Reducing Cost of Production

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Cost of production is a significant component of the overall cost of a product. Keeping the cost of production at a minimum is a continuous and uphill task. It also means that by saving money in this area being able to offer a better price and services to the customer and becoming more competitive against other market players. Low cost of production is synonymous to increasing profitability of an existing manufacturing unit. This is the line we always toe to keep the Organization going, 'Increase the Profitability'.

The cost of production can be reduced by focusing on various areas of operation, some of which are

- Reduced cost of raw material.
- Reduced material losses.
- Reduced rejection and recycling.
- Reduced process losses.
- Reduce labor cost.
- Reduce time loss. (Reduce down time).
- Reduce overheads.
- Optimize usage of resources
- Increase productivity.

The above and many other areas that have a potential for reducing the cost of production can be explored and exploited by making use of the following measures.

- Finding cheaper sources of raw material (cane in our case), including reduction in transportation cost of raw material (cane) from source to factory.
- Locating improved quality raw material (Cane) such that it's conversion to finished product is more yielding, easier and material loss is also low.
- Managing raw material inventory such that most of the raw material is procured when prices are suppressed. For perishable items optimal stock is held. Obsolescence may be considered.
- Always making efforts to reduce Milling losses, process losses, steam losses, time losses and electricity losses
- Employing trained workers or getting the existing work team trained, taking care of their social aspects such as salaries, health perks etc.
- Providing security of job and health to work team. Providing appropriate incentives to keep the work team motivated.

- Applications of Automation and Instrumentation to reduce losses, improve quality of final product, reduce labor cost, reduce time loss, optimize resources and increase productivity.
- Bring in more efficient processes and machines that result in lower rejection/recycling/rework ultimately reducing the process/material cost. This also improves the quality of finished product.
- Careful selection of equipment at the setup stage and better maintenance program in operation results in reduction in down time, increased productivity and optimizing usage of resources.
- Optimize Administrative costs, inventory, capitol investment, and reduce accident/life compensation by employing better safety measures to keep the ***overheads*** under control.
- Bring about change within the organization when ever felt necessary. This will reveal multifold advantages.

Some of these measures that are considered more important will be discussed in more detail.

Cost and Quality of Raw Material

This is especially important in the case of sugar factories. At times when the crop is relatively small there is an intense cane availability pressures, panic buying erupts a price war and then sky is the limit for cane price. It is also observed that factories at these times even buy cane from far off places and also from each other's operating areas in this manner an unhealthy price competition results in a cut throat situation. In addition extra transportation cost is incurred. This additional cane and transportation cost thus results in higher cost of production. Care should be taken at the proper forum in deciding these matters. Proper control is also necessary on procured cane movement.

Superior verities such as US633, SPF234, CPF237, HS12, Thutta10, SPSG26, of fresh cane, free of trash, sometimes reveals 1 % higher sugar recovery as compared to poor quality cane. These factors should be critically checked at the time of procurement and before milling. Extensive de-trashing of cane in the field or whatever is possible when cane arrives at the factory should be done. This will enable better color removal. It will also reduce bagasse and molasses losses. The trashes removed can be used as fuel at the boilers. These factors results in better quality sugar and reduced cost of production.

The impact of suitable material for processing is elaborated by studying Matiari's crushing example. Above 170 tons of cane per hour is crushed, having sugar loss % cane 0.75 and below, with fiber up to 14.70%; it is observed that with the same mill openings and higher milling speeds this capacity reduces to about 166 tons cane per hour or even lower having sugar loss % cane 0.75 and above when the fiber rises beyond 14.8%. Sample days are shown in Table shown in 'Annexure I'. This clearly shows that with higher fiber the milling capacity reduces and sugar loss in milling increases. Cane with higher fiber is thus not a preferred material for milling.

Similarly when cane juice produces massecuits of higher viscosity or has higher non sugars then molasses losses increase, Pan boiling time increases centrifuging becomes difficult. Higher quantities of pectin gum starch ash and other coloring material in cane juice make color removal difficult. It can be seen from Matiari's example from Table in 'annexure 2' that both the sugar loss in molasses and the boiling time increase with higher NS Pol ratio. This consequently increases the cost of production. Thus

again cane that produces higher viscosity in juice or has a higher non sugar content, is again not a preferred material for processing. In this light it can be said that it is very important to have material which is convenient to process. This will again make it possible to improve the quality of sugar and reduce the Cost of Production.

Continuous un-interrupted milling and other operations are also important because this makes it possible to crush fresh cane by keeping a low cut to crush time (24hours or lower). For this plant maintenance should be continuously improved. 100% plant availability should be the target.

Continuous cane development with the aim to make available improved varieties of healthy cane in one's own operating area is essential. Tissue culture activity is recommended (this is being done at Matiari). Procurement planning to acquire cane according to it's maturity, should also be considered as an important component of reducing production cost.

Reducing Losses, Rejection and Re-cycling

It is wisely said 'a penny saved is a penny earned'. Let us again study the example of Matiari Sugar Mills to first study the effect of material losses and later energy losses on cost of production.

Let us consider a crushing of 4,000 tons for 140 day with a recovery of 10% the total sugar produced in such a season will be 56,000 tons. If the total losses at this crushing reduce by 0.05% than the sugar gain will be 280 tons. Assuming a sugar price of Rs 53,000 per ton without taxes, with this gain in sugar the ***cost of production will reduce by Rs 252 per ton.*** This is a significant saving in just one area.

It is thus imperative to keep the material losses at a minimum. These losses can be controlled by getting good cane as already discussed above. Equally important is adapting good milling and processing practices. Some ^{of} these good practices may be:

Continuous operation; This demands top class maintenance. The desired outcome should be zero stoppage of any equipment. sugar will thus be bagged at the first instance. Resulting in minimum loss

Cane preparation; More are the cell walls of cane ruptured; more juice will be extracted during milling. And finally more will be sugar extracted.91 to 92% open cells is a reasonably excepted figure.

Cane feeding into the mills; A uniform blanket of bagasse into the mill, fed with a pressure of about 2 meter bagasse in the feeding chute of four mills will result in 94+ extraction.

Mill settings; this is an area which is mostly dependent upon the experience of mill engineer. Although many estimation methods are available, these still need practical correction according to mill type, no. of mills in the tandem, cane type, allowed water addition, expected throughput.

Mill hydraulic pressure; In a 4 mill tandem, a specific hydraulic pressure of about 16 t/dm^2 at the crusher and about 21t/dm^2 at the last mill is considered to give a good float of about 35 to 15mm to the mill top rollers across the tandem. This corresponds to a mill hydraulic pressure of about 160 kg/cm2 at the 1st mill and about 200 Kg/cm^2 at the last mill, with a journal size of about 450mm*500mm. Mill extraction

can be increased in excess to 96% with s.h.p. up to 30t/dm^2 but this value is limited due to 21 t/dm^2 due to considerations of excess steam consumption and excess stresses in the milling equipment. Sometimes it is also considered beneficial to keep the hydraulic pressure at the non drive end about 10 Kg/cm^2 higher than what is kept at the drive end.

Imbibition water quantity; 40% water added on cane is considered to be good. Now a days mills are using higher quantities of water and gaining advantage in mill extraction, reduced bagasse pole and increased undiluted juice. Matiari and Faran Sugar Mills are adding about 45% water on cane

Point of application of Imbibition water; the best point of application of Imbibition water is where the bagasse is exiting from a mill, here it has not captured air and is susceptible to absorb maximum water and replace pure juice with it.

Imbibitions water quality; (use condensate if available in excess), more is the quantity of non sugar in juice more is the loss of sugar in final molasses, any impurities if added to mixed juice will increase sugar loss. Thus water with as little contamination as possible may be used.

Juice liming; Free CaO is most commonly used for effective precipitation of impurities in mixed juice.. Lime with 95% CaO is considered to be excellent material. In our country this quality is seldom available, thus lime with about 78% CaO is frequently used. Milk of lime is prepared so that lime is uniformly mixed in juice. with proper mixing and retention time of about 20 minutes can reveal good results. When encountered with difficult to treat juices than literature refers to employing hot liming.

Juice heating; Primary heating up to 70^oC with third vapor and secondary heating up to 104^oC with first vapor and exhaust steam-if considered necessary would reveal the most economical results.

Syrup brix; 65 brix is good syrup to boil at Pans. In seasons 1991 to1996 in Sakrand Sugar mills a continuous brix of 68 was maintained. This resulted in steam % cane of 56 which in those days was considered to be good since sophisticated equipment of today was not available.

Skillful pan boiling; This is a vast field with numerous aspects to look after. One aspect which is considered important is the vacuum in boiling. Too low a vacuum is associated with high temperature boiling this will result in grain melting and consequent reduced exhaustion, where as too high a vacuum may cause entrainment of material at low brix and also energy loss due to excess water consumption at condensers. Excess water consumption on some Pans may cause water starvation at pans placed at the end of the injection header. A vacuum of 610 to 670mm of mercury column is considered efficient, depending on what sugar is being boiled.

Some other points to ponder are: pH control, proper molasses and massecuite conditioning, proper massecuite purging and Plant sanitation. Besides all these it is also important that sugar extracted should be processed at an optimum speed and bagged as soon as possible, this will minimize inversion losses. Spillages and leakages should be reduced to a minimum. The target in this area should be ‘zero losses’.

Rejection and consequent recycling are usually done due to quality issues, for example excess color formation or improper color removal, conglomeration, grain irregularities, burning of sugar and collected spillages. It is a common misperception that all leaked and spilled material is reclaimed and there is no loss after recycling. This is incorrect since all ***inherent losses of all the processes through which all the collected material passes during recycling are added up to the production cost. More over in cases of spillage and leakages all material cannot be and is never recovered, some of it essentially goes down the drain. In addition to the material cost there is energy cost, chemicals cost, labor cost and equipment's capacity loss, associated to recycling.*** All these add up to cost of production thus rejection and subsequent recycling should be avoided as much as possible.

The manufacturing process most suited to a plant's prevalent conditions should be employed. For example Carbonitation may be suitable for one plant having juice with low starch and high ash; but this may be considered energy inefficient at a plant with juice having high starch and low ash where floatation may be more effective. The juice characteristic of the operating area should essentially be determined before setting up the plant and then after be examined periodically.

Besides recycling and inappropriate manufacturing process material and energy losses also occur in other areas, such as having unsuitable, obsolete, inefficient, improperly sized equipment and Incorrect plant operation. ***Equipment with excess capacity requires more energy to operate, moreover, this equipment results in additional material loss and it's idle capacity makes a waste of resources.*** All these factors relating to excess capacity add to the cost of production.

Modern mills, steam turbines, electric motors, drives pans, evaporators centrifugal machines, pumps and heaters are amazingly efficient, replacing of all obsolete and inefficient equipment with efficient and time saving equipment is cost effective these equipment usually also have a low maintenance cost. The replacement will definitely reduce the cost of production.

We at Matiari have observed saving of about:

- 250 Kw electricity by replacing our condensers and spray Injection pumps with modern automated equipment. Consequently saving ***4830 tons bagasse per 140 days season***.
- 150 Kw electricity by installing VFDs and capacitors on motors. Consequently saving ***2890 tons bagasse per 140 days season.***
- 30,000 Kcal/ton steam by installing an economizer of 220 m^2 heating surface area each on 2, 24 $Kg/cm^{2,}$ 45Tph boilers. Consequently saving ***5,000 tons bagasse per 140 days season.***
- 1.3 % steam consumption on cane by Increasing the area of super-heater by 101m^2 each on 2, 24Kg/cm^2 , 45Tph boilers. Consequently saving ***3400 tons bagasse per 140 days season.***

Automation and Instrumentation

Automation and instrumentation can do nothing that human being cannot do. All that is done through instrumentation is more efficient. With automation and instrumentation each function of production is carried out according to a set of instructions given to a machine by man. The actions are taken without feelings, emotions and human limitations thus tasks are carried out with a uniform output and uninterrupted because of absence of human limitations like fatigue boredom or lack of concentration. Due to these advantages the ***work is done more efficiently more effectively and eliminating human error. Rejection and reworking are reduced to a minimum and productivity is maximized. It consequently reduces the cost of production drastically.*** Automation and Instrumentation also reduces the dependence on the work force thus reducing the man-hour cost. This does not mean that instrumentation and automation do not require any attention. Timely and apt maintenance and calibration by the work team are most essential for effective working of Instrumentation. Having new or maintaining already installed Automation and Instrumentation is still very expensive in our country, thus before getting new automation or reconditioning of already installed automation it's return on investment should be critically studied.

Some loops that may lower the cost of production in a sugar factory are Auto cane feeding system, Imbibition water temperature control, pH control, Evaporator brix control, Heaters temperature control, Continuous and batch pan boiling, Sugar re-melting and boiler operation.

We at Matiari have installed Automatic cane feeding to mills. The result is shown in Annexure 3. Throughput has increased to above 3800 TCD from below 3400 TCD. Mill extraction has Increased to above 95.15 from below 94.1. Imbibition has also increased.

Balancing, Modernization, Replacement and Extension

Four important tasks are essential and are needed to be continuously undertaken, to keep the business viable and vibrant.

i) Review and revamp the plant's equipment capacities for optimum operational output, revamp any equipment that has a capacity lesser than required. At the same time try and reduce excess capacity, this will keep material losses at a minimum and help to utilize the plant capacity to the fullest.

ii) Keep the plant up to date; replace obsolete equipment with latest efficient equipment that applies tried technology. All new equipment should be checked to have the desired ROI. Review the processes and change them whenever a more viable process is found. This will increase the plants productivity and reduce material and time loss,

iii) Replace equipment that is less efficient less productive or does not fit into the process capacity wise, this also reduces material and time loss,

iv) Extend the plant capacity when the optimum size of production goes up.

All these steps contribute in Reducing Cost of Production. All this is termed as BMRE. Many sugar factories have periodically taken care of these four steps and benefited. One of the many examples is

Habib Sugar Mills where the plant capacity has been increased from 1500 TCD to 10,000 TCD, the plant has been modernized many a times. It is still abreast with latest technology after 50 years of its inception.

Human Resource Development

It is an established fact that ***organizations having a formally trained work team have an edge over others.*** The trained work team understands the processes and equipment operation better and faster than untrained work force. They are also more receptive to change, thus they have a high productivity and they cause fewer losses. Training should be considered to be a regular component of business. ***Training and retraining is therefore the only way to keep abreast of the developments taking place in and around any specific field of activity.*** It is also an established fact that competence is not only aroused from the inborn creative abilities of a person but it is also achieved from fusion of ideas from different sources. Training sessions held by the organization gives a very good opportunity for doing this. ***Experience may teach what is wrong but what is right or new in a field can only be learned from the process of training and retraining.*** Training when coupled with employee's job and health security definitely results in lower production costs.

One should be mindful of the fact that more a person is trained and skillful more is his requirement for recognition and reward. To retain trained employees they should be offered incentives schemes for high productivity working. Career plans should be made for each employee and timely advancement in career should be ensured. Social benefits such as education and health programs for family go a long way in the efficient working of an employee.

Inventory Management

All tangible items held for sale or those under production for sale or those that may be consumed in production of salable items or help the production process are called INVENTORY. Inventories serve to uncouple all operations and make them independent enough of each other. Thus it is not only desirable, it is vital to low cost manufacturing.

We at present will be interested in control of raw material (cane), process material and plant spares. Effort should be made to keep these three inventories at an optimum value. This will control financial cost of inventory and thus reduce the cost of production. Holding too less sugar cane may result in stock run-out positions, this is more commonly termed as 'no cane'. This is undesired since it interrupts the operation and reduces the plant capacity utilization. On the other hand if too much cane is procured than staleness of cane due to long waiting time reduces the sugar recovery consequently increasing the cost of production.

A similar situation exists with spare parts and process consumables. Too much stocks means a large inventory cost. Stock for these items should be held in such quantities that they are sufficient to avert a

situation of stock run out during the time required for procurement and supply of new stocks reaching the plant. If this happens then the operation of certain equipment or a certain process may stop. Expiry dates of perishable items should also be considered while deciding upon quantity of stocks to be held. Old stocks should definitely be consumed before their expiry date reaches. FIFA Principle should be followed for consumption of stocks. Small stocks should be kept for items that can quickly get obsolete (such as computer spares).

Good practices in physical maintenance and careful keeping of inventory reduce material loss in storage. Similarly a proper documented inventory system helps to prevent over stocking or run out of stocks, enables easy excess to each item when needed, authorizes issues and returns, it also enables identification of redundant, leftover and obsolete items.

The inventory decisions have to be taken against conflicting factors. Thus one is usually faced with the choice between the devil and the deep sea while dealing with these issues. The available techniques for analysis are all indicative and the final decision always has to be made according to specific situation and company policy. If a careful eye is kept on inventory management than the inventory cost can be minimized and the cost of production will also reduce. **An important tip to deal with this situation is that 20% of the total inventory volume carries 80% of the capital value of inventory. Thus critical consideration of this 20% stock will simplify the problem and lead to a better control of the entire inventory system.**

Change

This process is inevitable anywhere. It is more rewarding when a change is brought about voluntarily, in a planned and structured manner, rather than bringing it in a panic, when compelled by prevalent conditions,. At this time the team is unprepared for the inescapable change. The success in such cases is staggering

Change within an organization relating to reduction in cost of production may be brought about to modernize or replace inefficient equipment and processes, use better raw and process materials, address competitive issues, respond to market demand, enhance employees' capabilities, improve working environment, address safety issues, structural changes in management or any other team component. For planning determining and pin pointing the need for a change, it is necessary to periodically review the company goals, profitability obtained compared to target, team performance process capabilities, equipment performance, environmental effect of in-place processes market trends, customer demands and new statutory requirements. Cost effectiveness of all changes should always be considered foremost. The most desired changes are those that require a low resource input and a high return.

Excellent team leaders and team members are required for the success of a change. If the management feels that the team is not strong enough or not suitable to undertake the change, than it should first change the team leaders or team members or get them suitably trained to take up the assignment. Then provide all required resources for the change to a capable team

There might be many other factors that bring down the production cost and have not been discussed here; it can be claimed with confidence that each of the factors discussed here have their contribution in lowering production cost. Focusing on any or all of them will bring prolific results.

Matiari Sugar Mills Ltd.

Annexure 1

28-05-2015

Comparison of Cane Crushing with respect to Fiber % Cane of Season 2014-15 (Sample Days)

#	Low Fiber					High Fiber				
	Date	***Cane Crushed (M.T)***	***Fiber% Cane***	***TCH***	***Loss in Bagasse % Cane***	***Date***	***Cane Crushed (M.T)***	***Fiber% Cane***	***TCH***	***Loss in Bagasse % Cane***
1	18.11.14	4102.98	**14.65**	173.36	0.75	18.02.15	3827.03	**14.83**	168.42	0.75
2	19.11.14	4140.92	**14.67**	173.14	0.75	19.02.15	3982.84	**14.80**	167.11	0.75
3	02.12.14	4059.81	**14.71**	170.34	0.74	20.02.15	3918.13	**14.82**	167.32	0.74
4	12.12.14	4084.13	**14.64**	173.18	0.74	22.02.15	3930.40	**14.82**	166.07	0.74
5	19.12.14	4090.78	**14.53**	170.45	0.72	24.02.15	33934.77	**14.85**	163.98	0.75
6	20.12.14	4006.27	**14.60**	170.48	0.72	25.02.15	3907.12	**14.82**	166.26	0.75
7	22.12.14	4127.93	**14.59**	172.00	0.72	27.02.15	3953.34	**14.86**	165.29	0.75
8	23.12.14	4112.65	**14.23**	171.36	0.72	28.02.15	3881.78	**14.80**	161.74	0.75
9	26.12.14	4180.44	**14.01**	174.79	0.71	07.03.15	3971.11	**14.81**	165.46	0.75
10	31.12.14	4090.51	**14.15**	170.44	0.71	08.03.15	3987.40	**14.81**	167.30	0.75
11	14.01.15	4087.73	**14.20**	172.11	0.74	09.03.15	3872.34	**14.82**	169.59	0.76
12	16.01.15	4026.86	**14.22**	172.58	0.73	13.03.15	3874.42	**14.81**	166.04	0.75
13	17.01.15	4059.13	**14.26**	170.31	0.73	14.03.15	3955.35	**14.78**	164.80	0.75

Annexure-2

2/6/2015

Season 2014-15					
Maximum					
Sr. #	Date	N.S pol ratio	Mol. Losses	R1 Colour	B.mass boiling time Hrs.
1	30.10.14	32.70	1.444	0	0:00
2	31.10.14	32.52	1.448	0	8:00
3	01.11.14	32.60	1.447	0	5:30
4	02.11.14	32.54	1.447	0	6:12
5	03.11.14	32.54	1.442	40	4:48
6	04.11.14	32.39	1.449	35	4:56
7	05.11.14	32.26	1.441	35	5:34
8	06.11.14	32.28	1.437	34	5:03
9	07.11.14	32.28	1.438	33	4:15
10	08.11.14	32.16	1.441	30	4:45
11	09.11.14	31.91	1.438	29	4:30
12	10.11.14	31.89	1.429	28	4:27
13	11.11.14	31.64	1.443	29	4:56
14	12.11.14	31.51	1.444	29	4:17
15	13.11.14	31.22	1.420	27	3:55
Average		**32.16**	**1.440**	**31.73**	**4:50**
Minimum					
Sr. #	Date	N.S pol ratio	Mol. Losses	R1 Colour	B.mass boiling time Hrs.
1	16.02.15	22.90	1.302	38	4:39
2	17.02.15	22.83	1.281	35	4:30
3	18.12.15	22.74	1.273	36	4:41
4	19.02.15	22.50	1.274	33	5:03
5	20.02.15	22.50	1.286	40	4:45
6	21.02.15	22.70	1.285	37	4:39
7	22.02.15	22.75	1.303	35	4:54
8	23.02.15	22.95	1.320	35	4:42
9	24.02.15	23.27	1.337	36	4:15
10	25.02.15	23.40	1.355	38	4:37
11	26.02.15	23.58	1.376	40	4:36
12	27.02.15	23.74	1.392	37	4:27
13	28.02.15	23.77	1.394	36	4:33
14	01.03.15	23.84	1.418	34	4:33
15	02.03.15	23.90	1.423	35	5:07
Average		**23.16**	**1.330**	**36.33**	**4:37**

Matiari Sugar Mills Limited

Anexure3

Mill Performance before & after Auto Cane Feeding & Milling

5/6/2015

#	Description	Year								
		Before Auto Cane	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
1	TCH	3374	3861	3885	3918	3823	38.43	3993	3944	3934
2	Loss in Bagasse % Cane	0.8334	0.7081	0.7092	0.6652	0.6847	0.701	0.708	0.7228	0.7397
3	Milling Loss %	5.9	4.8	4.66	4.55	4.77	4.63	4.71	4.92	5.05
4	Mill Extraction (Mittal)	94.09	95.19	95.34	95.45	95.22	95.36	95.28	95.15	95.12
5	Imbibition % Cane	42.69	44.14	49.24	47.42	49.04	46.04	43.89	44.06	43.79
6	Bagasse Pol	2.62	2.18	2.14	2.09	2.13	2.1	2.16	2.21	2.23