Concept Generation of Soybean Threshing Machine

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***Abstract*- This paper is regarding the selection of effective mechanism for the Soybean threshing machine out of several other alternatives based on the Pugh Matrix and Concept scoring matrix method.**

***Keywords* - Soybean, Threshing machine, Selection of effective mechanism, Pugh Matrix, Concept scoring matrix.**

I. INTRODUCTION

Soybean is considered as one very important grain grown commercially in more than 35 countries of the world. It contains 40% protein, 35% total carbohydrate and 20% cholesterol-free oil. Soybean requires careful processing to bring out its best qualities.

But due to non-availability of suitable machinery for the harvest and post-harvest operations, the output of traditional manual threshing is time consuming, inefficient and labor dependent. Considering the above facts and socio economic conditions of farmers of the state there is a need to develop a device that fulfills the expectations of the farmers.

Threshing can be done either mechanically or manually. Manual system of threshing is characterized with time wastage, threshing losses, and high drudgery. The mechanical threshing involves high technology which is very expensive, though it helps to maintain the quality of the final products; it eliminates drudgery associated with local threshing system and reduces threshing losses.

Threshing is a major post-harvest operation which is carried out after all crops have been gathered from the field. Threshing consists of separating the beans from the pods (portion of the plant fruit that encases the soybean seeds).Threshing as a post-harvest operation is as old as man. It can be done by hand using simple tools or motor-driven machines. Most soybeans are harvested and threshed simultaneously by modern combines. Whatever system used, it is very important that threshing be done with care to prevent breakage of the beans or hulls

The various threshing methods are:

1. Wire mesh type thresher
2. Perforated GI type thresher
3. Pedal operated thresher

A Flow chart is prepared before the project is proceeded further to understand the sequence of activities. [1][2]

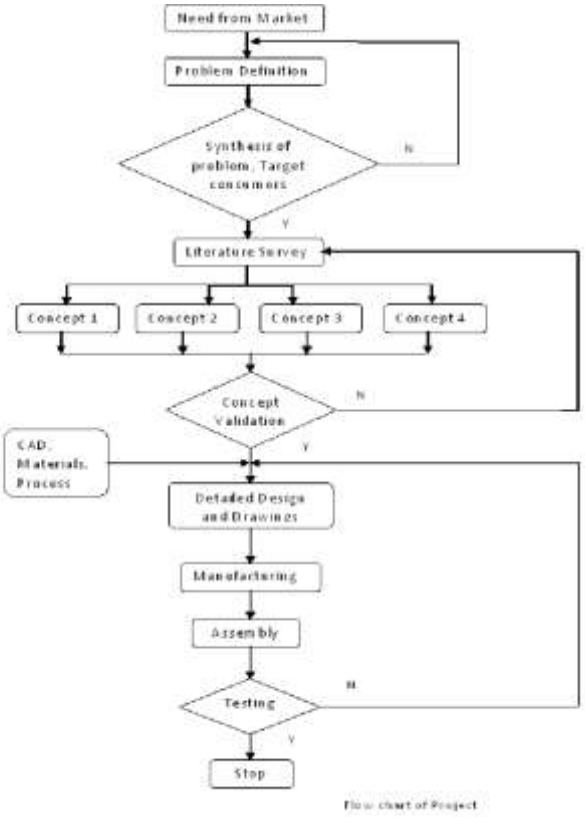

Fig 1: Activity flowchart for concept generation of soybean threshing machine

A. Concept Selection :

A product concept is an approximate description of the technology, working principles, and form of the product. It is a concise description of how the product will satisfy the customer needs. A concept is usually expressed as sketch or as a rough three dimensional model and is often accompanied by a brief textual description.

The concept generation process begins with a set of customer needs and target specifications and results in a set of product concepts from which it is decided to make a final selection. The mission statement for the project, the customer needs list, and the preliminary product specifications are the ideal inputs to the concept generation process, although these information's are still being refined as the concept generation phase begins. [3] The concept methodology used broadly follows that used by Somashekara, et al as a part of their work [4].

Concept Selection involves four stages, namely:

- Concept Generation.
- Concept Screening.
- Concept Scoring.
- Concept Selection.

1) Concept Generation:

Keeping the functionality feature in mind, various concepts are generated which give the desired output. After a study of the available literature, manufacturability aspects to address customer needs which might not be clearly stated, but are implied, such as Compatibility with existing Fixtures/Machines, Reliability (optimum material selection) and Stiffness of loaded members against lateral deformation was also considered by the authors. [7]

TABLE 1 [8]

List of various Concepts

Sl .No	Driver	Media	Mechanism	Operation's
Concept 1	IC engine	*Belt drive with tension* adjuster	Axial flow, throw in peg tooth cylinder	Continuous Movement
Concept 2	IC engine	Belt drive with tension adjuster	Axial flow, Hold on type ,wire Loop tooth cylinder	Continuous Movement
Concept 3	IC engine	Belt drive with tension adjuster	Axial flow, through in type, angle bar Soybean	Continuous Movement
Concept 4	IC engine	Belt drive with tension adjuster	Through flow, through in type, rasp bar threshing	Continuous Movement
Concept 5	IC engine	Belt drive with tension adjuster	Through flow, Hold on type, Hammer mill	Continuous Movement

Concept 1:

Axial flow, throw in peg tooth cylinder soybean threshing machine. [6] [7]

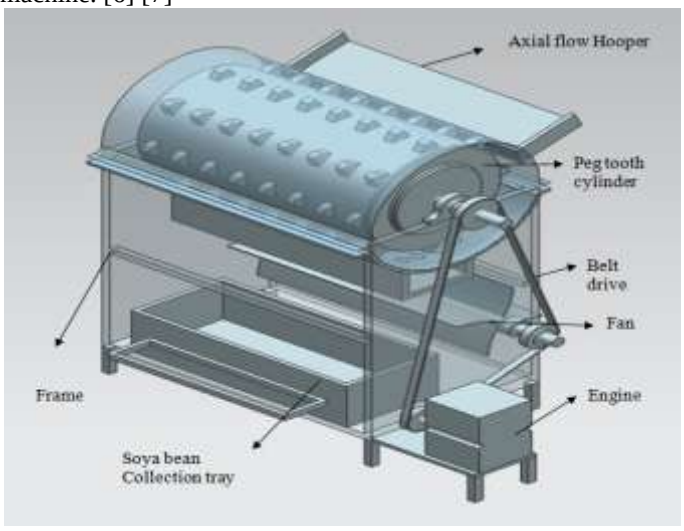

Fig 2: Axial flow, throw in peg tooth cylinder soybean threshing machine

Concept 2:

Axial flow, Hold on type, wire Loop tooth cylinder soybean threshing machine. [6] [7]

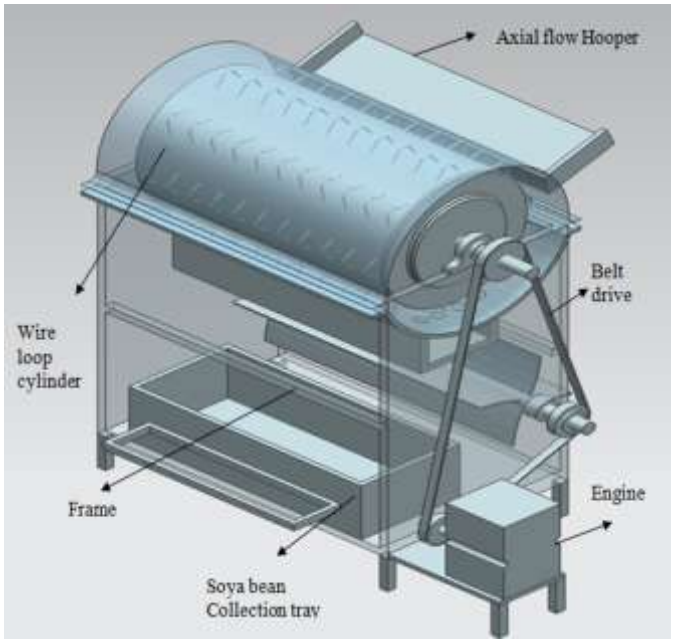

Fig 3: Axial flow, Hold on type, wire Loop tooth cylinder soybean threshing machine

Concept 3:

Axial flow, through in type, angle bar Soybean threshing Machine. [6] [7]

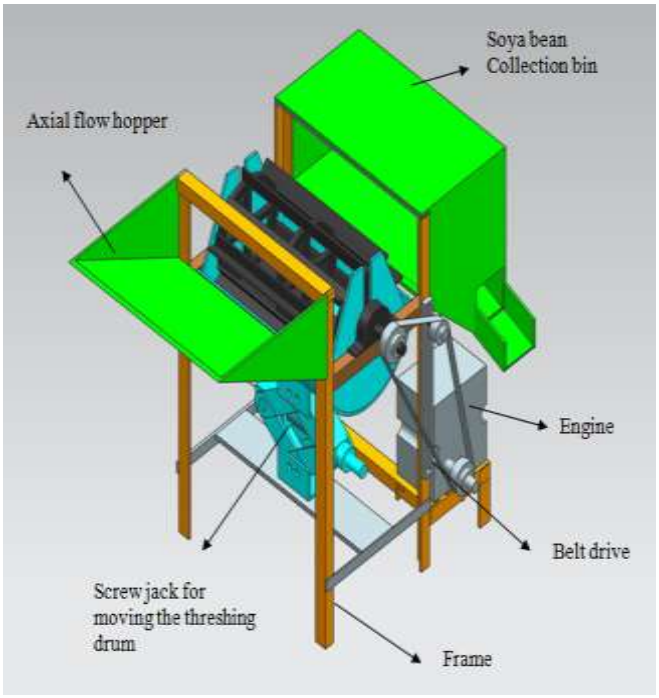

Fig 4: Axial flow, through in type, angle bar Soybean threshing machine

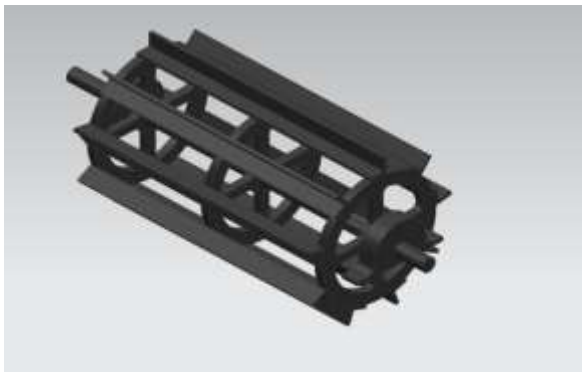

Fig 5: Rotor of through flow, Hold on type, hammer mill Soybean Threshing machine

Concept 4: Through flow, through in type, rasp bar threshing [6][7]

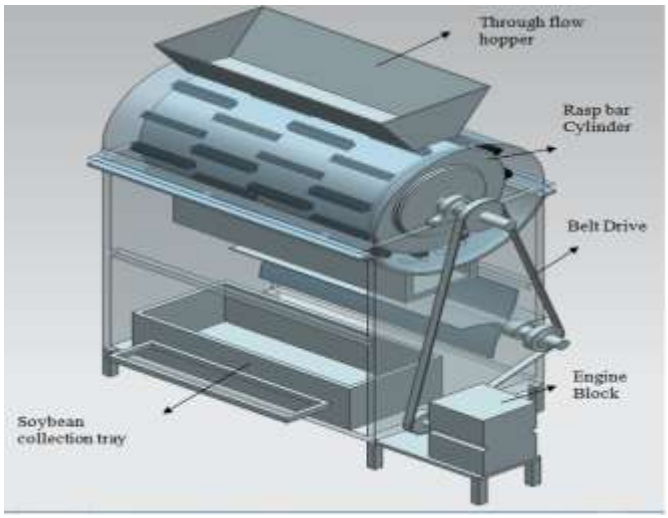

Fig 6: Through flow, through in type, rasp bar threshing machine

Concept 5: Through flow, Hold on type, hammer mill Soybean threshing machine. [6][7]

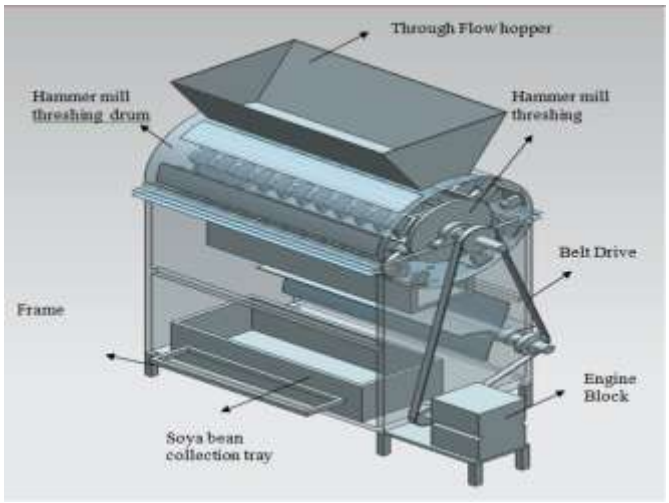

Fig 6: Through flow, Hold on type, hammer mill Soybean threshing machine

2) Concept screening:

The concept screening is based on the method developed by the Pugh concept selection. The purpose of this stage is to narrow down the number of concepts quickly and to improve the concepts. [8][9]

Table 2, illustrates the screening matrix used. The concepts are rated against the reference concept using a simple code (+ for better than, 0 for same as, - for worse than) in order to identify some concepts for further consideration.

TABLE 2 - [8] [9]

Concept Screening Matrix

Selection criteria	**Concepts**				
	C 1	C 2	C 3	C 4	C 5
Customer needs					
A machine to thresh soybean	+	+	+	+	+
Machine cleans the immature (light weight) grains and broken straws from the grains	+	+	+	+	+
It reduces the strain of standing in the sun light	+	+	+	+	+
The machine will be portable for easy transfer	+	+	+	+	+
Machine cleans the soybean faster than manual method	+	+	+	+	+
Machine cost will be affordable to small farmer	-	-	+	-	+
Machine does not use electric power connection	+	+	+	+	+
It keeps the farmer free from the dust during cleaning	+	+	+	+	+
Ergonomic consideration					
Safer(Belt guard/chain guard)	+	+	+	+	+
Height of the Hooper	+	+	+	-	-
Height /location	+	+	+	+	+
Collection tray	+	+	+	+	+
Manufacturing					
Ease of manufacture	-	-	+	-	+
Ease of Assembly	-	+	+	+	+
Can be maintained with readily	-	-	+	-	+
Sums + 's	11	12	15	11	14
Sums -'s	4	3	0	4	1
Sums 0	0	0	0	0	0
Total score	7	9	15	7	13
Rank	**4**	**3**	**1**	**4**	**2**
Continue	**No**	**Yes**	**Yes**	**No**	**Yes**

From the table, concept 1 & 4 are screened off due to the low scores obtained from the above Scoring matrix. Concepts 2, 3 & 5 are considered for the further stages of selection.

3) Concept scoring:

The concept scoring is used because increased resolution will better differentiate among competing concepts.

In this stage, the weights of the relative importance of the selection criteria are recorded and focused on more refined comparisons with respect to each criterion. [8][9]

TABLE 3- [8] [9]

Concept scoring Matrix

Selection criteria	weight in %	Concept - 2		Concept - 3		Concept -5	
		R	WS	R	WS	R	WS
A machine to thresh soybean	10%	4	0.4	4	0.4	4	0.4
Machine cleans the immature (light weight) grains broken straws from the grains	10%	2	0.2	4	0.4	3	0.3
It reduces the strain of standing in the sun light	10%	4	0.4	4	0.4	4	0.4
The machine will be portable for easy transfer	5%	4	0.2	4	0.2	4	0.2
Machine cleans the soya bean faster than manual method	5%	4	0.2	4	0.2	4	0.2
Machine cost will be affordable to small farmer	5%	4	0.2	4	0.2	4	0.2
Machine does not use electric power connection	5%	4	0.2	4	0.2	4	0.2
It keeps the farmer free from the dust during cleaning	5%	4	0.2	4	0.2	4	0.2
Ergonomic consideration							
Safer(Belt guard/chain guard)	5%	4	0.2	4	0.2	4	0.2
Height of the Hooper	5%	4	0.2	4	0.2	3	0.15
Height /location of the grain collection unit	5%	4	0.2	4	0.2	4	0.2
Removable collection tray	5%	4	0.2	4	0.2	4	0.2
Manufacturing consideration							
Ease of manufacture	10%	3	0.3	4	0.4	2	0.2
Ease of Assembly	10%	3	0.3	4	0.4	2	0.4
Maintainability consideration							
Can be maintained with readily available tools	5	2	0.1	4	0.2	3	0.15
Total score	100		2.9		3.2		2.9
Rank			**2**		**1**		**2**
Continue			**No**		**Yes**		**No**

R – Rating (on a scale of 5), WS – Weighted score

The concepts scores are determined by the weighted sum of the ratings. The concept uses weighted sum of the ratings to determine concept ranking. While first concept serves as the overall reference concept.

The concept is selected based on the following eight criterion which the choice of the product concept would be based which are developed by Pugh. The concept selection process, which is closely related to concept generation, concept screening and concept scoring, which helps to refine and improve concepts, leading to one or more promising concepts upon which further testing and development activities will be more focused.

II. CONCLUSION

From the above discussions, the concept 3 which had the maximum score in the Concept screening and Concept scoring stages is selected and considered for the design of the Soybean Threshing Machine.

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