Impact Factor 3.582 Case Studies Journal ISSN (2305-509X) – Volume 9, Issue 2–Feb-2020

Designing For Sheet Metal Fabrication of Cocoa Deposing and Winnowing Machine

Author Details: Rufus Ogbuka Chime
Mechanical Engineering Department-Institute of Management and Technology
(IMT)Enugu. Nigeria - rufuschime@Imt.edu.ng

Abstract

As with many modern fabrication techniques, sheet metal manufacturing can be automated and parts produced directly from CAD models. The technology uses a variety of materials and a range of processes for shaping finished components and products. Perhaps most important, in a world of mass production, sheet metal fabrication is highly scalable. While setup for the first piece can be costly, the price per piece drops quickly as the volume increases. This is, of course, true of many processes, but cost-per-piece for sheet metal generally drops more steeply than for a subtractive process like machining. Depending on the application, sheet metal offers advantages, not just over nonmetal alternatives but over other types of metal fabrication as well. Compared to machining, it generally has a significantly lower material cost. Rather than starting with a block of material, much of which will be machined away, sheet metal lets you buy what you need and use what you need. The remainder of a metal sheet is still usable, while swarf—the shavings removed in machining—must be recycled. The technology uses a variety of materials and a range of processes for shaping finished components and products. Cocoa beans contain about 50% fat. It is useful in the production of: lightening oil, ointments, candles, soaps and medicine. Cocoa is best known for its derived products, especially chocolates, rather than its original botanical form i.e. fruits and beans. These products are consumed in great demand worldwide due to its unique flavour and aroma that cannot be replaced by other plant products [Wood and Lass, Cocoa is prominent commercial cash crop grown globally, it is one the economic cash crop produced in west Africa. The most useful and valuable part of the crop is the bean. The processing of cocoa after harvest, include the breaking of the pods, extraction fermentation, drying dehulling and winnowing of the bean for production of cocoa butter beverage and cake. Traditionally, the process of breaking cocoa pods is done manually using wood and asses. This is an arduous task apart from the large labor requirement and time consumed during the operation.], the cutlass used, damages the beans resulting a poor quality of the beans bagged. The machine would be fabricated using locally available materials assemble and tested at a relatively low cost.it would be powered electrically using a prime mover of about 5-7.5hp. The machine to be develop would be simple to develop, assemble easy to maintain and affordable for small cooperative farmer

Key Words; *Design, Sheet Metal, Fabrication, Cocoa Deposing and Machine*

INTRODUCTION

Winnowing is the process of removing the outer shell from the cocoa beans. The basic process of winnowing involves an initial crack of the beans. During this step, it is important not to crack the bean too vigorously because it can lead to the formation of fine particles. [1,2.3] Overly fine shell and nib particles can't be used for fine chocolate because it is too difficult for the winnower to separate between the two. The goal of a good crack is to keep the nibs as large as possible while simultaneously separating the shells and removing the dirt. The basic principle behind winnowing is that the shell is less dense than the nib, so if the correct velocity of air flow is used, then the shell should blow away, leaving the nib behind

We can say that almost 73% [4] of population of India lives in villages and their main occupation is agriculture. More than 40% [5] of these areas do not get regular electricity supply. So using energy for agricultural processes incurs various losses in terms of finance. Also the traditionally used processes have become outdated causing wastage of yield and hence require serious upgrade. It is estimated that about 10% [6] of food grains produced in India, are lost due to various reasons. Of which it has been reported that about 9% [7] of food grains is lost due to use of old and outdated methods of post harvesting processes like drying, winnowing, milling, transportation and handling, improper and unscientific methods of storage. It has been estimated that total post-harvest losses of food grains at producer's level was about 2.71% [8] of total production.

DESIGN CONSIDERATIONS

The winnowing system should fulfill the basic task of cleaning the grains and removing husk, twigs, chaff etc.

- It should be economical and the running cost should be at its minimum level. The grain and unwanted material should be distinguishingly separated i.e. there should not be a requirement to repeat the process.
- The device should be portable and robust such that it can be transported to the field easily.
- The design should be optimized to reduce the fatigue of farmers. Even it should be appropriate for women and children.
- The attachment should employ low-cost materials and manufacturing methods, standard spare parts should be used for easy and local availability.
- The weight of the system should be minimal to reduce the human effort in transport.
- The system may employ other attachments to integrate the post harvesting and related activities.
- The fabrication of system should be suitable for local capabilities i.e. use of simple tools in machine shop such as hack saw, files, medium duty welder, drill press, lathe and milling machine [9]

SHEET METAL

Sheet metal, can be shaped in many different ways to meet many different requirements. While this paper focuses on the technologies that shape sheet metal by bending it along a single axis, a variety of techniques exist for shaping the material into multi-axis forms that are not made up of flat planes or bent along a single axis. These include hot and cold forming techniques of deep drawing, hydroforming, spinning, and stamping. These are the kind of processes that create the body panels for modern vehicles, complex formed objects like metal sinks, and aluminum beverage cans. In many cases these techniques are iterative, shaping the metal by repeating the process several times to change the shape of the metal in increments. Sheet metal is one of the most versatile materials in the manufacturing industry. It's made from steel, aluminum, brass, copper, tin, nickel, titanium, or precious metals. It ranges in thickness from wispy leaf through light foil to heavy plate. It takes a variety of forms: plain flat sheets, embossed, etched, ribbed, corrugated, and perforated. And its uses expand across many different industries including transportation, aerospace, appliance manufacturing, consumer electronics, industrial furniture, machinery, and more.

DESIGN CONSIDERATIONS FOR SHEET METAL FABRICATION

Sheet metal fabrication is a non-additive, non-subtractive process. It begins with flat material and, by definition, maintains constant material thickness throughout a part. In some cases, areas of a part can be selectively thickened by welding multiple metal sheets together, but this is a costly and uncommon practice. Designing for sheet metal fabrication has its own criteria, which differ from those of other production processes. The more that's known early in the design phases about a part's features and functions, the sooner a manufactural design will finalized. If, however a design has problematic features, a manufacturing supplier should be able to point those out and suggest ways of addressing them. In some cases, the supplier may even have design analysis software that can quickly highlight issues for design improvement. Some design consideration:

- Sheet metal fabrication is most economical when it uses configurations of "universal" tools rather than part-specific tooling. If a single part becomes too complex, consider welding or riveting together parts that can be made using universal tools.
- Because bends stretch the metal, features must stand away from bends to avoid distortion.
- A useful convention is 4T—four times the material thickness.
- A press brake creates a bend by pressing sheet metal into a die with a linear punch, so design does not allow the creation of closed geometry.

- Sheet metal tolerances are far more generous than machining or 3D printing tolerances. Factors affecting tolerances include material thickness, machines used, and number of steps in part production. Suppliers will typically provide detailed information on tolerances.
- A uniform bend radius such as 0.030 in. (industry standard) should be used across a single part to reduce the number of machine setups and accelerate production. Where possible maintain a standard distance of four times the material thickness from bend to edge. This will eliminate the need to remove excess material required to make the bend.
- Welding thin materials can lead to cracking or warping. Other assembly methods are preferable.
- When using PEM hardware, always consider the minimum requirements of the manufacturer for installation locations and material thickness

LITERATURE REVIEW

Sheet metal has been used for millenni a, having reportedly shown up in ancient Egyptian jewelry. It was a mainstay of medieval armor when metal fabrication was still a costly manual process. There was an explosion of sheet metal work beginning at the time of the Industrial Revolution. Today it is in our cars and appliances can be found in almost any room in the home or office, it encases computer hardware, and is travelling around the world in aircraft and through space in rockets and satellites.

After centuries of hammer-forming, the first rolling mills appeared in the 16th century to produce sheet metal stock, in at least one case using a design originated by Leonardo da Vinci. The 17th century saw the industrialization of sheet metal manufacturing culminating in the creation of the first cold rolling plant in England. The Industrial Revolution of the 18th century saw the advent of assembly line production, press brakes, and the hydraulic press. In the 19th century, aluminum was introduced; the Bessemer converter allowed mass production of steel, and the steam hammer was also introduced. Developments affecting sheet metal production and use have continued at an ever-growing rate into the 20th and 21st centuries making sheet metal today an industry worth tens of billions of dollars

Cacao has donated to the socio-economic development of Trinidad and Tobago for over 200 years. It has been stated that the Spaniards first planted the Criollo (native) variety in Trinidad in 1525 [10], cacao plants were introduced for commercial purposes from Venezuela around 1678, and the cocoa trade became operative in the colony at the beginning of the 18th century. The industry was almost completely destroyed in 1727 by a ‘blast’ (a hurricane or Ceratocystis wilt or bark canker, a Phytophthora infection). Consequently, Forastero (exotic) cacao was introduced from Venezuela in 1757, and eventually inter-bred with the remnant Criollo to produce hybrid cacao referred to as Trinitario. Cacao cultivation and cocoa production expanded in earnest with the introduction of the Spanish Cedula of Population in 1783. The resultant influx of French migrants, who were granted agricultural lands, accounted for this expansion, and the implementation of the Negro Code of 1789 consolidated it. The economics of cocoa in this period was thus dictated by land grants, slave labour and port prices. The plantation system of agriculture flourished under the extant conditions.

After the abolition of the slave trade in 1807, there was a Crown Lands Utilization programme in which Crown lands were distributed at low cost. Many freed slaves occupied these lands due to squatter’s rights. Most of the Crown lands occupied in this way were cultivated in cacao. A large class of small farmers, who farmed marginal cacao lands, thus emerged. The cocoa industry was moderately prosperous between 1840 and 1866. However, it experienced a tremendous boom between 1866 and 1920. since cocoa was traded at a very high price at that time [11], and eventually ‘dominated the economy’ ([12. Many small and medium businesses mushroomed with the expanding cocoa trade, new villages were established and some measure of prosperity was enjoyed by a fairly large section of the society.

In 1828, chocolate manufacture became possible when van Houten, a Dutchman, developed a method to extract butterfat thus facilitating the development of eating chocolate. By the 1840’s, Britain was manufacturing chocolate bars, and by 1866, Cadbury Brothers were also manufacturing “cocoa essence”. Consequently, the demand for cocoa products increased in Europe and North America, and cocoa prices remained stable at an appreciable level. This served as an impetus for further cocoa production worldwide. In 1830, Trinidad and Tobago was the third highest producer of cocoa in the world after Venezuela and Ecuador. This was before Ghana began its large-scale cultivation of cacao. The local industry continued to prosper between 1870 and 1920. In 1870, when the second phase of internal colonisation (this time by the English) began in the country, the annual production of cocoa beans was 6,800 tons. The demand for cocoa in Europe had increased along with the price, and the availability of labour was not a limiting factor in Trinidad due to the existence of the indenture ship system. Cocoa soon replaced sugar, which entered a period of depression at this time (1884), as the leading agricultural commodity and became the "financial barometer" of the country (Shepard, 1932). Much land was transferred from sugarcane to cacao cultivation. Thereafter, the cocoa industry expanded in tandem with the expansion of Trinitario plantings in several areas on the islands. [13] [14]

METHODOLOGY

The methodology to this research took care of the design analysis of the winnower, material selection for each component designed, and operating description of the system, engineering drawings, required system assembly and its production cost.

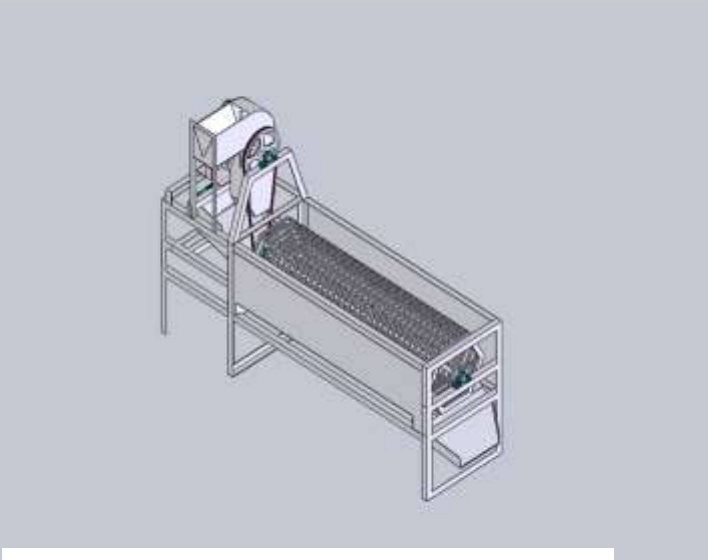
IDENTIFIED COMPONENTS TO BE DESIGNED FOR PRODUCTION

The components identified and designed were listed as follows: inlet hopper, loading hopper or receptor, conveyor drive, beans silo, auger shaft, crushing unit, separating or sieving unit, suction fan, electric motor and blowing unit

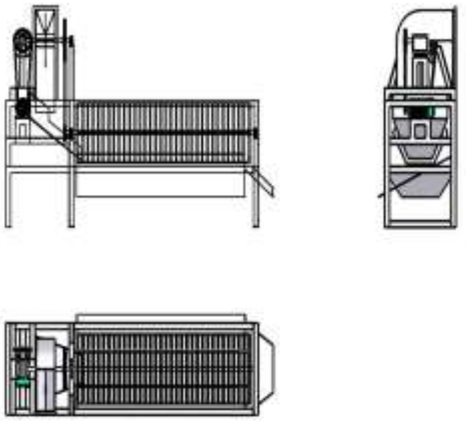
MATERIAL SELECTION

In the context of product design, the main goal of material selection is to minimize cost as well as selecting the appropriate material to be used for each component considering engineering factors as well as environmental factors so that the components used will be able to perform properly with high degree of reliability

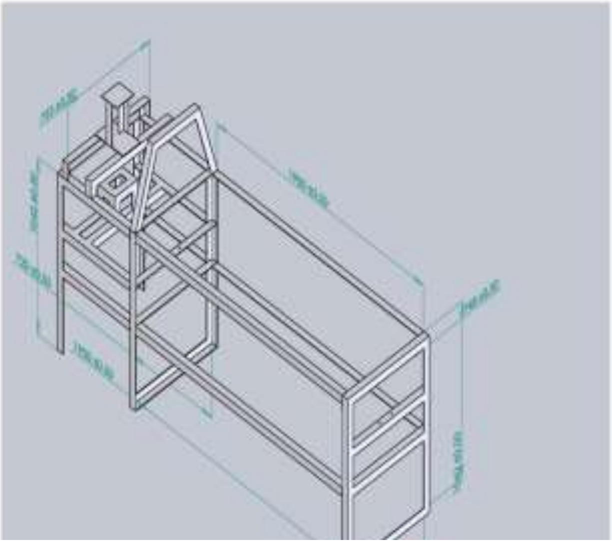
MACHINE AND COMPONENTS DESIGN



Fig; 1 CAD Drawing



Fig;2 Isometric Views



Fig; 3 Frame

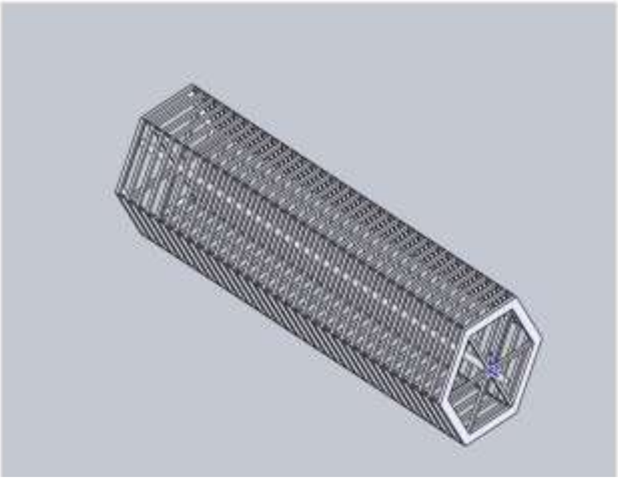


Fig ;4 Rotary Sieve unit

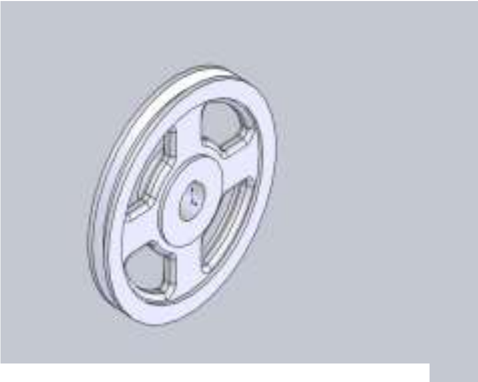
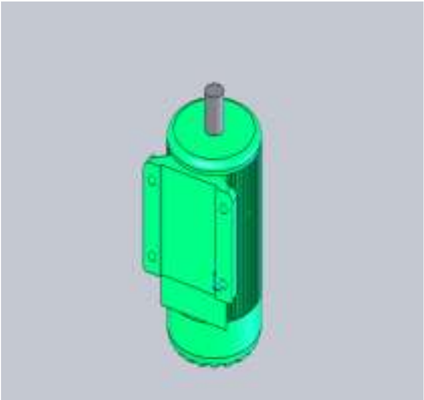


Fig ;5 Pulley



Fig; 6 Electric Motor

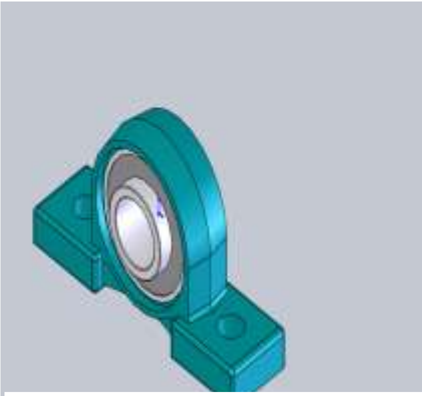
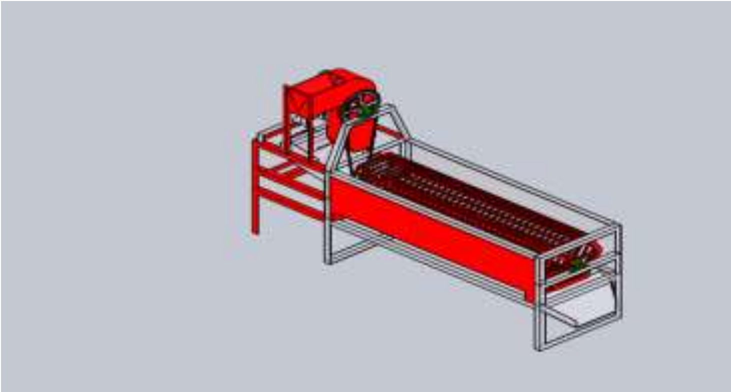
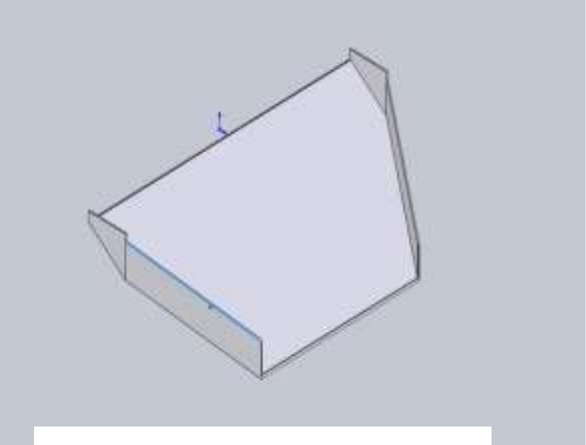


Fig ;7 Bearing

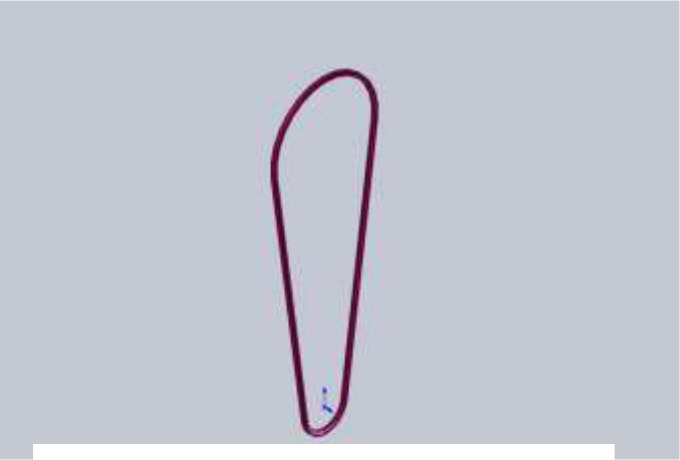
Fig; 8 Costing Analysis



Fig; 9 Sustainability Analysis



Fig;10 out let



Fig; 11 Belt

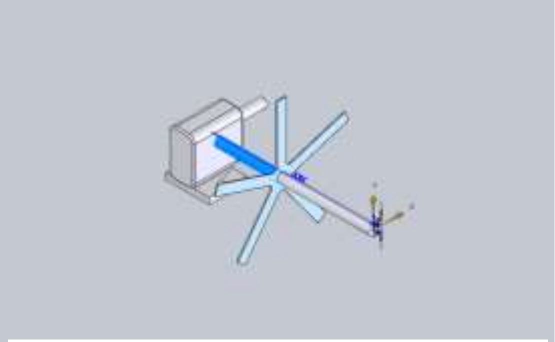
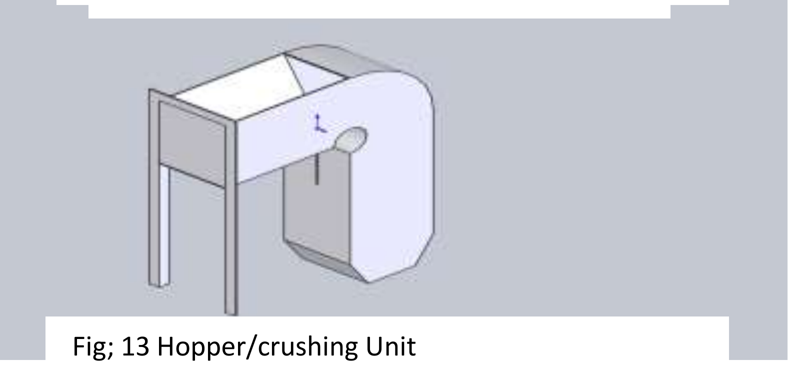
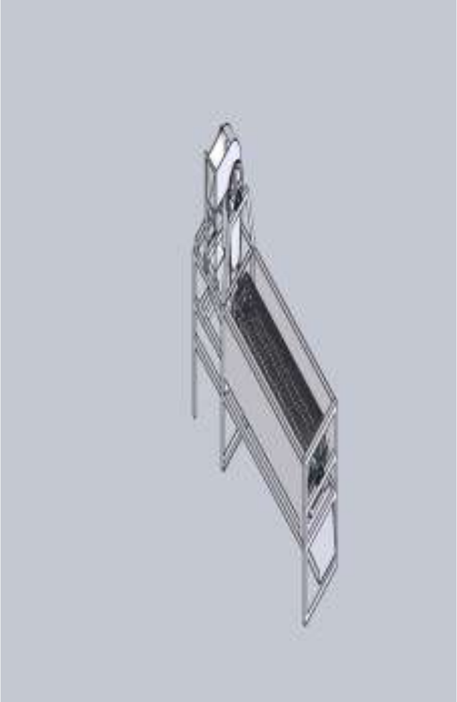


Fig ;12 conveyor Drive Unit



Fig; 13 Hopper/crushing Unit



Fig; 14 Costing Analysis

Assembly Name:	Assem1234
Date and time of report:	Sat 11.01.20 6:11:51 AM
Total weight:	932.29 lb
Total stock weight:	50009.20 lb

Quantity to Produce

Total number of assemblies:	100
Lot size:	100

Estimated cost per assembly:	**109607.66 USD**
Costing main template:	**multibody template default(English standard).sldctc**
Comparison:	

Cost Breakdown

Calculated Parts:	1.10E+5 USD	100%
Purchased Parts:	0.00 USD	0%
Toolbox Parts:	0.00 USD	0%
Operations:	0.13 USD	0%
Markup:	0.00 USD	0%

Component Cost Impact

Top Ten Components Contributing Most to Assembly Cost

Component	Configuration	Material Cost (USD/Assembly)	Manufacturing Cost (USD/Assembly)	Total Cost (USD/Assembly)
Out 2	Default	28183.41	14255.34	42438.75
wwe	Default	14397.50	10264.17	24661.67
Frame 112	Default	12746.21	6451.32	19197.53
DD	Default	4198.59	2131.35	6329.94
TT	Default	3436.03	1975.18	5411.21
Shaft	Default	2545.03	1267.72	3812.75
Out 1	Default	1196.96	607.38	1804.33
Frame12	Default	951.21	460.86	1412.07
Frame 113	Default	408.05	205.27	613.32
Frame 115	Default	260.23	136.49	396.72
Total		68323.22	37755.07	1.06E+5

Cost Breakdown for Each Part

Calculated Parts	Method	Quantity	Part Cost (USD/Assembly)	Total Cost (USD / Assembly)	Costing Template
BLOCK 123 [Default]	Machining	3	143.84	431.51	machiningtemplate_default(englishstandard).sldctm
Out 2 [Default]	Machining	1	42438.75	42438.75	machiningtemplate_default(englishstandard).sldctm
pulley 22 [Default]	Machining	1	37.86	37.86	machiningtemplate_default(englishstandard).sldctm
DD [Default]	Machining	1	6329.94	6329.94	machiningtemplate_default(englishstandard).sldctm
Electric motor 12 [Default]	Machining	1	256.87	256.87	machiningtemplate_default(englishstandard).sldctm
pulley a12 [Default]	Machining	1	117.33	117.33	machiningtemplate_default(englishstandard).sldctm
B1 [Default]	Machining	1	68.26	68.26	machiningtemplate_default(englishstandard).sldctm
wwe [Default]	Machining	1	24661.67	24661.67	machiningtemplate_default(englishstandard).sldctm
Shaft [Default]	Machining	1	3812.75	3812.75	machiningtemplate_default(englishstandard).sldctm
pp 12 [Default]	Machining	1	13.99	13.99	machiningtemplate_default(englishstandard).sldctm
p1 [Default]	Machining	1	68.13	68.13	machiningtemplate_default(englishstandard).sldctm
Out 1 [Default]	Machining	1	1804.33	1804.33	machiningtemplate_default(englishstandard).sldctm
B2 [Default]	Machining	1	169.41	169.41	machiningtemplate_default(englishstandard).sldctm
TT [Default]	Machining	1	5411.21	5411.21	machiningtemplate_default(englishstandard).sldctm
pully11 [Default]	Machining	1	21.70	21.70	machiningtemplate_default(englishstandard).sldctm
Frame123 [Default]	Machining	4	165.40	661.59	machiningtemplate_default(englishstandard).sldctm
Frame 114 [Default]	Machining	2	135.25	270.51	machiningtemplate_default(englishstandard).sldctm
Frame 112 [Default]	Machining	1	19197.53	19197.53	machiningtemplate_default(englishstandard).sldctm
Frame12 [Default]	Machining	2	1412.07	2824.14	machiningtemplate_default(englishstandard).sldctm
Frame 113 [Default]	Machining	1	613.32	613.32	machiningtemplate_default(englishstandard).sldctm
Frame 115 [Default]	Machining	1	396.72	396.72	machiningtemplate_default(englishstandard).sldctm
Total			1.07E+5	1.10E+5	

Air Acidification

Material:	54 kg SO_2e
Manufacturing:	47 kg SO_2e
Use:	0.543 kg SO_2e
Transportation:	9.5 kg SO_2e
End of Life:	1.2 kg SO_2e

110 kg SO_2e

Total Energy Consumed

Material:	1.7E+5 MJ
Manufacturing:	3.4E+4 MJ
Use:	1200 MJ
Transportation:	4700 MJ
End of Life:	1700 MJ

2.1E+5 MJ

Environmental Impact (calculated using CML impact assess

Carbon Footprint

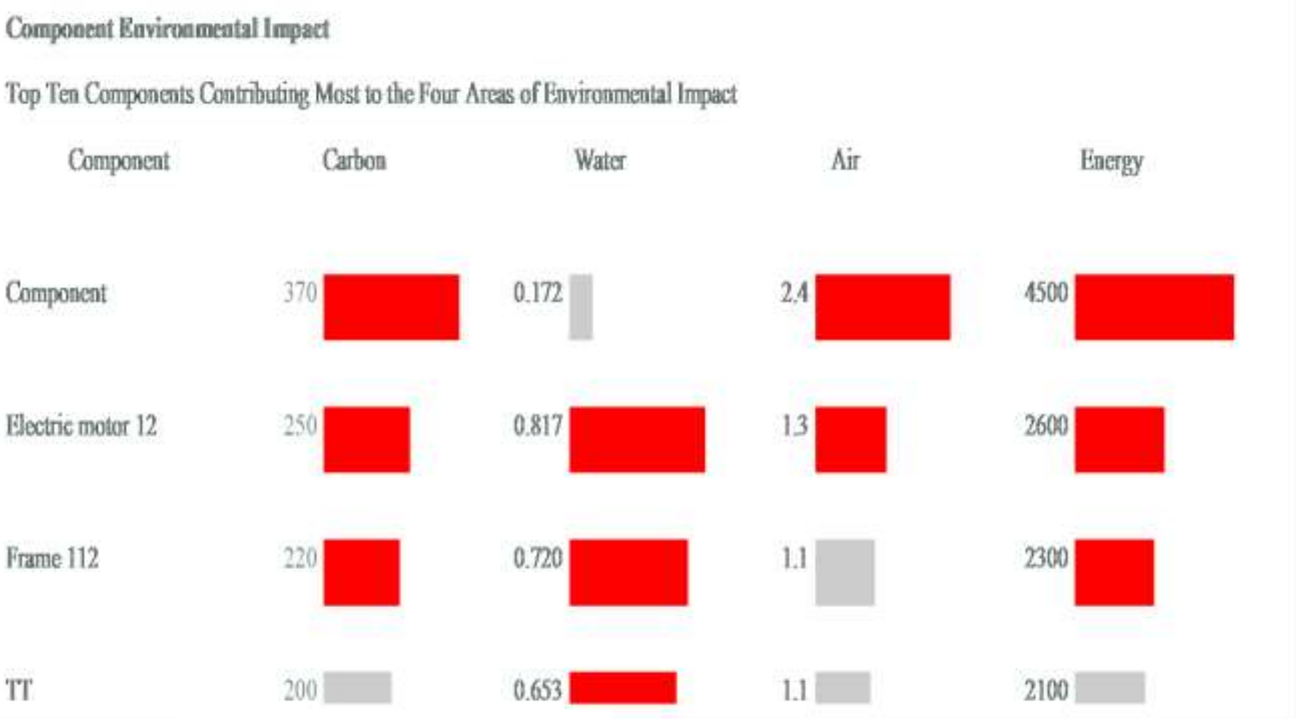
Material:	1.5E+4 kg CO_2e
Manufacturing:	3400 kg CO_2e
Use:	81 kg CO_2e
Transportation:	380 kg CO_2e
End of Life:	2300 kg CO_2e

Water Eutrophication

Material:	49 kg PO_4e
Manufacturing:	1.8 kg PO_4e
Use:	0.020 kg PO_4e
Transportation:	0.943 kg PO_4e
End of Life:	2.9 kg PO_4e

54 kg PO_4e

Table 2



Component Environmental Impact

Top Ten Components Contributing Most to the Four Areas of Environmental Impact

Component	Carbon	Water	Air	Energy
Component	370	0.172	2.4	4500
Electric motor 12	250	0.817	1.3	2600
Frame 112	220	0.720	1.1	2300
TT	200	0.653	1.1	2100

Table 3

Design Process

Engineers use CAD to create two− and three−dimensional drawings, such as those for automobile and airplane parts, floor plans, and maps and machine assembly. [15] While it may be faster for an engineer to create an initial drawing by hand, it is much more efficient to change and adjust drawings by computer. In the design stage, drafting and computer graphics techniques are combined to produce models of different machines. Using a computer to perform the six step „art to part" process: The first two steps in this process are the use of sketching software to capture the initial design ideas and to produce accurate engineering drawings. The third step is rendering an accurate image of what the part will look like. Next, engineers use analysis software to ensure that the part is strong enough as shown in fig;1 Step five is the production of a prototype, or model

Modelling Modeling is the process of producing a model; a model is a representation of the construction and of interest A model is similar to but simpler then the system it represents. One purpose of a model is to enable the analyst to predict the effect of change to the system. On the other hand, a model should be a close approximation to the real system and incorporate most of its salient features shown Fig;13. On the other hand, it should not be so complex that it is impossible to understand and experiment with it. A good model is a judicious tradeoff between realism and simplicity. In the final step the CAM software controls that the part. During the design of the machine, the drafting software was used (see the final drawing fig 1, and views fig 2).

PREDICTIVE SIMULATION

The methods described above are useful for assessing the performance of a design with respect to specific environmental indicators. However, at some point in the new product development process, there is a need to consider the trade-offs between environmental factors and other important objectives—cost, quality, manufacturability, reliability, and so forth. If environmental performance were independent of these other factors, they could be analyzed separately. Shown in in fig;9 and fig 14

However, as seen in environmental performance is often closely connected with other factors. Sometimes there are synergies, e.g., decreasing waste may result in lower costs; and sometimes there are compromises, e.g., increasing durability may interfere with recyclability. As mentioned above, scoring matrices provide a qualitative means of analyzing these trade-offs.

Detailed simulations can be extremely labor intensive, e.g., Gaussian plume dispersion models for airborne releases from production facilities. Only under exceptional circumstances would such tools be used for product and process development purposes. Nevertheless, with increased computing power, it is now possible to embed simulations into computer-aided design toolkits so that engineers can test new designs for compliance with important environmental constraints. [17]

Impact ASSESSMENT

Within the life-cycle assessment framework described above, the third and most challenging step is assessment of the impacts associated with resource use and environmental emissions during each life-cycle stage—acquisition, manufacture, transport, use, and disposal of products. These impacts may include environmental, health or safety impacts upon humans and ecosystems, as well as economic impacts such as land use restriction and resource depletion. Moreover, impacts may be local, regional or global in nature. The assessment of impacts is problematic because we have a relatively poor understanding of the complex physical and chemical phenomena that determine the fate and effects of substances released to the environment. Despite a great deal of continuing scientific research, our knowledge remains fragmentary and largely theoretical. In some cases, such as greenhouse gas emissions or energy consumption, the impacts are cumulative and broadly distributed, but in other cases, such as mercury emissions or water resource consumption, the impacts are highly localized and dependent upon specific environmental conditions. Illustrated in table 2 and 3

There is a vast literature on environmental impact assessment (EIA), mainly oriented toward the evaluation of proposed policies or projects that may affect the environment. In the United States and many other countries, EIA is a legal requirement prior to the initiation of major construction or development projects. However, most of the methods used in this field are not appropriate for product development purposes because they are detailed and site-specific; whereas LCA is applied at a broader system level. Instead, life-cycle impact analysis uses simplified models that provide *relative* measures of impact within broad categories. These categories reflect "midpoint" indicators of potential impact rather than final endpoints. For example, the TRACI tool developed by U.S. EPA uses the following categories [18]

Life-Cycle Assessment

Life-cycle assessment (LCA) methods are used to estimate the net energy or material flows associated with a product life cycle as well as the associated environmental impacts [17]. The Society for Environmental Chemistry and Toxicology was the first organization to develop a standard methodology for LCA in the early 1990s, involving the following steps:

1. **Goal and Scope**. Define the product, process, or activity to be assessed and the goal, scope, and system boundaries of the assessment.
2. **Life-Cycle Inventory**. Develop a system-wide inventory of the environmental burdens by identifying and quantifying energy and materials used and wastes released to the environment at each stage of the life cycle.
3. **Life-Cycle Impacts**. Assess the impacts of those energy and materials uses and releases upon the environment and/or human health.
4. **Interpretation**. Evaluate the results and implement opportunities for improvement.

The original LCA methodology has been updated and standardized through guidelines developed by the International Organization for Standardization (ISO 14040:2006 and ISO 14044:2006). These guidelines ensure that all assumptions are transparent, that the system boundaries and functional unit of analysis (i.e., product or service value delivered) are clearly defined, and that data quality, uncertainty, and gaps are clearly stated.

Traditional LCA studies have been based on "bottom-up" analysis of specific industrial processes along the supply chain, which can be burdensome. Although many companies have adopted LCA inventory methods, the use of impact analysis is more controversial. There are a number of limitations to the LCA methodology:

- Rigorous application of LCA requires specialized expertise and training, and can involve considerable time and expense.
- Process-level data are difficult to obtain and may have large uncertainties, especially with new technologies that have not been in widespread use.
- Drawing system boundaries is necessary but may omit important stages in the upstream supply chain or downstream product use chain.
- Inventory assessment alone is inadequate for meaningful comparison, yet impact assessment is fraught with scientific difficulties.
- Conventional LCA does not account for ecosystem goods and services and the impacts of renewable resource use
- However, with appropriate definition of system boundaries, LCA can be useful for identifying the environmental advantages or drawbacks of various design options, thus supporting product development decisions

CARBON FOOTPRINT

A carbon footprint can be calculated by taking an inventory of the total greenhouse gas emissions for a company, facility, product, community, family, or any other entity. The Kyoto Protocol identifies six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). Each greenhouse gas has a global warming potential that can be expressed in terms of equivalent CO_2 [19]. Carbon footprints are typically organized in terms of three successively broader scopes, covering the following GHG sources: illustrated in table 2

Scope 1: Fuel combustion in vehicles or facilities that are directly owned and/or controlled Scope 2: Purchased electricity from fossil fuel combustion (e.g., coal, oil, natural gas) Scope 3: Other indirect sources of GHG emissions (e.g., waste disposal, business travel) The methodology for Scope 1 and Scope 2 assessment is straightforward—it involves enumerating emission sources and estimating their emissions based on standard "emission factor" coefficients. The results can either be expressed in absolute terms, i.e., CO_2-equivalent metric tons per year, or in normalized terms, e.g., CO_2-equivalent kg per sales dollar, per kg of product output, per employee, or per square foot of space. The accepted practice for Scope 3 is to allow considerable latitude in the inclusion of indirect emissions [20]

Financial Analysis

The last category of DFE analysis methods, very important but sometimes overlooked, is the analysis of the financial implications of design decisions. Taking a product life-cycle perspective implies that designers must go beyond conventional cost accounting methods to consider the broader costs and benefits incurred either by the manufacturer, its customers, or other parties at various stages of the product life cycle. [21] shown in table 1

Air Acidification - Sulfur dioxide, nitrous oxides other acidic emissions to air cause an increase in the acidity of rainwater, which in turn acidifies lakes and soil. These acids can make the land and water toxic for plants and aquatic life. Acid rain can also slowly dissolve manmade building materials such as concrete. This impact is typically measured in units of either kg **sulfur dioxide equivalent (SO_2), or moles H+ equivalent**.

Carbon Footprint - Carbon-dioxide and other gasses which result from the burning of fossil fuels accumulate in the atmosphere which in turn increases the earth's average temperature. Carbon footprint acts as a proxy for the larger impact factor referred to as Global Warming Potential (GWP). Global warming is blamed for problems like loss of glaciers, extinction of species, and more extreme weather, among others.

Total Energy Consumed - A measure of the non-renewable energy sources associated with the part's lifecycle in units of megajoules (**MJ**). This impact includes not only the electricity or fuels used during the product's lifecycle, but also the upstream energy required to obtain and process these fuels, and the embodied energy of materials which would be released if burned. PED is expressed as the net calorific value of energy demand from non-renewable resources (e.g. petroleum, natural gas, etc.). Efficiencies in energy conversion (e.g. power, heat, steam, etc.) are taken into account.

Water Eutrophication - When an overabundance of nutrients is added to a water ecosystem, eutrophication occurs. Nitrogen and phosphorous from waste water and agricultural fertilizers causes an overabundance of algae to bloom, which then depletes the water of oxygen and results in the death of both plant and animal life. This impact is typically measured in either kg **phosphate equivalent (PO_4) or kg nitrogen (N) equivalent**.

Life Cycle Assessment (LCA) - This is a method to quantitatively assess the environmental impact of a product throughout its entire lifecycle, from the procurement of the raw materials, through the production, distribution, use, disposal and recycling of that product.

Material Financial Impact - This is the financial impact associated with the material only. The mass of the model is multiplied by the financial impact unit (units of currency/units of mass) to calculate the financial impact (in units of currency) [22]

DESIGNING FOR SHEET METAL FABRICATION OF COCOA DEPOSING AND WINNOWING MACHINE

It is general knowledge that those who are engaged in agriculture are the poor in comparison with those who engaged in other sector of the economy in Nigeria that is to say their standard of living is so low that shortage of funds to enable them facilities has been a major handicap in the development. Investigation shows that the few available small scale processing equipment are not very efficient. This lack of efficiency small scale processing equipment to farmers has increased the inability of their farming activities. Agricultural productivity is measured as the ratio of agricultural outputs to agricultural inputs. While individual products are usually measured by weight, their varying densities make measuring overall agricultural output difficult. Therefore, output is usually measured as the market value of final output, which excludes intermediate products such as corn feed used in the meat industry. This output value may be compared to many different types of inputs such as labour and land (yield). These are called partial measures of productivity. Agricultural productivity may also be measured by what is termed total factor productivity (TFP). This method of calculating agricultural productivity compares an index of agricultural inputs to an index of outputs. This measure of agricultural productivity was established to remedy the shortcomings of the partial measures of productivity; notably that it is often hard to identify the factors cause them to change. Changes in TFP are usually attributed to technological improvements. It is against this background that our research theme was derived and the BENEFITS are summarized below

Cocoa is a cash crop grown throughout the humid tropics with about 6.5 million hectares planted with the crop in 57 countries. Although cocoa has been cultivated for centuries in Central America, it is a relative newcomer to Africa, and even more recent in Asia. In 1998, world production reached 2.7 million tons of cocoa beans. Africa holds a dominant position with almost 70% of production volumes, 40% coming from the Côte d'Ivoire. Ghana (15%) and Indonesia (12%) are two other important producers. The average yield is approximately 400 kg of beans/ha/year.

Almost 90% of production come from smallholdings of under 5 hectares, where cultivation is generally extensive. But production structures differ depending on the continent. In Africa, most production comes from smallholdings, in Ecuador and Brazil, large estates predominate, and in Asia the two sectors are similar in sizing total, more than 20 million people depend directly on cocoa for their livelihood. Once produced and processed into fermented dried merchantable cocoa, the beans are bought from farmers by one or more successive traders, transported then sold to grinders who make semi manufactured products (liquor, butter, press cake, powder). These products are intended for chocolate makers or confectioners for the production of chocolate or chocolate-based products.

Consumption is clearly on the up, with increased consumption of chocolate products and the emergence of new markets in Eastern Europe and Asia. Forecasts expect a production shortfall in the coming years.[8]

Depending on the application, sheet metal offers advantages, not just over nonmetal alternatives but over other types of metal fabrication as well. Compared to machining, it generally has a significantly lower material cost. Rather than starting with a block of material, much of which will be machined away, sheet metal lets you buy what you need and use what you need. The remainder of a metal sheet is still usable, while swarf—the shavings removed in machining—must be recycled. As with many modern fabrication techniques, sheet metal manufacturing can be automated and parts produced directly from CAD models. The technology uses a variety of materials and a range of processes for shaping finished components and products. Perhaps most important, in a world of mass production, sheet metal fabrication is highly scalable. While setup for the first piece can be costly, the price per piece drops quickly as the volume increases. This is, of course, true of many processes, but cost-per-piece for sheet metal generally drops more steeply than for a subtractive process like machining.

Conclusion

It was appreciated that cocoa can be, and is, grown in an environmentally friendly way in many situations. Opportunities may exist for improved resource management and income. Like most other technologies today, sheet metal fabrication is evolving. Materials, equipment, and tooling have become more specialized than ever before. To take full advantage of sheet metal, it is critical that you leverage the correct supplier and method of manufacturing for your parts and their application. Base on this conversation the succeeding policy stay essential, hard work ought to be finished to accept as well as disseminate the design-**DFX, DFA,** DFE illustrated in Figures above ETC particularly for the profits of menfolk who create up a pronounced proportion of the Nation's inhabitants. If, the usage Designing for Sheet Metal Fabrication of Cocoa Deposing and Winnowing Machine embraced, the difficulty in cocoa as well as supplementary agricultural handing out Tools will be lessened besides hunger as well as poverty will be exterminated.

Reference

i. *Adewumi BA. Cocoa bean processing and drying equipment for small and Medium Scale industries. A paper presented at a conference titled 'The Role of Science and Technology in the Development of Small/Medium Scale Industries in Nigeria' organized by the Centre for Research and Development, Ondo State University, AdoEkiti. 1997;17*

ii. *Ademosun OC. Performance evaluation of a medium scale dehulling and winnowing machine. Agricultural Mechanization in Asia, Africa and Latin America. 1993;24(2): 57-60*

iii. *Faborode MO, Oladosun GA. Development of a cocoa pod processing machine. The Nigerian Engineers. 1991; 26(4):26-31.*

iv. *M.M. Kashyap; A.C. Panoya.; "A Qualitative Theoretical Approach to the Problem of Winnowing", Journal of Agricultural Engineering Research; Volume 10, Issue 4, December 1965*

v. *S.P. Singh; Surendra Singh; Pratap Singh; "Ergonomics in developing hand operated maize Dehusker-Sheller for farm women" Applied Ergonomics , 14 November 2011*

vi. *Dr.R.T Patil; "Post-Harvest Technology of Rice", Rice Knowledge Management Portal*

vii. *4 Ricky Smith; "Best Maintenance Repair Practices", Life Cycle Engineering, Inc.*

viii. *Protolabs manufacturing accelerated , Designing for Sheet Metal Fabrication by Proto Labs, Inc. 1999–2018 Protolabs HQ, 5540 Pioneer Creek Dr., Maple Plain, MN 55359 USA*

ix. *Shepard, C.Y. (1932). The cacao industry of Trinidad - some economic aspects. Part 1. The Government Printing Office, Port of Spain. Reprinted from Tropical Agriculture Vol IX 4 pp. 95-100.*

x. *Shepard, C.Y. (11932,1937). The cacao industry of Trinidad - some economic aspects. Part V. The Government Printing Office, Port of Spain, Trinidad and Tobago.*

xi. *Brereton, B. (1981). A history of modern Trinidad 1783-1962. Heinemann Educational Books Inc. 262 pp.*

xii. *, Faborode MO, Oladosun GA. Development of a cocoa pod processing machine. The Nigerian Engineers. 1991; 26(4):26-3*

xiii. *10 Wikipedia ''Material selection'' Available:http://en.wikipedia.org.material selection Retrieved on 31/11/2012, 2011*

xiv. *17, Takeda F, Peterson DL. Machine harvest of eastern Thornless blackberry cultivars. Hort. Science. 1988;23(1):120-123*

xv. *Rufus Ogbuka Chime(2020) Eco Innovation; Computer Simulation In Cassava Grating Machine by www.wjert.org*

xvi. *Baral and B. R. Bakshi, "The Role of Ecological Resources and Aggregate Thermodynamic Metrics for Assessing the Life Cycle of Some Biomass and Fossil Fuels," Environmental Science and Technology, 2009*

xvii. *A good overview of life-cycle assessment methods and applications is:G. A. Keoleian and D. V. Spitzley, "Life Cycle Based Sustainability Metrics," in M. A. Abraham (Ed.), Sustainability Science and Engineering (Amsterdam: Elsevier B.V., 2006).*

xviii. *Water Footprint Network estimates. See www.waterfootprint.org*

xix. *S. Bringezu, H. Schutz, and S. Moll, "Rationale for and Interpretation of Economy-Wide Materials Flow Analysis and Derived Indicators," Journal of Industrial Ecology, 2003, Vol. 7, No. 2.*

xx. *Committee of Sponsoring Organizations of the Treadway Commission, Enterprise Risk Management—Integrated Framework, 2004*

xxi. *Solid work (2018) sustainability analysis*

xxii. *R.O.Chime ,F .O. Odo (2018)Design Innovation In Palm Fruit Bunch Stripper: A Contribution To Sustainable Development by World Journal of Engineering Research and Technology www.wjert*

xxiii. *Hubert OMONT – IPGRI – Commodity Chains January 2001*

xxiv. *Faborode MO, Oladosun GA. Development of a cocoa pod processing machine. The Nigerian Engineers. 1991; 26(4):26-31. 10*

xxv. *Takeda F, Peterson DL. Machine harvest of eastern Thornless blackberry cultivars. Hort. Science. 1988;23(1):120-123*