International Journal of Advanced Research and Publications
ISSN: 2456-9992

Design And Development Of Manually Operated Reaper Machine

Tesfaye Olana Terefe

Faculty of Mechanical Engineering
Assistant Lecturer, Post Graduate Student (Mechanical System Design)
Jimma University, Jimma Institute of Technology, Jimma, Ethiopia, 2017.
tesfitti2016@gmail, robatesh@gmail.com

Abstract: Grain harvesting is the important part in agricultural mechanization. The use of reaper technology in developing countries to minimize the product cost which will be result in economic development of agricultural production. This paper tends to provide the design and development of manually or mechanically operated reaper machine. The current situation in our country the traditional use of harvesting mechanism is more tedious, time consuming and not able to develop the agricultural sector of the low farmers in economic. Depending on the problem stated through abstraction of literature and the existing reapers, to satisfy the customer needs the gathered data has been interpreted to meet the requirement of the objective of the problem. The mission of this project through which the product is developed to spread out the appropriate technology to the countries primary and the secondary market are identified with the stakeholders. The general procedure of conceptual design used; concept generation by decomposing into main and sub function, product ideas from internal and external search, generating alternative solution by setting criteria's and Digital Logical Approach has been used for concept evaluation and selection. The product architecture and configuration finally introduced in the embodiment design after the selection of final concept. Design and development of mechanically or manually operated reaper for grain harvesting machine which is evaluated against the technical and economical criteria's can be carried out to be suitable with the most Ethiopians low farmers capacity.

Keywords: Agricultural mechanization, design and development, grain, harvesting machinery, reaper,

1. Introduction

Harvesting is the first and major post-harvest operation for separation, processing and storage of grains. Harvesting of grains by machines is an important part of mechanized agriculture. At present, developed countries all over the world are using automatic combine harvester for harvesting grains. Some developing countries are also using combine harvesters for harvesting as a high-grade technology. As a medium grade technology, many developing countries are using reaper for harvesting to minimize production cost, and are thereby, making agricultural production economical. [1] The harvesting of grain crops in our country Ethiopia is traditionally done by manual methods. Harvesting of major cereals, pulse and oilseed crops are done by using sickle. All these traditional methods involve drudgery and consume long time. [3]

1.1. Objective

Objective of this project is investigating, acquiring, reviewing and product development of simple harvesting machine, mechanical or manual driven reaper with a reasonable cost for our farmers to an end of the tedious handiwork, the harvesting using sickle, develop or to increase their income by minimizing harvesting cost, their time and number of workers that participating during harvesting season.

1.2. Methodology

In this project the main goal is the development of manually driven reaper by reviewing the previous reaper used for grain harvesting and drawbacks of the reapers. The objective identified to accomplish the goal were:

- Studying and identifying the present mechanisms
- Identifying the potential problem through abstraction.
- Collecting useful data.
- Interpreting data as the problem definition
- Developing conceptual design and selecting based on the digital logic approach procedure of product design and development.
- Finally preparing the embodiment design of the product

2. Literature review

2.1. Background

Until the 19th century, most grain was harvested by cutting with a sickle, scythe, cradle or manual mowers then manually flailed or beaten to break the bond of the grain with the stalk, then winnowed to separate the grain from material other than grain. In the developing world, these practices or the use of small stationary threshers are still in use for grain harvesting. A sickle is a curved, hand-held agricultural tool typically used for harvesting grain crops before the advent of modern harvesting machinery. The inside of the curve is sharp, so that the user can swing the blade against the base of the crop, catching it in the curve and slicing it at the same time. Scythe is a similar tool with the sickle used to harvest grain crops. The most noticeable difference between a sickle and the scythe is the shape of the blade of which the Scythe blade is more linear whereas a sickle blade is more in the shape of a C with a point at the top.

Figure 1: a) *Sickle* ***b)*** *Scythe [18]*

Cradle is a more developed tool for reaping and harvesting. It consists of an arrangement of fingers attached by a light frame work to the snatch of a scythe. Its purpose is to gather the straw as it is cut and deposit it in a swath. At the end of the cutting stroke, the cradle is tilted to drop the straw in a pile. Also, substantially more grain can be cut in a day with the cradle. However, loss due to shattering (grain dislodged from heads due to shock) is greater with the cradle which makes to continue using the sickle to harvest grain. Reapers are harvesting-machines used for cutting grain-crops. They either deliver the grain to one side in gavels ready to bind into sheaves, or elevate the gavels upon a platform where two operators bind them into sheaves by hand. During the 19th century, mechanical reapers and binders were developed to cut and windrow grain for field drying. The sheaves were then hauled to stationary threshers. Around the start of the twentieth century animal drawn machines, “combines,” were developed that integrated cutting, threshing, and separating wheat and small grains. A reaper has been designed and fabricated at the University at the Agriculture, Faisalabad Pakistan [19].

Figure 2: a) Cradle **b)** Reaper [18]

This was a 5kw gasoline engine fitted self-propelled reaper (without conveyor) can harvest a hectare in 2.5hours, and is equally effective for wheat, rice and forage crops. A tractor front mounted reaper has been developed in 1980, at Agricultural Mechanization Research Institute (AMRI), Multan, Pakistan [20]. The drive for its power requiring mechanism is drawn through the shaft with the help of V-belt drive. The mechanism is hydraulically through the 3 point linkage and has a field capacity of 0.5 ha/hr. The vertical conveyor type reaper was developed in People’s Republic of China [21]. This was an 8.95kw diesel engine fitted reaper having a field capacity of about 0.65 ha/hr. and is equal effective for both wheat and rice crop. It is an engine operated, walking type harvester suitable for harvesting and windrowing cereals & oilseed crops. The engine power is transmitted to cutter bar and conveyor belts through belt-pulleys. Grag et al. (1985) designed and developed a front mounted vertical conveyor reaper windrower of 1.9m cutting width, operated by a tractor of about 25hp, could effectively harvested wheat and rice and place the harvested crop on the ground in net windrows that they could be easily collected [22]. An increase in the cutting width of the machine to 2.2m vas recommended for commercial manufacturing to overcome its minor operational problems. Yadav and Yadav (1985) designed and developed a tractor drawn side mounted reaper [23]. The basic design criteria of the machine were to cut the crop green and from crop bunch. The crop is gathered simultaneously with harvesting and dried for threshing at a date. Yadav et al. (1991) designed and developed a light-weight, simple and sloped animal-drawn reaper requiring low draught compared to earlier machines [23]. The crops harvested, cereal, pulses, and oilseeds are delivered in liar bunches behind the cutter bar. The special feature of this machine is transformation of low soil thrust developed at the traction wheel into a higher for cutting crops by a crank and level mechanism at the cutter bar. Singh et al. (1995) designed and constructed an animal drawn reaper with an engine operated cutting and conveying mechanism for harvesting wheat and rice [24]. However, field trails indicated that further improvements in the power transmission system are needed. Farming in Ethiopia is also, generally labor intensive. However, in some localities of Arsi (Asasa, Etheya, Lole, and Dhera) there has been a shift towards the use of agricultural machinery, especially for wheat production since the inception of Chilalo Agricultural Development Unit (CADU) in 1969. [3] Farmers in the aforementioned areas have been interested in mechanical harvesting due:

- To the initial promotion of agricultural machinery
- CADU’s research section evaluated the performance of local farm implements against new farm
- Machines various models of harvesting and threshing machines were evaluated, and a substantial output loss resulting from traditional harvesting and threshing techniques was found.
- The main consequences of introducing mechanical technologies during the 1970s were the eviction of Tenants, increased unemployment, and soil erosion. [25]

Based on the literature reviewed above it may be inferred that the identification of the problems of the reaper is an important aspect to popularize it among the farmers level. Previous studies had been gone through only improvement, development and settings of the machine. No one did find out the main functional problems of reaper and as a result there was very little number of reapers available in the farmer’s field in working condition. So the present study was designed to find out the main functional problems of the reaper and popularize it among the farmers level.

2.2. Statement of the problem

In the present Scenario due to the gradual increase in population, there is too much of demands in the farm sector due to the scarcity of daily labors. The output from these labors is less productive due to manual or hand operations adopted by them. Since heavy machines cannot be introduced due to affordability and limited area of cultivation, it is very essential to bring in a machine which is cost effective, compact and easy to use for low end farmers. So there is the need to make a machine which can perform the following operations,

- Easy harvesting of grains
- Less manual efforts
- Low cost and less maintenance

3. Problem definition

3.1. Defining the problem and objective clarification

As being stated in the statement of the problem in order to develop the product which solve the specified problem the following basic product design specification should be considered. The need to make a machine which should perform the following operations,

- Easy harvesting of grains
- Less manual Efforts

- Low cost and less maintenance

The machine should be functional, reliable, feasible, affordable, etc. The aim is to clarify design objectives and sub-objectives, and the relationship between them. A design has to start from some basic information when confronted with the design task. Sources of the information the data gathered and analyzed from customer or an invention proposition.

3.2. Project mission statement

In order to provide guidance during product development phases, which usually formulates a detailed definition of the product, target market and assumptions under which product will be developed. These decisions are highlighted in the product mission statement which includes the following

- Mission statement:- Mechanically or manually operated reaper machine for grain
- Key business goals:
  - To spread appropriate technology to the country
  - Serve as plant form for all future grain cropping products and solutions
- Primary market:- Farmers
- Secondary market:- Medium Investors
- Assumptions and constraints
  - Manually operated: mechanically
  - Weight of the machine: should be driven by human force
  - Can be manufactured in Ethiopia
- Stake holders:
  - Purchasers and farmers
  - Manufacturing operations
  - Service operations
  - Distributors and resellers

3.3. Customer needs process

Identifying customer needs is itself a process, for which we present a five-step method. We believe that a little structure goes a long way in facilitating effective product development practices, and we hope and expect that this method will be viewed by those who employ it not as a rigid process but rather as a starting point for continuous improvement and refinement. The five steps are:-

1. Gather raw data from customer: through reviewing different literature, existing solution etc.
2. Interpret the raw data in terms of customer needs
3. Organize the needs into a hierarchy of primary and secondary
4. Establish the relative importance of the needs
5. Reflect on the result and the process

3.4. Gathering raw data

During analyzing the customer need process, raw data should be gathered by the following methods

- Reviewing different international and national journal papers
- Observing the traditional method in use and the existing technical problems of a solution

Regarding the mechanically operated reaper machine, the following questions to help us know what their need is.

- When and why do they use the manually operated reaper machine?
- What do they encounter about the existing manually operated reaper machine?
- What do they want to be improved about the existing method?
- What issues do they consider when purchasing the manually operated reaper machine?

3.5. Interpreting data

While interpreting the data the following guidelines are considered

- Express the need as specifically as the raw data
- Express the need as an attribute of the product

Based on the above questions and guidelines, data were gathered from the customers through data collection method stated in the methodology and interpreted as follows.

- The harvesting reaper machine will crop grain
- The harvesting reaper machine is light weight
- The harvesting reaper machine is easily push able and operated

4. Conceptual Design

4.1. Definition of Conceptual Design

The feasibility study of manually operated reaper machine is the process by which its design is initiated, carried to the point of creating a number of possible solutions of manual reaper, and narrowed down to a single best concept, we call this Conceptual design phase. Dieter, G.E., (1991) had given the definition of conceptual design as follow as: "It is the phase that requires the greatest creativity, involves the most uncertainty, and requires coordination among many functions in the business organization. The goal in this phase is to validate the need, produce a number of possible solutions, and evaluate the solutions on the basis of physical realizability, economic worthwhileness, and financial feasibility." [16]

4.2. Concept Generation Methods

In the concept generation phase we should ask the following questions to start with,

- What existing solution concepts, if any, could be successfully adapted for this application?
- What new concept might satisfy the establishment needs and specifications?
- What methods should be used to facilitate the concept generation process?

Basically there are five concept generation methods:-

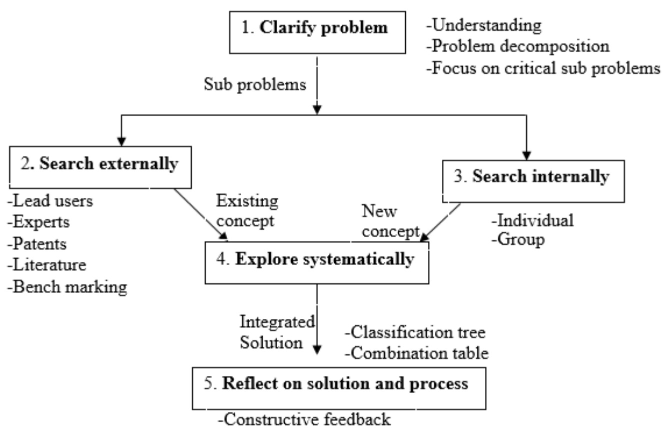

Figure 3: *Concept generation method structure [16]*

4.3. Decomposition into Main Function and Sub Function

Decompose complex problem into simpler sub-problems is essential because many design challenges are too complex to solve as a single problem. Consequently let's decompose the harvesting machine in to simpler sub problems in order to tackle the problems one by one in a focused way. This is the main function of the manually operated reaper machine with the input and output diagram.

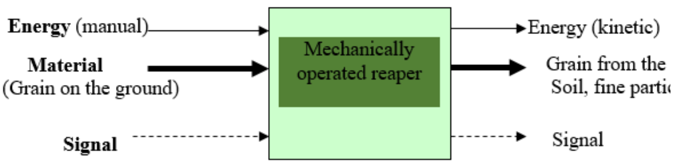

Figure 4: *Input Output Diagram [15]*

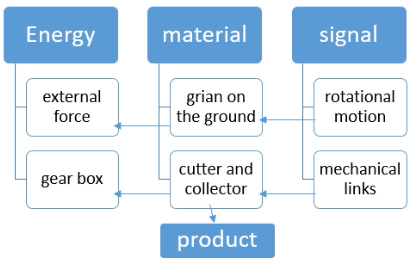

Figure 5: *Main Functional decomposition*

4.4. External and Internal search

By conducting external searches from literature to find existing solutions to satisfy either the overall problem or a sub-problem identified during the decomposition step. These results are found; Tractor driven reaper machine which is

1. Heavy duty.
2. Medium duty.
3. Light duty and for small size row.

Conducting internal searches to find the new solution to satisfy the overall or sub function. Finally come up with the following solution.

1. Human force driven reaper machine.
2. Manual and Animal driven reaper machine

4.5. Functions means tree

Using function tree means we are going to further analyzing the function of the mechanically operated reaper machine we can divide the main function of the harvester into sub functions and we can determine the means for these sub functions.

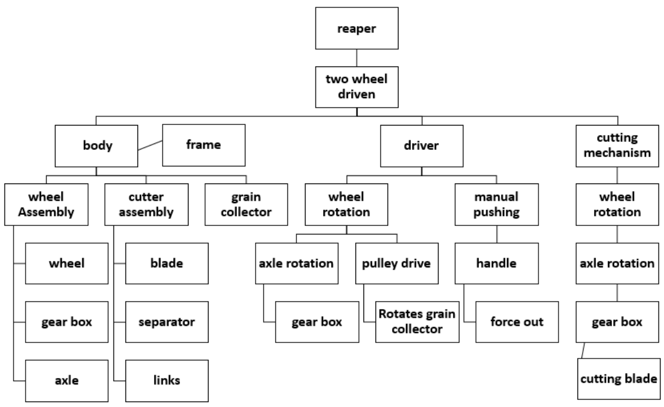

Figure 6: *Function Tree means*

4.6. Generating alternative design

To select one of the superlative choices given for each component, there are steps to be followed.

1. Setting Criteria
2. Calculating a weighting factor for each criterion
3. Evaluating each design with respect to the selected criteria by using a decision matrix.
4. Select the preeminent design based on the decision matrix.

The type and number of criteria are determined by individual judgment. There are no proper set of rules for setting design criteria, since it depends on the type and application of design and its complication. The aim is to generate the complete range of alternatives design solutions for a product, and hence to widen the search for potential new solutions. Of course this is achieved by analyzing the functions and means that we have established in the previous section. Here we should think exhaustively what possible solution we might get to achieve every sub functions of the reaper. As a result we get number of design alternatives. In the design of mechanically operated reaper machine out of the possible alternatives four of them will be analyzed here just to show the methods.

a) Single person driven light duty
b) Two person driven medium duty
c) Three person driven medium duty
d) Animal driven medium duty

Labelling the above concepts as concept 1, 2, 3 and 4.

4.7. Evaluating alternative design concept

In order to make any kind of evaluation, it is necessary to have a set of criteria and these must be based on the design objectives i.e. what it is that design is meant to achieve. The objective will include technical and economic factors, user requirements and so on. Hence the following objectives are chosen to evaluate the design characteristic of each feature. Cost, performance, reliability, availability, maintainability, power we may have the same or different evaluating criteria, which depend on the type of features to be evaluated as well as the amount of dependency if it affects adversely, we could use as a measuring criteria for that feature.

4.8. Determination of weighting Factor

When many design criteria's are used to specify the degree of importance of each, it may be difficult to re-establish weighting factors. One way to do so is to use a digital logic approach. Each property is compared in every combination taken two at a time. To make the comparison, the property that is considered to be the more important of the two is given a one and the less important a zero, the total number of properties under consideration are:

$$N = \frac{n(n-1)}{2} \qquad [17]$$

Where N- The total number of possible comparison pairs.
n- The total number of criteria
w_i - the weighting factor $= m_i / N$
m_i - the total number of positive decisions for the i th criteria

Now using this principle we can apply for the listed design alternative in generating alternative to select the best one.

4.9. Basic selection criteria

- Durability
- Ease of handling
- Ease of maintenance
- Ease of manufacture
- Ease of mountable
- Ease of use
- Few disturbing factors
- Low complexity of components
- Low cost
- Low susceptibility of vibration
- Low wear of moving parts
- Many standards and bought out parts
- Portability
- Simple assembly
- Small number of components [15]

These criteria are general ones. We may evaluate component wise and for the design as a whole too. But we may not use all the criteria for the every component. That is we make selection of criteria to suit the much intended purpose of the component. Now let us screen our design alternative using the set of above selected criteria and let us give their scored values in order to have the best screened design alternatives for the manually operated reaper machine

4.10. Selection of Mechanically Operated Reaper

Table 1: *Selected design of major components*

Design of single person driven light duty
Design of Shifting belt
spoke wheels
Design of fold frame using RHS
solid tyres

4.11. Product structure

The construction of a decision tree is a useful technique when decisions must be made in succession into the future. Determining weighting factors for criteria is an inexact process. Intuitively we recognize that a valid set of weighting factors should sum to 1. Therefore, when n is the number of evaluation criteria and w is the weighting factor,

$$\sum_{i=1}^{n} W_i = 1, \quad 0 < Wi < 1 \quad [19]$$

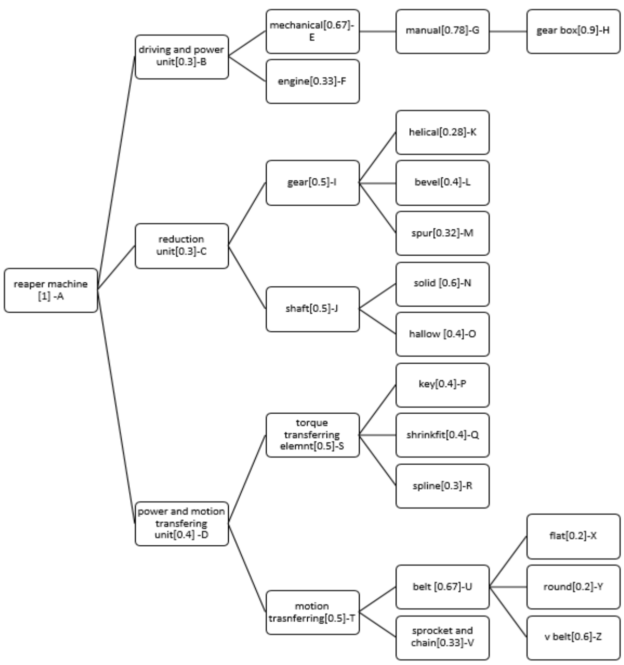

Figure 7: *Product structure division tree*

a) Selection of driving and power unit
Gear box- path **ABEGH=1*0.3*0.67*0.78*0.9=0.141102**
Engine- path ABF=1*0.3*0.33=0.099

b) Gear selection
Helical gear – path ACIK=1*0.3*0.5*0.28=0.042
Bevel gear – path **ACIL=1*0.3*0.4*0.5=0.06**
Sur gear – path ACIM=1*0.3*0.5*0.32=0.048

c) Type of shaft
Solid shaft – path **ACJN=1*0.3*0.5*0.6=0.09**
Hallow shaft – path ACJO=1*0.3*0.5*0.4=0.06

d) Torque Transmitting Elements
Key – path **ADSP=1*0.4*0.5*0.4=0.096**
Shrink fit – path **ADSQ=1*0.4*0.5*0.4=0.096**
Spline – path ADSR=1*0.4*0.5*0.3=0.06

e) Belt Selection
Flat belt –path ADTUX=1*0.4*0.5*0.67*0.2=0.0268
Round belt - path ADTUY=1*0.4*0.5*0.67*0.2=0.0268

V-belt – path **ADTUZ=1*0.4*0.5*0.67*0.6=0.0804**
Chain and sprocket - path ADTV=1*0.4*0.5*0.33=0.066
Note: The bold lines are selected one.
Hence the weighted value of the selected design is =0.141102+0.06+0.09+0.096+0.0804=0.467502

5. Embodiment Design

5.1. Definition of embodiment design

Embodiment design is well known in product development. Kesselring (1654) was the first to refer to embodiment design and introduced a set of principles: minimum manufacturing costs, minimum requirements, minimum of weights, minimum losses and optimal handling. [17] The definition of embodiment design according to Pahl and Beitz (1996) runs as follow as: "Embodiment design is the part of design process starting from the principle solution or concept of consumer product. The design should be developed in accordance with engineering and economical criteria's." [15] Structured development of the design concept occurs in this engineering design phase. It is the place where flesh is placed on the skeleton of the design concept. Embodiment design of the manually operated reaper machine is concerned with two major tasks: product architecture and configuration design.

- **Product architecture:** It is concerned with dividing the overall design system into subsystems or modules. In this step we decided arrangements and combinations of the component; tyre with wheel, shaft with gear & bearing, frame with shaft, gearbox placement and belt driving mechanism, the cutting blade positioning and means of motion transferred to it, and etc. of the reaper machine to carry out the cutting operation properly.
- **Configuration design of parts and components**: Parts are made up of features like holes, ribs, RHS, and curves. Configuring a part means to determine what features will be present and how those features are to be arranged in space relative to each other

5.2. The basic rules of embodiment design

The final design phase will finish the development of the reaper. At the end it has to be completely defined in the following three basic rules of embodiment design: simple, unambiguous, reliable.

- **Unambiguous**: - fulfillment of technical use of manually operated reaper is clear and uncomplicated
- **Simple**: - there are no unnecessary functions or shapes other than fulfilling the main function in which any one can simply understand how it will work, can use the machine
- **Reliable**:- the reaper is usable in a myriad of conditions without harming the user or environment

5.3. Principles of embodiment design [16]

- **Minimum manufacturing cost:** machining manufacturing procedure will be used to simple production of the machine.
- **Minimum space requirement:** all the designed part after assembly
- **Minimum weight:** spoke wheel, RHS frame, hallow shaft of the product
- **Minimum losses** : during manufacturing, by means of machining and welding
- **Optimum handling**: caster will be used for the stability of the machine from the back of the wheel

5.4. Component construction

The main components of the machine are; gear box, RHS frame, spoke wheel, hallow shaft, pulley, cutter assembly, castor, and sub components like bearing, bolt, key, belt & belt housing, and others might be selected as their level of importance. The product configuration, architecture of the reaper is prepared using solidwork software. In the 3D figures below, the geometry and mechanism by which the components assembled together is clear and understandable, while the working principle in which the machine is human force operated by transmitting motion from the wheel to the gear box by means of belt driving mechanism and the cutter assembly operates by converting the rotational motion to slider crank mechanism in order to generate back forth motion. The grain collector from the front which helps to collect the grains from the overhead of the cutter at the time of cutting/reaping directly operated by the rotational motion supplied from gearbox with the help of belt driving mechanism. The castor which assembled from the back side helps the stability of the machine during operating and also keeping it in stationary.

5.5. Bearings, bolt and key selections

a. Bearings

Depending on the type of design, size and operational parameters of the driving mechanism, we use deep groove ball bearings for the shaft and other motion transferring. Since it takes both radial and axial loads. These bearings require little maintenance and their starting resistance is negligible. [14] Strength check type: ISO Bearing type: Deep groove ball bearing single raw

b. Bolts

Here the bolts are used to connect two parts together for assembling.

c. Keys

The keys are used to connect the gear and pulley with the shaft and transfer motion.

5.7. Conclusion

Manually operated reaper machine is very crucial for our country Ethiopia, even though is not currently produced in industries as well as in a small enterprise industries. As clearly the design worked out in this paper we can have the production of manually operated reaper machine that is produced in local industries with the available and cheap materials. The design can be carried out with affordable capacity of most of Ethiopians. And also a better quality product can be produced. That in turn will save a huge amount of foreign currency which was paid to import these huge machineries and also able to provide the low farmers to use the machine in affordable cost.

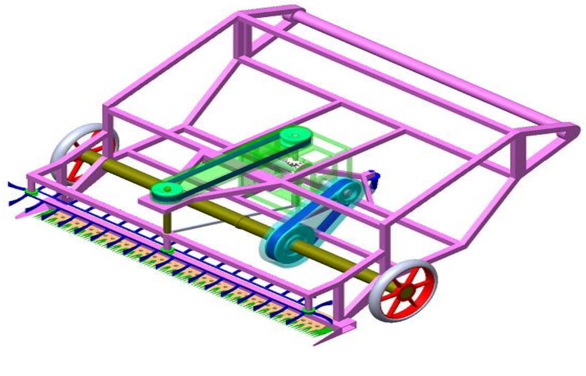

Figure 8: *Solidwork software Drawings*

Reference

[1] Http://Www.Countrystudies.Us/Ethiopia

[2] Alemu Yemane, "Design of Mechanical Driven Reaper" Ethiopia, 2012.

[3] CADU 1969 Progress Report No.1. "Implement Research Section" CADU Publication No. 32.

[4] Ankur S. S, & Prof, Sachin V.D, "conceptual model preparation for wheat cutter for small scale farmer" IJPRET, 2013 vol. 1(9)

[5] Siddaling S & B.S.Ravaikiran, 2015, "Design And Fabrication Of Small Scale Sugarcane Harvesting Machine," IJERGC Vol 3.

[6] Prof. P.B.Chavan, et al, 2015, "Design and Development of Manually Operated Reaper," Vol 12.

[7] Rayapura V.R. 1947, "Design and Development or Reaper for Indian Conditions," India.

[8] Laukik P et al. 2014, "Design, Development and Fabrication of Compact Harvester, IJSRD.

[9] Thomas D. Etal. Development Of Working Prototype Of For Ragi Harvesting And Threshing

[10] Sharmin A. 2014, "Identification of the Functional Problems of Reaper Available," India.

[11] Godfrey M., 2013, "Development of Power Tiller Operated Rice Combine Harvester for Small Holder Firmest," Tanzania.

[12] Aravind C. Etal. , 2015, "Design & Development Of Mini Paddy Harvester," Vol. 3

[13] Handaka and Joko Pitoyo, 2011, "Modification of A Grass Cutter into A Small Rice Harvester," India.

[14] Neil S., 2011, "Mechanisms and Mechanical Devices Sourcebook," 5th Ed. New York.

[15] Pahl G. et Al. 2007, "Engineering Design; A Systematic Approach," Germany, 3rd Ed.

[16] Dieter, G.E., 1991 "Engineering Design," Mcgraw-Hill, New York

[17] Kesselring F., 1954, "Technical Composition," Springer, Berlin.

[18] Http://www.Americanartifacts.Com/Smma/Grain/Cradle.Htm

[19] Chaudhry, A. D. 1978, "Design and Development of Self-Propelled Multi-Crop Reaper." Agricultural Mechanization in Asia, Africa and Latin America, Vol. 6.

[20] Chaudhry, A. D. 1978, "Design and Fabrication of Multipurpose Self-Propelled Low Cost University Reaper." Pakistan Science Foundation Project.

[21] Nafziger, M., V. et al. 1981, "Design and Development of Reaper- Harvester." Publication, Los Banos, Philippines.

[22] Grag, I. K.et al. 1985, "Design, Development and Field Evaluation of a Tractor-Front-Mounted Vertical Conveyor Reaper Windrower." Indian Journal of Agricultural Sciences.

[23] Yadav,R.N.S And Yadav, B.G. 1991, "Design and Development of Bullock Drawn Reaper" Indian Journal Of Agricultural Engineering.

[24] Singh, T. P, et al. 1995, "Design and Development of an Animal-Drawn, Engine Operated Reaper." Agricultural Mechanization In Asia, Africa And Latin America, Vol. 26,

[25] Henock Kifle. 1972, "Investigations on Mechanized Farming and Its Effect on Peasant Agriculture." Cadu Publication No. 74.

Author Profile

Tesfaye Olana received B.Sc. degrees in Mechanical/Design Engineering from Adama Science and Technology University in 2015. And now studying MSc in Design of Mechanical System at Jimma Institute of Technology, Jimma University. During 2015-2016, he stayed in Mizan-Tepi University serving as Assistant Lecturer in Mechanical Engineering Department and other educational positions as well as.

Author pervious work

Tesfaye Olana. Review of Basic Principles of Embodiment Design, International Journal of Business Intelligents, Vol. 6, Issue 1, 2017, pp., DOI:, ISSN: 2278-2400