Other promotions may follow but management is focusing their attention on other areas of the business for the near future.

Competition

There are currently four major competitors in the taxi-light market with-in the United States and a few--north of the border--in Canada. Plasticraft's price point is approximately 30% below the competition on comparable products, but they lack the marketing campaign to reach all potential clients. The Canadian competition primarily markets its product to Canadian customers but has recently begum marketing to northern states within the U.S. The internet is the choice storefront for this market due to its ability to reach a greater number of customers via e-commerce. The new owners of Plasticraft are currently designing a web page to drive sales in this consumer rich environment. The new web page will allow consumers to browse the product line and place orders directly from the manufacturer.

Operational Practices

The following section of our report will outline areas that the company is performing well and will follow with areas of potential improvement. Management was kind enough to allow our team to make multiple trips to the facility to observe operations to better understand the internal workings of the company.

Areas of Exemplary Performance

Just-In-Time Manufacturing

When the new owners took control of operations they implemented a form of Just In Time manufacturing. It is important to mention that Plasticrafts JIT system is relatively simple in comparison to some of the larger operations like GM, Ford, and Boeing. Plasticraft has adapted some key principles of JIT that have significantly impacted the organization at all levels. Although management has not studied or trained in the principles of JIT, some of the key concepts were apparent at the facility.

Management is of the mind-set to keep things simple because complexity breeds confusion. Visibility is also a primary concern with respect to raw materials for the purpose of identifying the proper time to place an order. With out knowing it management also practices continuous improvement, constantly looking for better, more efficient ways to conduct business. And finally waste minimization, or the elimination of muda, a term that management was not familiar with until our visit to the facility.

Waste elimination is a key principle at Plasticraft, which was evident when we visited the facility. Raw materials are an excellent example of this. When cutting the material for the lights from large sheets of plastic the excess is used for the smaller lights. Less than 2% of the sheet plastic that is used to form the light is wasted. Not only does this minimize the cost of raw materials it also helps the reduction of discarded waste into the environment. Plasticraft is an environmentally conscious company and they strive to reduce, reuse, and recycle.

Plasticraft only produces lights to meet customer orders. They call this a "Pull ordering system." When an order is received production begins and only enough lights are produced to meet that order. This system helps to minimize the amount of finished goods inventory held at the facility at any one time. Management informed us that the reason for this was to keep the company competitive. They wanted to be able to respond to changes in customer demand with out holding finished goods that may become obsolete.

They never know when a customer will change the style of the light they are using on their taxis and when they change they rarely go back to a previous model, unless another geographic area is still using the old model. Plasticraft has noticed a trend in its customers of switching models by area, probably to reduce the one time cost of the change. It is more cost effective for the customer to replace part of the lights rather than the entire fleet at once and for consistency reasons customers tend to prefer that all taxi cabs in a particular market have the same light.

Inventory Management

Inventory control is a top priority at Plasticraft in all phases of the production process. Raw materials are stored in a highly visible shelving area to easily identify the re-order point and in close proximity to the cutting station. At the time of our study Plasticraft was still using the abundance of raw materials that had been purchased by the previous owner. This made it difficult to identify the concepts of control that will be used by the current owners. As we mentioned before management is in the process of building relationships with suppliers to reduce the amount of raw materials that are stored at the facility. To do this they will need to reduce the lead-time associated with placing and receiving an order of raw materials.

Continuing our discussion of inventory management we will now focus on work-in-process. Plasticraft minimizes WIP by producing in batch sizes of only 10 units. The batch starts at the cut station and moves through the various work-stations to assembly, and finally packaging. Completed orders are shipped out to the customer prior to starting a new batch. By limiting the batch size to just 10 units Plasticraft is able to hold no more than 10 units of WIP at any time in the facility. A batch size of just 10 units allows Plasticraft to maintain the flexibility necessary to meet changes in customer demand, with out holding partially finished goods that may then become waste if another customer does not place an order for the model being produced.

To round out our discussion of inventory management we will look at finished goods and how they impact the production process. Once the taxi lights are assembled they are moved to the packaging station where they are wrapped and packaged for shipment to the customer. Management believes that by shipping batches as they are finished and minimizing finished goods inventory they can reduce the amount of cash tied up in inventory. This idea is in line with the cost conscious approach that Plasticraft takes to its operations. Now that we have taken an in-depth look at areas that Plasticraft is performing well we will focus our attention on possible areas of improvement.

Identifying Areas of Improvement

In order to understand the multiple steps associated with producing a taxi light we studied the various work-stations and they're consequent value adding characteristics. In our analysis we focused on the following key areas, Metal processing and Plastic processing. We recorded times at each of the work stations to help us define a precedence diagram that would include process times. We broke down our recording into task time, setup time and load time while also noting the batch size used. Load time represented an operation that happened for each product the operation was performed on and setup time was the time it took to ready the workstation for use. For one unit the task time would be added to the setup and load time. For ten units the task and load time would be multiplied by the batch size and then added to the setup time. By doing this we were able to see the advantages of either reducing or increasing batch sizes. See exhibit 1 for a summary of our findings.

Exhibit 1

Current Production Times

Plastic Work Stations	Task Time	Setup	load	Batch	Total	Min Sec	1 Unit
Table Saw-Cut materials	900	120	0	20	17.00		165
Oven-Heat materials	3900	720	45	10	84.50	84m 30s	1155
Press-Mold Materials	3000	10	45	10	57.67	57m 40s	355
Grinder-Shape & Bore							
Opt.1 Shape material	460	2	20	10	11.03	11m 2s	68
Opt.2 Bore light hole	550	0	4	10	9.83	9m 50s	59
Drill w/Plastic Drill Press	370	3	3	10	6.72	6m 43s	43
Optional-Glueing Lens Caps	630	10	5	10	11.50	14m 10s	78
Metal Work Stations							
Tape, Measure metal stock	900	40	0	50	15.67	15m 40s	58
Chop Saw-Cut metal stock	330	5	0	50	5.58	5m 35s	11.6
Drill Press-mounting holes							
Large Leg Hole	130	40	0	10	2.83	2m 50s	53
Small Leg Hole	110	40	0	10	2.50	2m 30s	51
Large Hole Light Bar	360	55	0	10	6.92	6m 55s	91
Small Hole Light Bar	140	55	0	10	3.25	3m 15s	69
Dis & Clean Light Bar	160	2	0	10	2.70	2m 42s	18
Dis & Clean Legs	150	2	0	10	2.53	2m 32s	17
Riveting Sockets to Bar	300	4	0	10	5.07	5m 4s	34
Bending Station	200	15	0	10	3.58	3m 35s	35
Optional-Riveting center post	300	20	0	10	5.33	5m 20s	50
Packaging							
Measure & Cut Bottom Seal	540	60	0	10	10.00		114
Bag Inner Components	180	60	0	10	4.00		78
Wrap & Box	1020	180	0	10	20.00		282
Lettering-Optional							
Software Input	1500	0	0	1	25.00		1500
Vinyl Cutting	1620	30	0	10	27.50	27m 30s	192
Weading-Remove excess vinyl	1620	30	0	10	27.50	27m 30s	192
Apply Application Tape	990	10	0	10	16.67	16m 40s	109
Apply Vinyl Lettering to light	5400	60	0	10	91.00		600
							1093
				Current State Total	**475.88**		

If setup or load times of a workstation were high special attention was placed on looking for ways to more efficiently handle the operation. This made it easy to identify wasted movement and possible procedural inefficiencies.

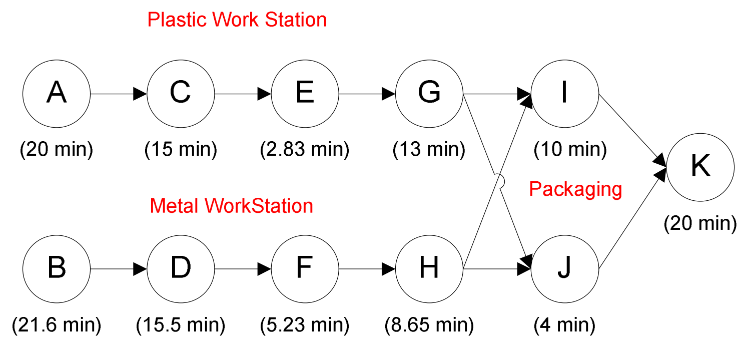
The Critical Path

We found the *Critical Path* to identify the “longest sequential path” [1]through the precedence diagram shown below.

Plastic Total: 56 min

Metal Total: 51 min

Packaging: 34 min



The critical path showed the area where improvements would actually shorten total production time for a single unit. An improvement in an area other than the critical path would not shorten the overall production time.

The Pacemaker Process

To identify the *Pace Maker Process* we created a product matrix (shown below) that identified product lines with similar end workstations and the longest product development times. By identifying the pace maker process we were able to identify the bottleneck product line that holds up production. We found that the product lines that included the optional lens caps determined the pace of production.

		Plastic Process						
		Cut Plastic	Heat Plastic	Vacuform Light	Shape Corners	Bore Light hole	Drill Mount hole	Glue Lens Cap
Products	19	x	x	x	x		x	
	400	x	x	x	x		x	
	500	x	x	x	x		x	
	600	x	x	x	x		x	
	25N	x	x	x	x		x	
	400L	x	x	x	x	x	x	x
	25NL	x	x	x	x	x	x	x
	19L	x	x	x	x	x	x	x

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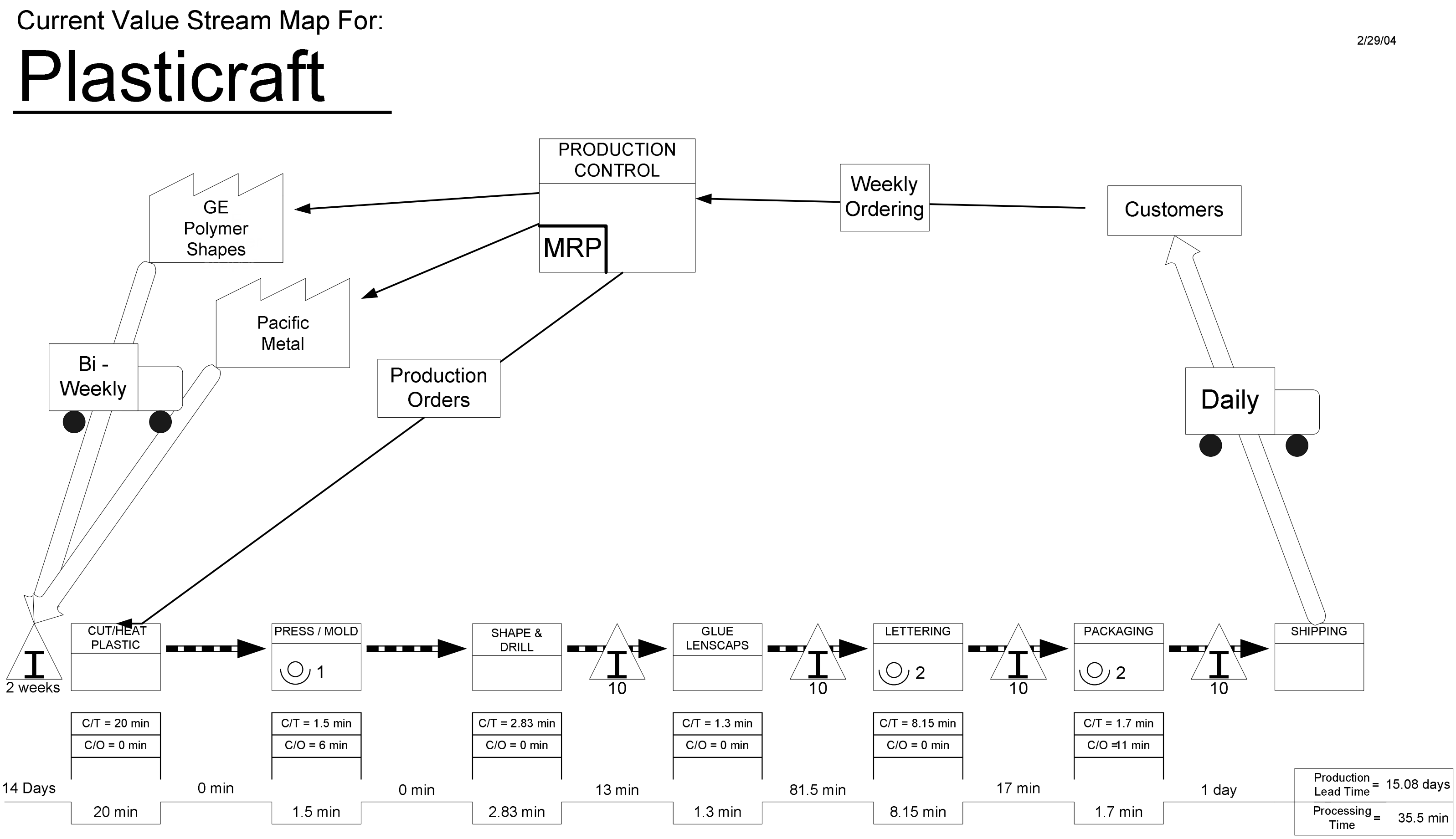
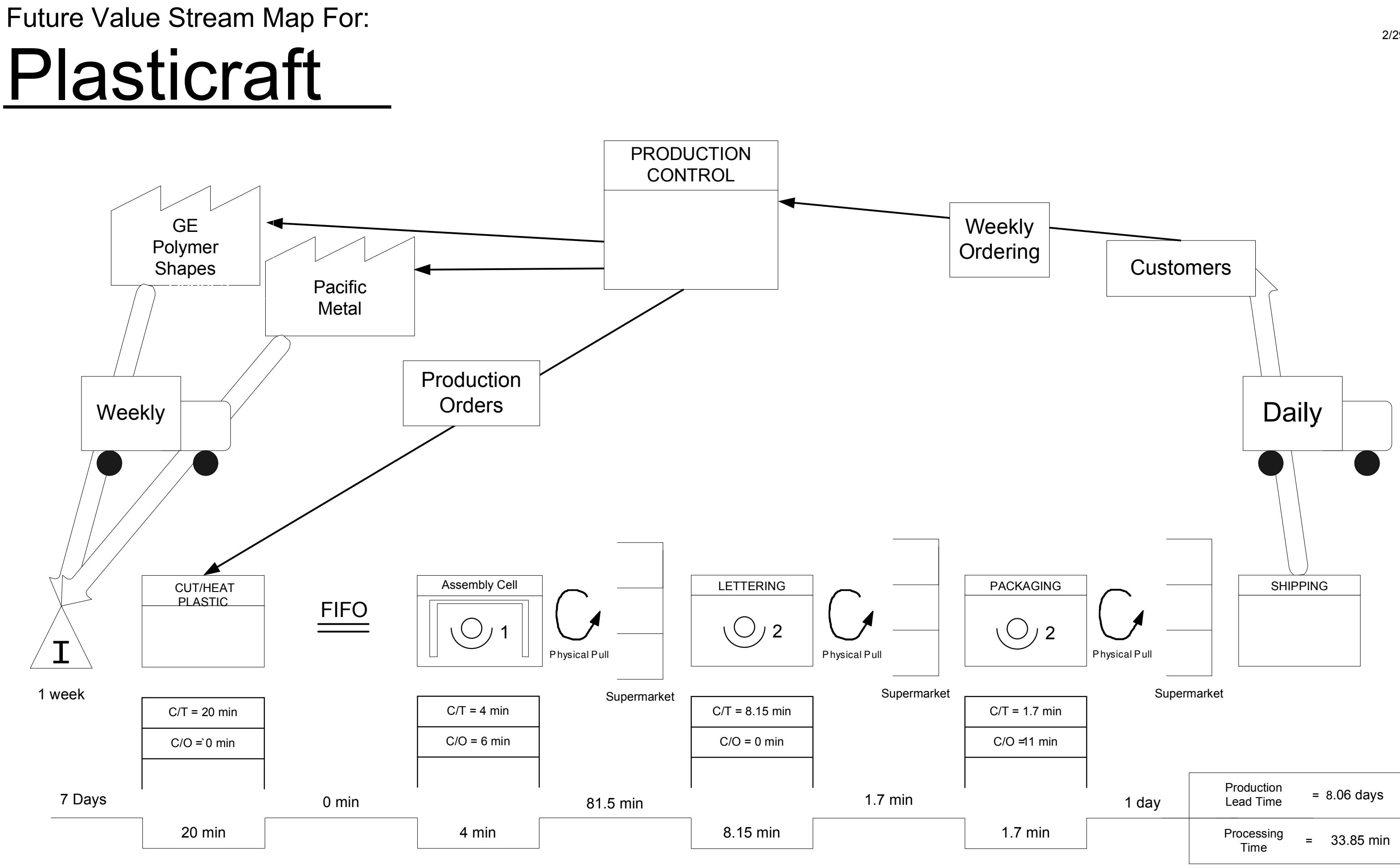
[1] “Operations Management,” Reid and Sanders (BBUS340 Ops Mgmt Text) Copyright 2002 John Wiley and Sons.

Value Stream Map

In the current value stream map you see the pacemaker product going through the plastic forming work stations. Inventory begins to build up in areas where a single product can not make it through the small assembly steps before the operator must go back to the oven and tend to the time critical heating and pressing operations. In the current state the operator is able to grind the corners of the light and drill the holes in the plastic but is not able to glue the lenses on before another light is ready to be taken out of the oven and put into the press. The lead time and initial raw materials inventory is quite large in this current value stream map.



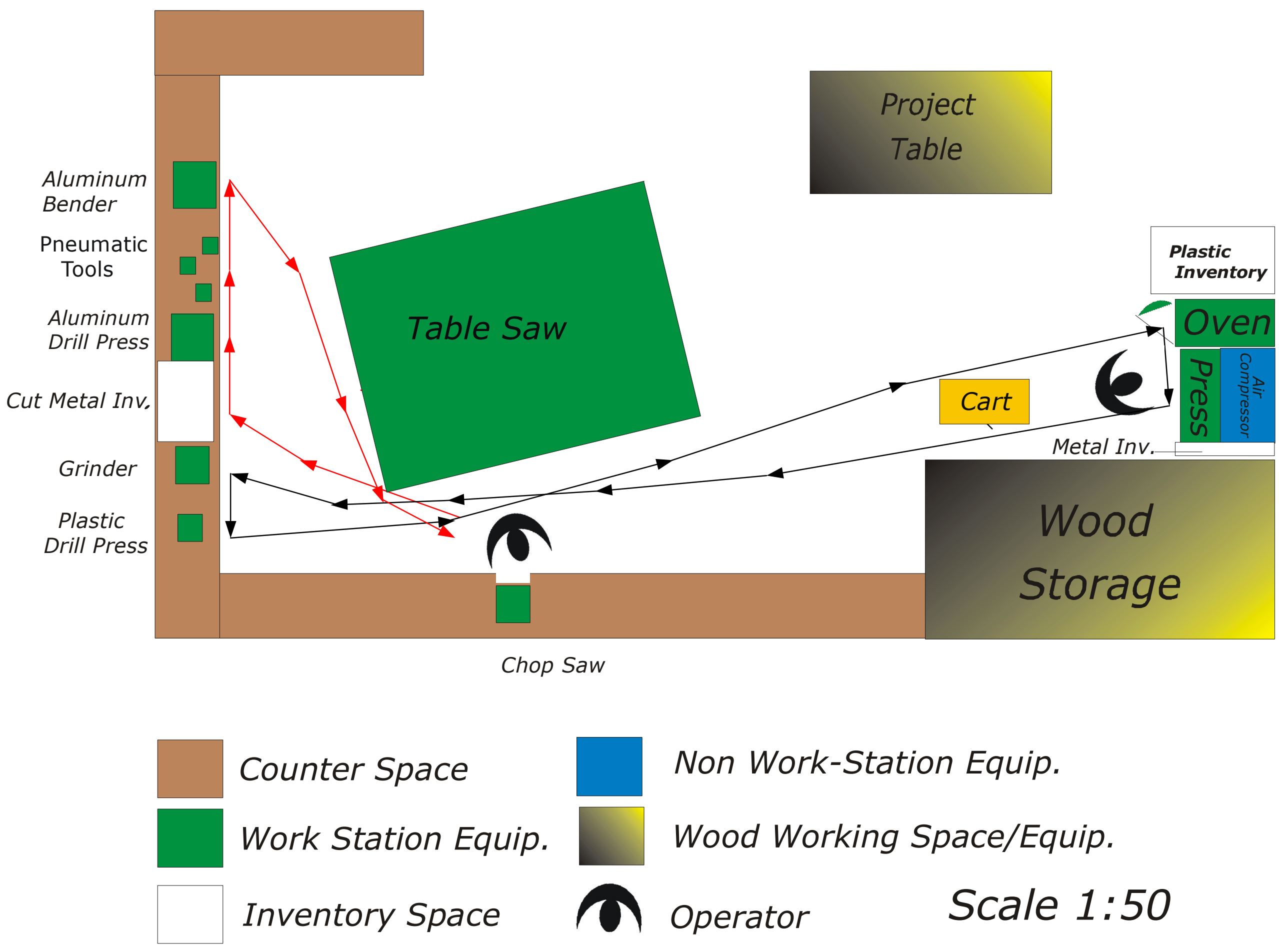
In the future value stream map we were able to combine all plastic processing workstations into a small assembly cell after the pressing of the light. This means that inventory no longer will build up at the work-stations associated with drilling and installing the lens caps. It was also suggested that lead times and beginning inventory levels be reduced to decrease on hand inventory.



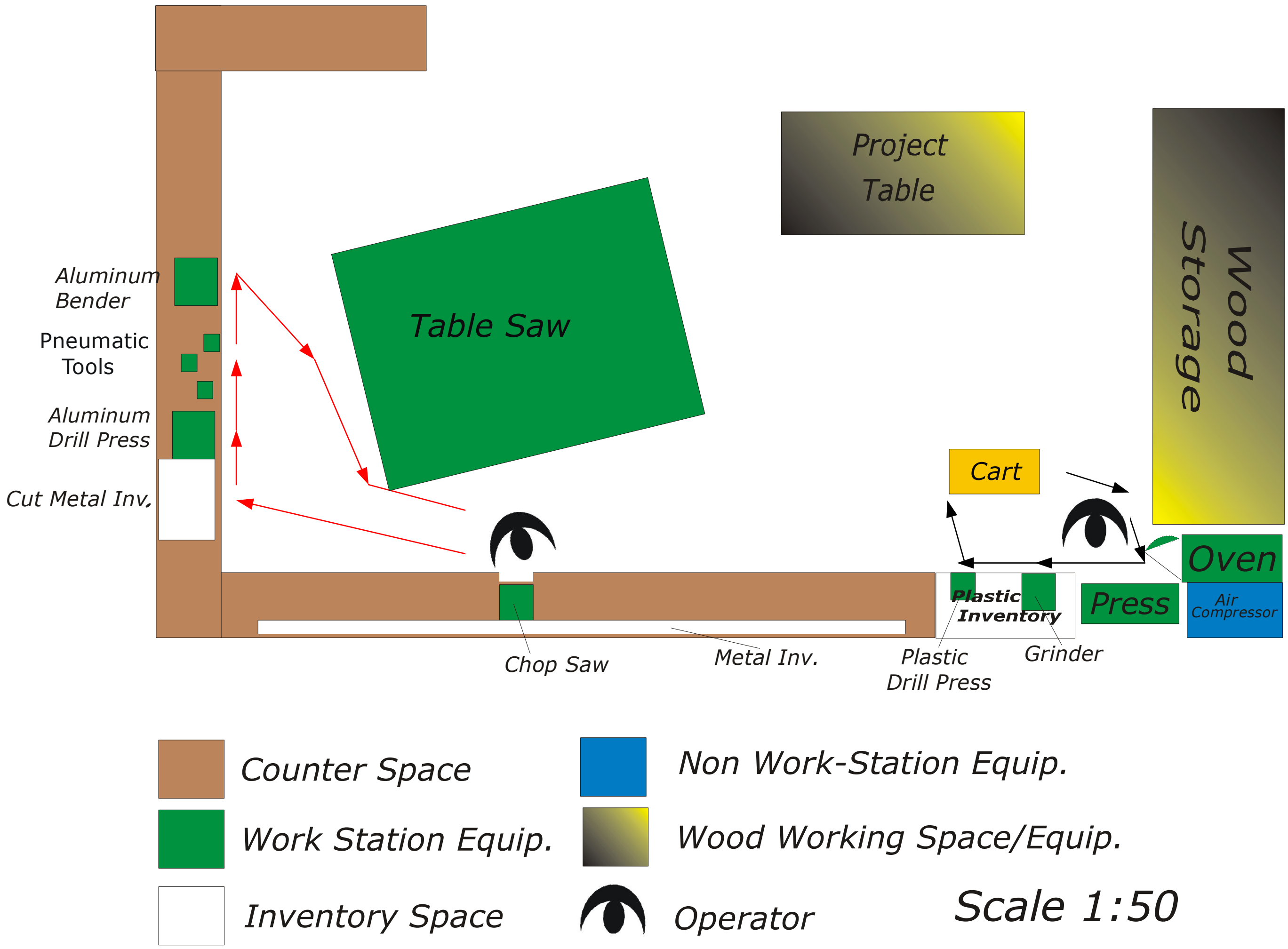
We were actually able to help Plasticraft realize the benefits of the plastic assembly cell by suggesting the moving of some key workstations and putting them into a small cell area. We were also able to implement a moving line system using a gorilla rack on wheels to hold the lights as various operations are performed on them. This will enable a moving line system which will allow the storing of glue and option lens caps as well as pre-cut plastic so that they are always available to the plastic operator.

Facility Layout

The existing facility layout has the plastic operator wasting a lot of movement by navigating the length of the facility to move materials from the press station to the grinder and drilling stations. The layout sketch shown below details the operators movements while performing these operations. There is excessive movement with the existing layout when compared to our recommendation.



As you can see from the movement arrows in the existing facility layout the operator must walk the WIP inventory across the facility to the grinder and press. Compare this to our recommended layout shown below to see the reduced walking distance of the operator.



In our recommended facility layout we moved the plastic drilling and grinding station across the facility to create a plastic production cell. The proximity of this cell to the oven and press contribute to the reduction in times associated with their activities. The production times were reduced enough to allow the operator to complete all necessary tasks in the four minutes it takes to heat the plastic before the operator must return to the oven to turn the material.

Recommendations for Future Strategy

For Plasticraft to be competitive in the world market which will soon be accessible through e-commerce, they will have to continuously improve operations to compete with more established competitors. Their cost conscious approach to operations has them in the drivers seat but they cannot get complacent, and areas that create waste will need to continue to be focal points for improvement. To maintain a competitive advantage, Plasticraft will have to continue to identify the critical path and pacemaker process in order to reduce the overall production time. We recommend a few key ideas that will help Plasticraft in their bid to regain the market share they previously held.

First we recommend a focus on decreasing the process times associated with the new critical path, the metal workstations. By implementing our recommendations the critical path changed from plastic to metal. Reducing the cycle times of the various metal stations should create a new critical path. It is crucial for Plasticraft to continually identify the critical path as improvements are made so that the focus of improvements are on areas that will reduce the overall production time of the taxi lights.

One way to reduce the production time of the metal process is to implement an automatic lubrication system at the metal drilling station. When drilling metal, lubrication is applied to reduce vibrations of the drill bit caused by friction. This vibration can cause the holes to become to large and outside the acceptable quality specifications of the product. The existing station requires the operator to stop drilling every three plunges to apply the lubricant by hand. This action slows the entire process down because in order to drill one hole the operator must stop and lubricate at least five times. By attaching a Lubricant Holding Can to the drill press with a flexible neck, it will allow the operator to determine the amount and placement of the lubricant with out stopping the process to hand apply the lubricant. This is a common instrument in machine shops because when drilling or cutting a substantial amount of metal, lubricant is always used. The lubricant not only helps to minimize wasted material it also extends the use-full life of the drill bit. These recommendations are inline with Plasticrafts cost reduction strategy.

The packaging center is also a potential area for improvement. The existing layout has the packaging center located at the far end of the facility (see the Existing Facility Layout sketch shown above, the area that says project table). The plastic operator has to navigate the entire shop floor just to package a batch of lights. We recommend that Plasticraft move the packaging center to a central area so it is easily accessible by both operators. This will reduce wasted motion and speed up the entire process because all products are packaged prior to shipment.

As we mentioned before Raw material lead-times need to be reduced. Currently it takes two weeks from the time an order is placed to receive the raw materials. We feel it is realistic to reduce the lead-time by ½ in order to receive materials in one weeks time. Building a relationship with a local supplier would have a dramatic impact on this problem. Currently raw materials are shipped form California, which is partially why the previous owner over-ordered to take advantage of economies of scale. By finding a local supplier, Plasticraft would not only reduce lead times they would also reduce shipping costs and position the company to be more responsive to changes in customer demand. Management is currently identifying suppliers with this capability.

Our final recommendation is a technological innovation. The oven that heats the plastic in order to achieve the necessary pliability to form the light is an area of potential improvement. Currently the operator needs to return to the oven every 4 minutes to turn over the sheet plastic in order to heat both sides evenly. By designing an oven that turns the material automatically the operator would not need to spend less time rotating material and would be able to achieve a greater number of tasks before removing the material. This innovation was well received by management who thought it realistic and began research to see if such equipment already existed, we suggested looking at hot dog rotation ovens or other fast food type heating systems for ideas.

Should Plasticraft implement these next recommendations a new analysis of operational practices will be necessary. The new *critical path* and *pacemaker process* will need to be identified in order to focus efforts on areas that will reduce the overall production times.