CIS-Carbon Footprint Evaluation and Improvement in Production Line

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16 September 2011

Outline

* Introduction
  - Background
  - Problem Statement
  - Goals & Objectives
  - Work steps
* Carbon Footprint Evaluation
  - Calculation Steps
  - Final result
* Optimizations
* Conclusions & Acknowledgement

Background

Carbon footprint

The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO_2)

Background

CIS is a global solutions provider specializing in electro-mechanically integrated solutions for a wide variety of industries.

Products

CIS

IBM

DELL

hp

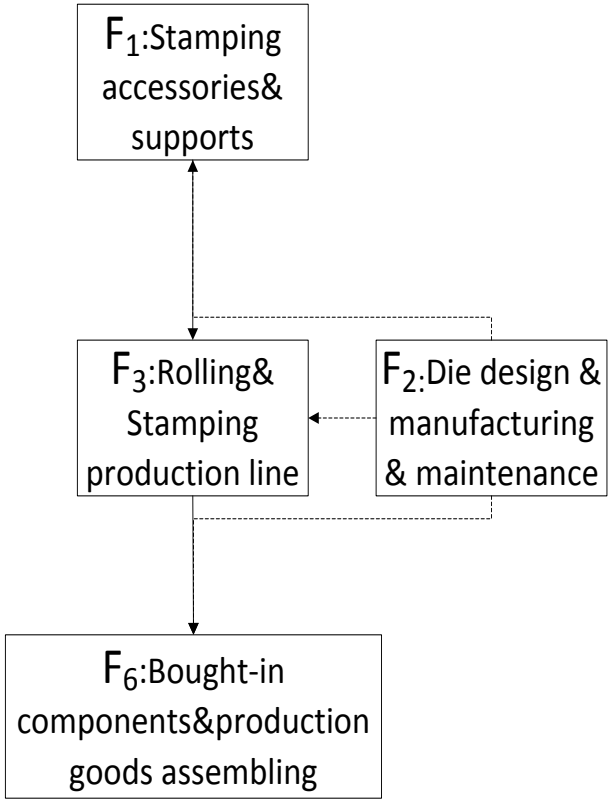
Canon

Powerwave

Clients

Background

- Actual production conditions of CIS :



Problems Statement

- ✓ How to figure out the relationship between the energy consumption and carbon emissions.
- ✓ How to calculate the carbon footprint of one specific product.
- ✓ How to optimize the machines or the production line to lower the emission of carbon footprint.

Goals & Objectives

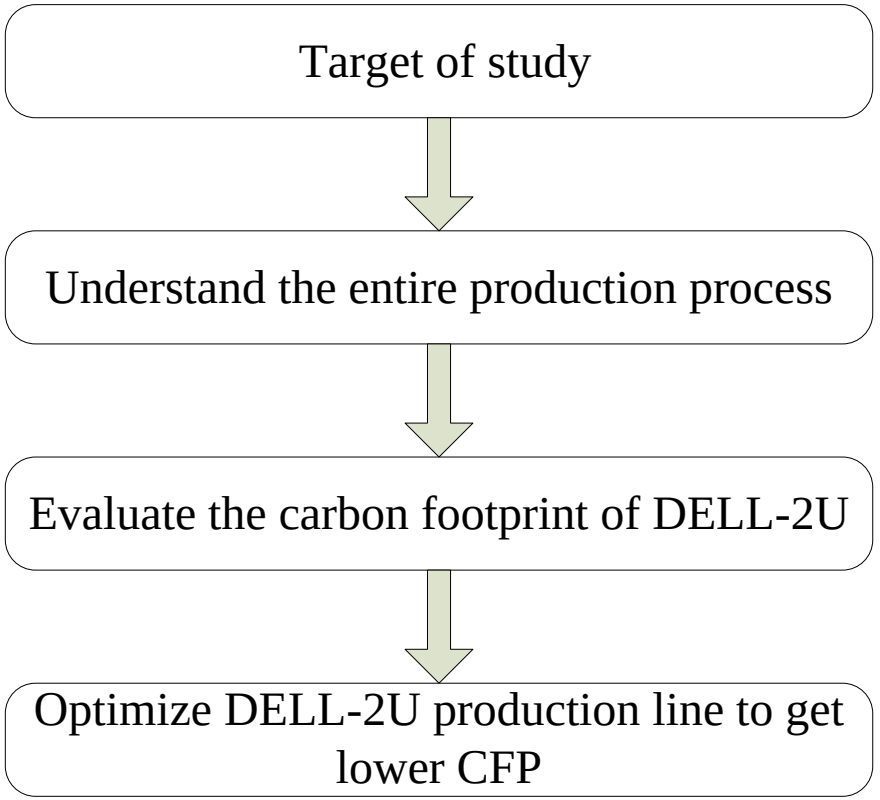
✓ Goals

- Aiming at Dell 2U production line, make the statistical analysis and detailed evaluation of the carbon emissions for the entire production line.
- Aiming at one machine or one process flow in above production line, optimize the machine or the production line to reduce carbon emissions with low cost.

✓ Objectives

- Create concrete formula to measure the production lines , do the measurement and calculation.
- Analyze the result and identify the weakest link in production line
- Redesign system or device (line level or machine level) that limits carbon emissions.

Work Steps


Target of study
Understand the entire production process
Evaluate the carbon footprint of DELL-2U
Optimize DELL-2U production line to get lower CFP

Carbon Footprint Evaluation

- **Calculation Steps:**

1. Establish production process map.
2. Determine the system boundary.
3. Get the formula to calculate CFP
4. Collect data.
5. Calculate carbon footprint.

Production Process Map

Bought-in components

Storage

Preassembling

Electricity

Raw material

Tra & Sto

Rolling

Stamping

Electroplating

Tra

Assembling& packaging

Products

Air compressor & lighting & Ventilator

Colored parts are what we focus on

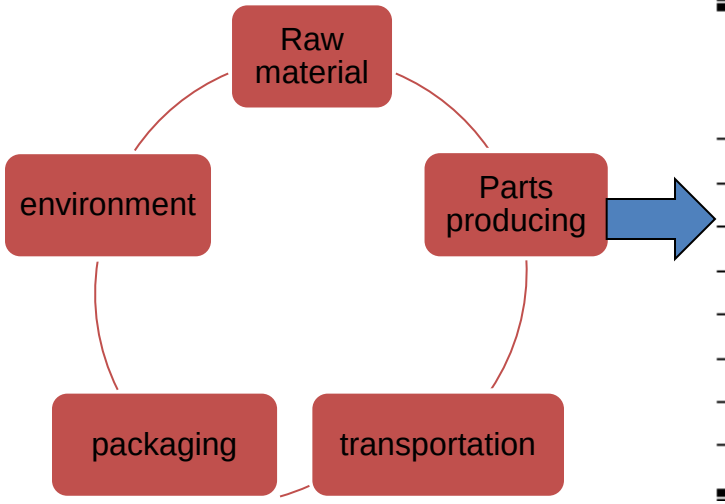
Formula: $E = \sum_{i=1} Q_i \times C_i$

Q_i C_i E

eg:1L gas *2.357kg/L=2.357 kg

- E is the product's carbon footprint.
- Q_i is the number or intensity data (mass/Kwh)of substance.
- C_i is the unit of carbon emission factor(CO_2eq/unit).

Data collecting:



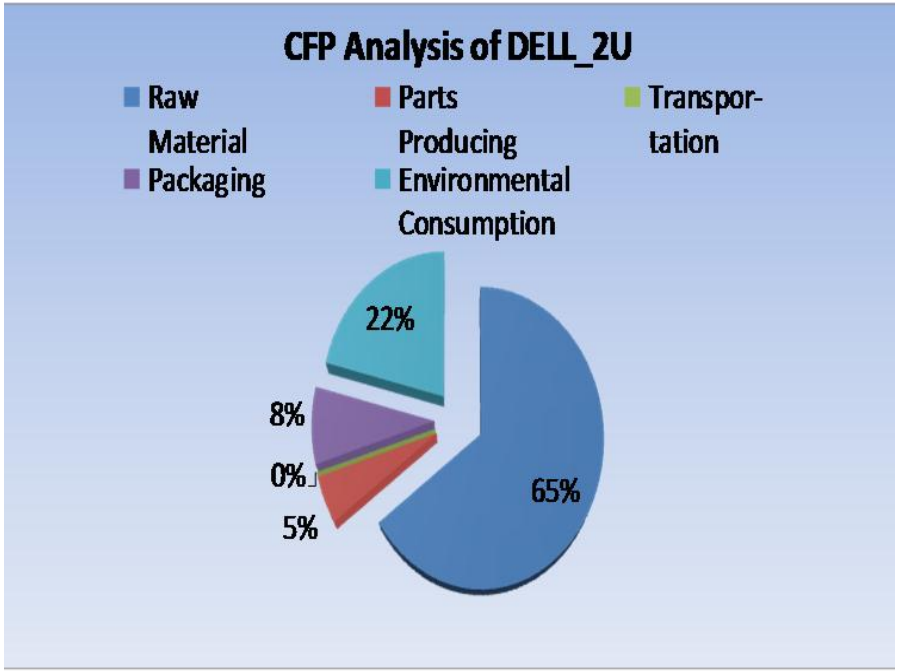
Station	Parts Made	stamps per minute	Time per stamp(s)	Rated Power(kw)	Working power(kw)	Holding Power(kw)	...
M-20	10	10	4.5	37	42.53	0	...
M-30	13	13	0.82	7.5	8.62	1.04	...
M-40	15	15	0.55	4	4.6	0.61	...
M-50	13	13	0.62	4	4.6	0.61	...
M-60	10	10	3.63	1.5	1.72	0	...
M-70	11	11	5.45	0.58	0.67	0	...
M-80	16	16	0.55	4	4.6	0.61	...
...	...	...	...	...	...	...	...

Final result

CFP Analysis of DELL_2U						
category	Raw Material	Parts Producing	Transportation	Packaging	Environmental Consumption	total
CFP(per pair)(g)	5414.7	426.1	0.66	688.9	1770.6	8301.0
Ratio (%)	65.2	5.	0.007	8.2	21.3	100

Conclusions:

- ✓ Raw material takes the largest part
- ✓ Transportation: too small ratio to be considered
- ✓ Focus on the parts producing, packaging and environmental consumption



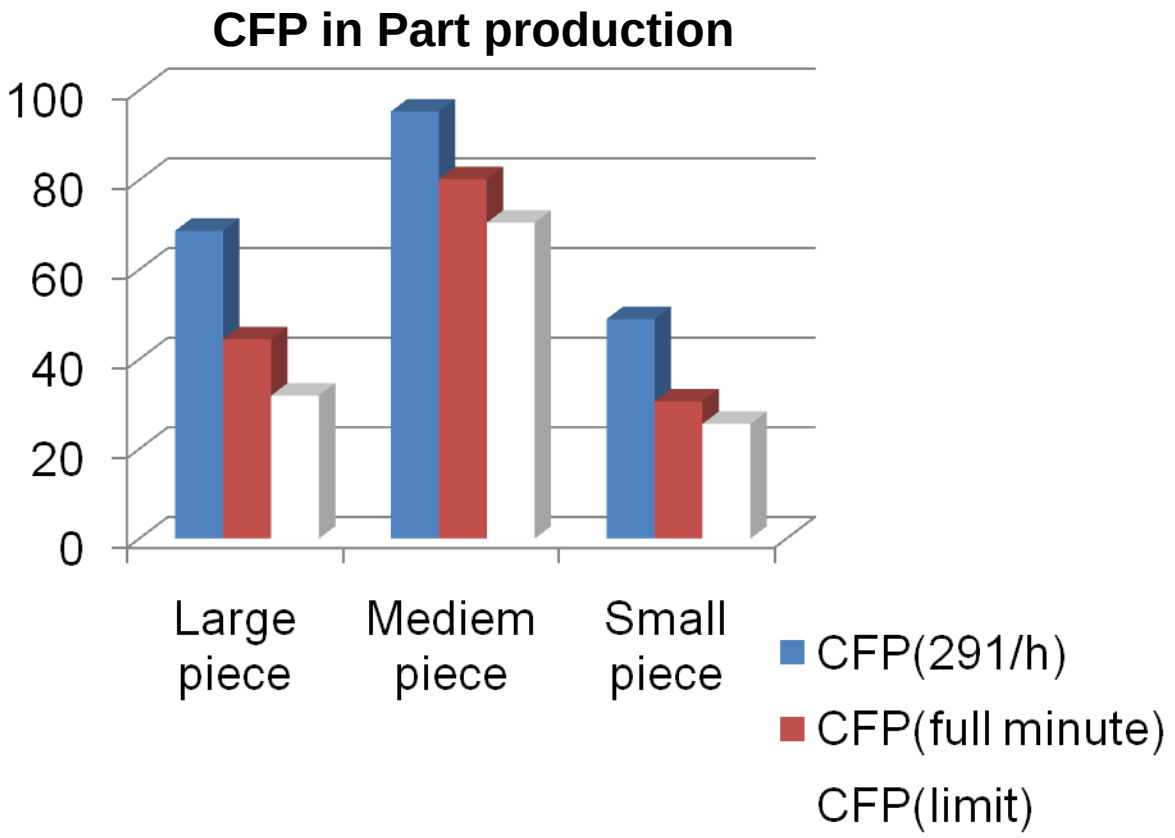
Parts producing

- The machine is always on, while only part of the time is meaningful
- Take the stamping machine for example

JH21-100

Parts producing

- The difference between the three CFP value comes form the difference in holding time
- The CFP in parts production can be greatly decreased



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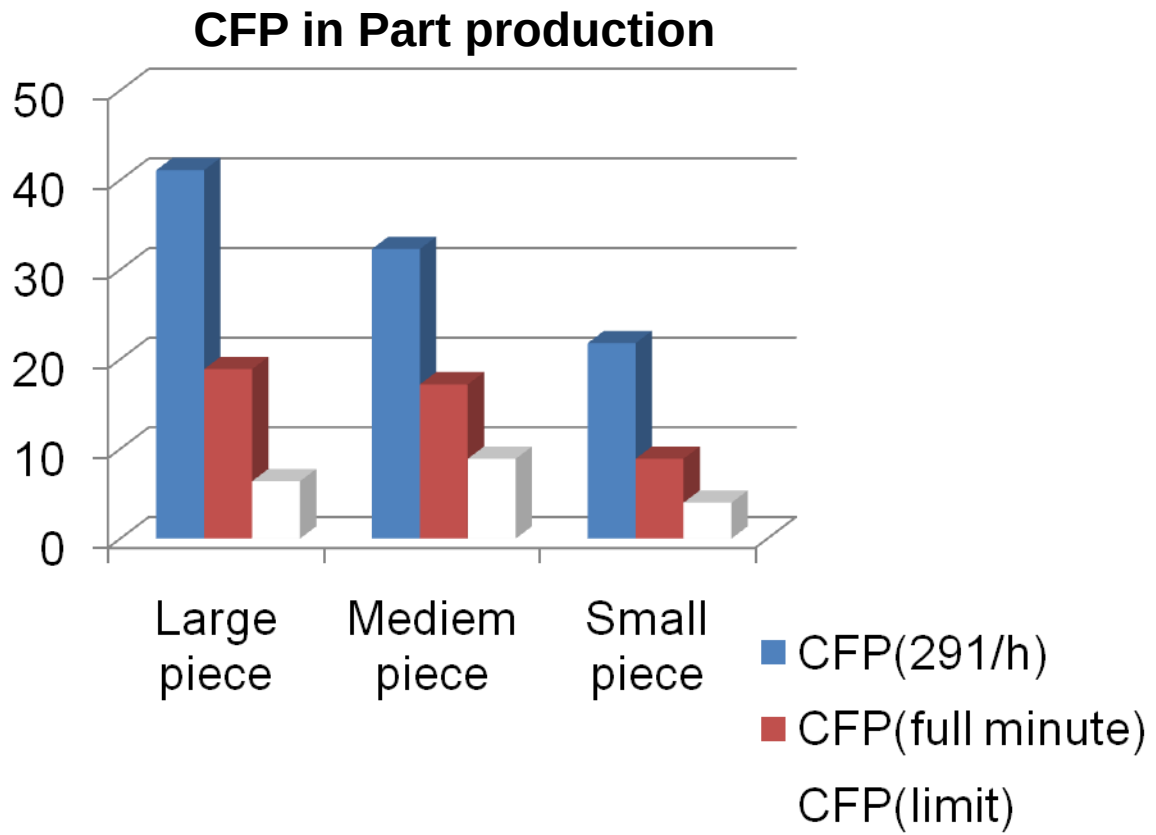


Parts producing

Problem:

The holding time is long , during which the machine consumes electricity but don't make a difference

	Actual working rate	Efficiency
25T	9.05%	37%
40T	32.28%	52%
45T	9.60%	19%
80T	14.53%	57%

Parts producing

✓Solution:

- Change or redesign the inefficient machine
- Design a feeder
- Redesign the hand tool used by workers

Optimization- replace 45T stamping machine

Type	Working current（A）	No-load current（A）	Force（KN）	Die height（mm）	Height adjustment（mm）	Motor powe（KW）
OCP-45N	9.6	5.4	450	240	60	5.5
JE21-40C	7	1.1	400	270	60	4

Problem: the no-load current of OCP-45N is large, thus consuming more electricity but making no difference.

Suggestion: replace the OCP-45N with JE21-40C

Proof: the force and die height of JE21-40C can meet the requirement of stamping .

Purpose: save electricity and reduce carbon emissions

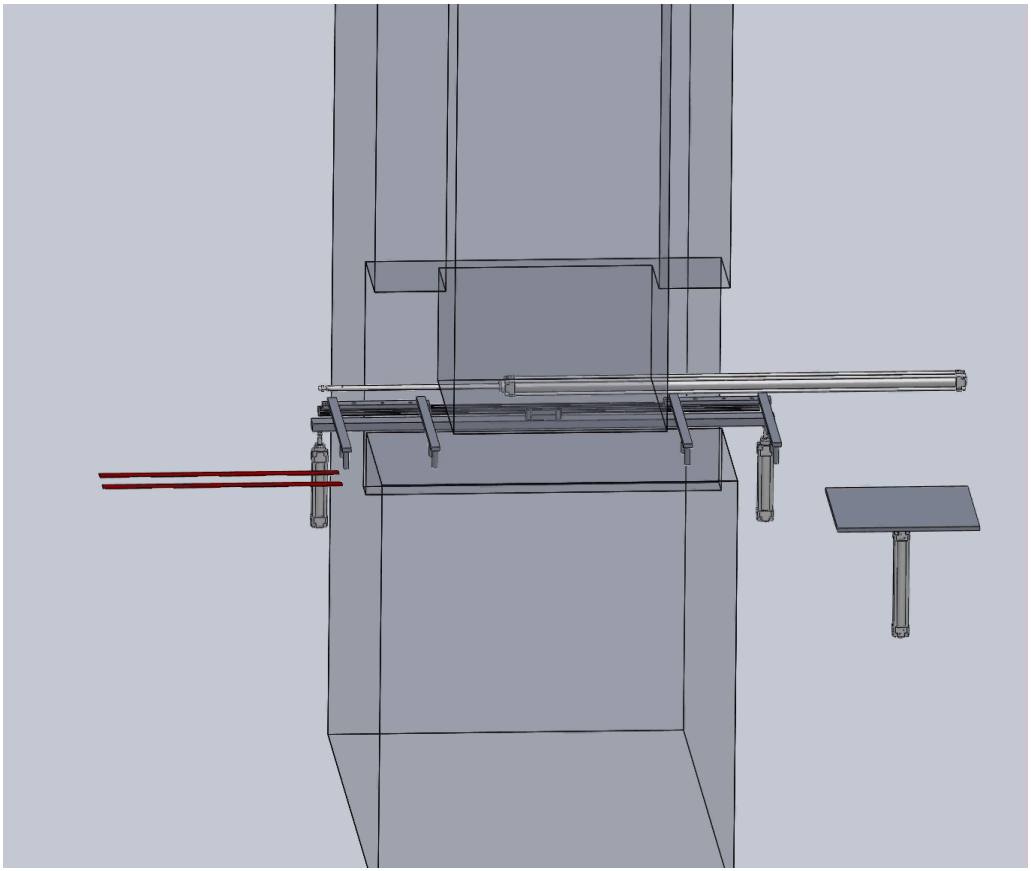
Optimization- feeder

M-100

M-110

Optimization- feeder

- Cylinders drive
- Height difference compensation
- PLC, travel switch and iron block control
- One operator

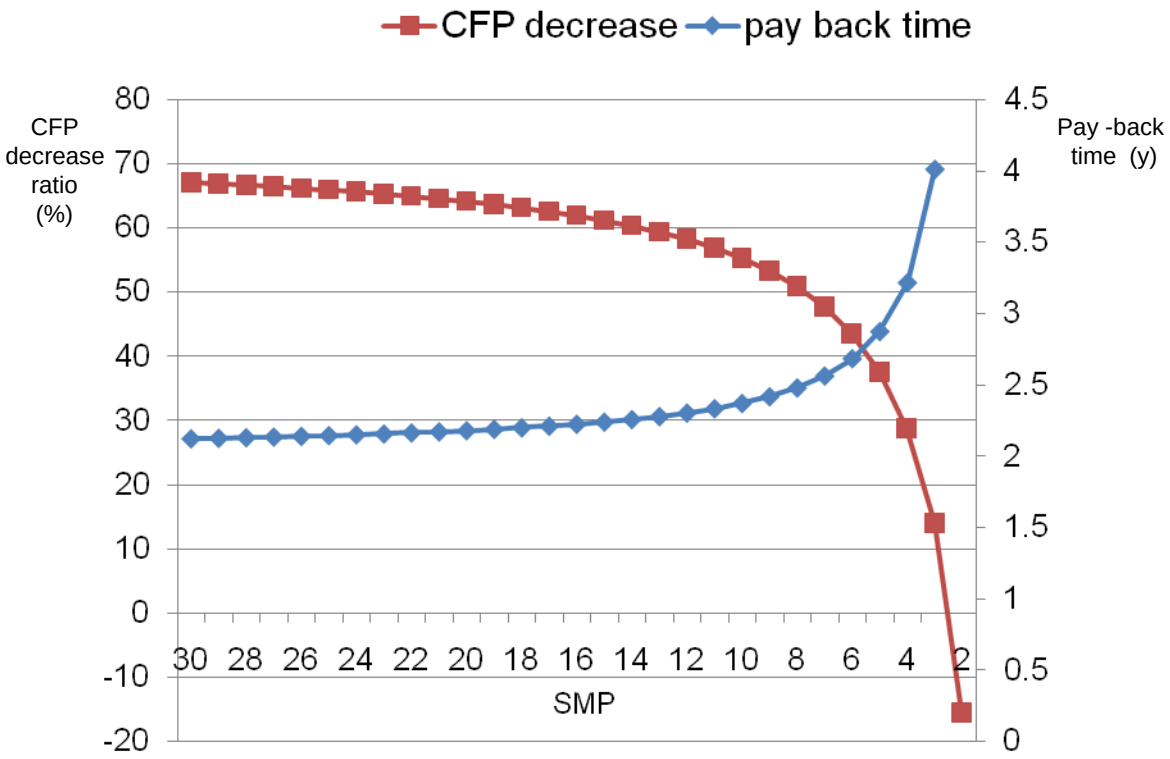


Optimization- feeder

✓Efficiency analysis

- The feeder cost no more than 100k RMB
- Cost of worker: 2000 per month
- Electricity price: 0.8/kwh

CFP and economical analysis

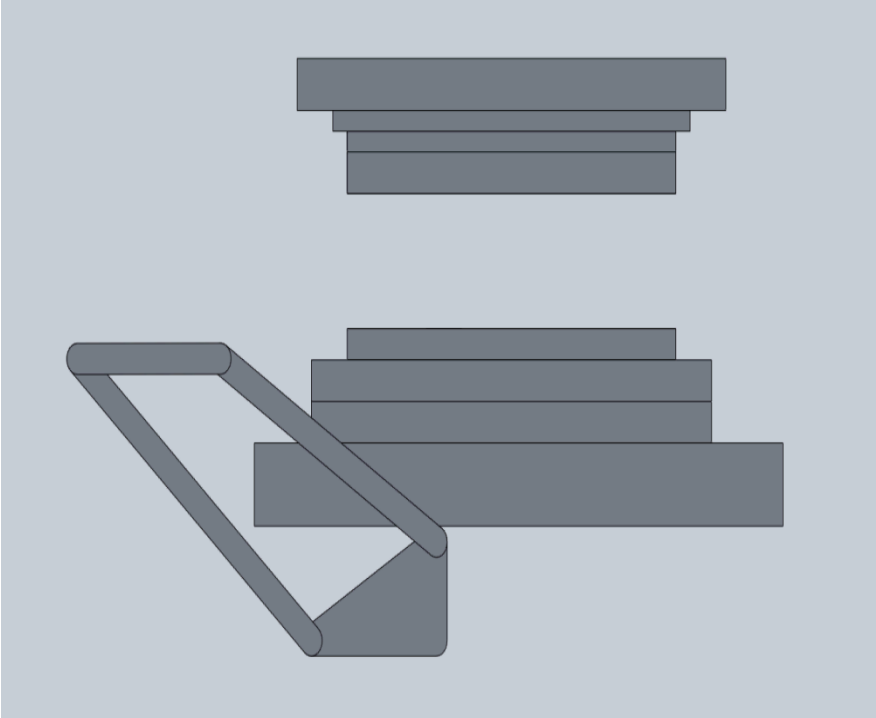


Optimization- hand tool

- A device that helps load the 80T machine and others like it.
- NOTICE due to its low clearance the second part can’t be placed in efficiently (seen in video).

Optimization- hand tool

- The design is a four bar linkage on a piston that accurately place the parts into the machine.



Optimization- hand tool

WPI Optimization - packaging

Replaced by

EPS foam

Paper mould

Advantages of paper mould:

✓The price is lower than EPS foam, for its main raw material is waste paper.

✓The process is environment-friendly, it is recyclable and easy to break.

✓The size is smaller than EPS foam and it can be placed overlapping to save space and transport costs.

✓With good shock protection.

Optimization –air pipe

Connectors are directly down

Problems: water and dust depositing in main air pipe directly get into the intake manifold

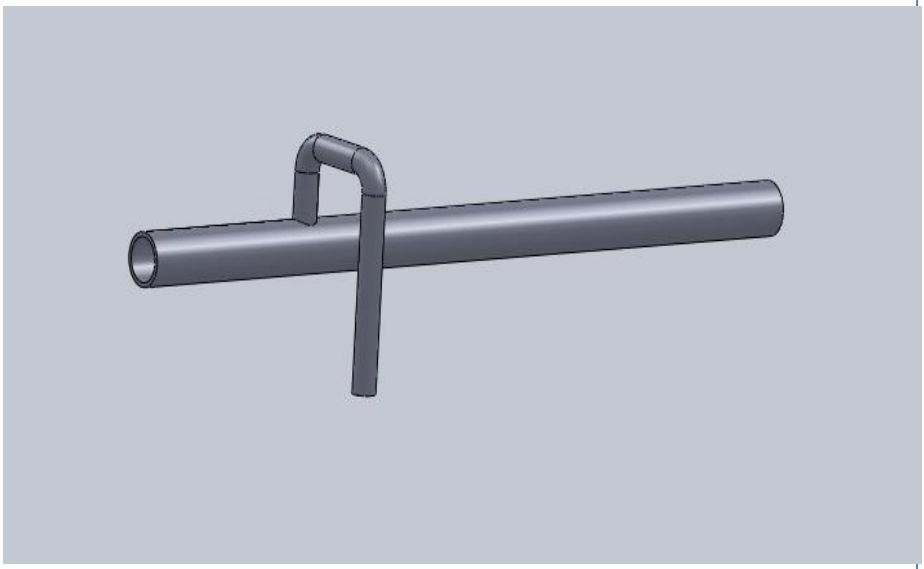
- Water makes machines easy to rust. Oil mixed with water will reduce the lubricating effect, increase wear of machines and shorten the life of machines.
- Dust may block up air valves, increase air flow resistance and wear of machines.

Damage to the machine extend the production time, resulting in an increase in carbon emissions, on the other hand increase maintenance costs.

Optimization –air pipe

Connectors are directly down

Suggestion: Connector up

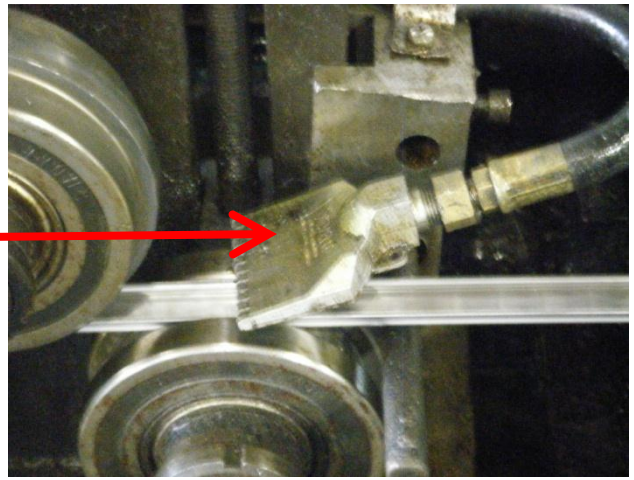


Using the connector above decreases the amount of water and dust from getting into the intake manifold. This reduces the failure rate of machine and electricity consumption, thus reducing carbon emissions of product.

Optimization- outlet valve

Function: blow away saponification liquid on the slides

Problem: air flow quantity can only be determined by the main airway, it can not be adjusted according to the actual production conditions, such as producing big, medium, or small ones.



Suggestion: install adjustable throttle valve before the outlet

Purpose: adjust the air flow quantity according to actual production conditions

Price: 10~100 yuan

Optimization- air pipe not in use

Not In use

Suggestion: remove the air pipe not in use or install valve at the joint to shut off the air flow.

Purpose: reduce the gas leakage caused by these useless pipes, thus reducing electricity consumed by air compressor and carbon emissions.

Optimization- air compressor

Problem:

- ✓ No-load time: working time is 20:1
- ✓ If one can not work, some stamping machine must stop working
- ✓ Extend the production time and waste energy

Suggestion:

- ✓ Purchase one more air compressor to make them work by turn

Conclusion

1. After the measurement and calculation, we get the carbon footprint of DELL-2U: 8301.0g per pair.
2. We focus on the parts producing, packaging and environmental consumption for optimization, including:

- ✓ 45T stamping machine replacement;
- ✓ Automatic feeder designing;
- ✓ Magnet hand tool updating;
- ✓ Packaging material updating;
- ✓ Air pipe/outlet valve optimization;
- ✓ Air compressor.

Acknowledgement

- Sincere thanks to CIS for the cooperation.
- Acknowledge the support from Ms. Wang at CIS
- Thanks for the help from Prof. Tang, Prof. Li and Prof. Chen at HUST.
- Special thanks to Professor Rong and Professor He for their valuable guidance and support.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Questions?