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Logarithm for Sustainable of Value Addition Processes

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ABSTRACT

The port based merchant pellet and pig iron plants are unable to be economically efficient, when constraints are inevitable, causing capital assets at risk. By keeping the constraints as integral part, the improvement of value addition processes are studied, through value stream mapping verses pay off functions. Integral Power Logarithm is used to assess risk index and sustainable process where eco efficiency acts determinant .The algorithm can be used for constraints satisfaction and a tool in the decision making process.

Keywords: Capital Assets, Sustainable Optimization, Information capacity, Pareto Sets, Integral power Logarithm

I. INTRODUCTION

The port based merchant pellet and pig iron process involves multiple logistics due to path flow and modes of raw materials transportation. The logistics are causing economic ineffectiveness thereby the sustainable of the enterprise become uncertainty (Garg 2015). To minimize logistics impact, it is essential to review the flowsheet for overall assessment of product life cycle. Manufacturing of low priced products with high value resources is affecting the productivity apart from human efforts overutilization. The logistics of capital assets and operational methods act as constraints and needs review.

The closure of low grade iron ore captive mine and consequent cease of slurry transportation facilities are the problem scenario leading to economic ineffectiveness. .Geometallurgical facilities can be located either at: 1.Mine 2.Mine and Port .Mine location is suitable for primary as well as secondary process. Mine and port location is depending on transportation such as: Slurry transportation or Land Waterway Modes Raw Materials Transportation Facilities (LWMRMTF). A case study is undertaken for optimization of scenario constrained value addition processes. The scope of this paper is to formulate algorithm to find the sustainable level value addition processes with Land and Waterway Modes of Raw Materials Transportation Facilities (LWMRMTF). Four options are proposed for improvements of value addition processes at port location when constraints are inevitable as practiced in Japan. (NSP (2017) and IBM (2011)).

II. METHODS AND MATERIAL

Back ground of the problem

The backgrounds of the problem are embedded constraints, linear economy and mismatched technology unsuitable for change due to constraints.

2.1 Embedded Constraints*:*

A problem scenario has caused Port based merchant pellet and pig iron plants as "Probability and Loss making value addition processes that resulted uncertainty or risks to capital assets and the enterprise. The risks are due to Entropy imbalance and expressed as cost rationality function as:

$$\text{Entropy Imbalance} = \frac{\text{Transformation Process} - TP_{CV}}{\text{Landing Cost} - LC_{HVRI}} < 1$$

The landing cost of High Value Resources Input (HVRI) like iron ore and coke are more than cost of value addition process. Consequently, the product cost value (LC_{HVRI} + TP_{CV}) is more than Market Rate (MR_1)

2.2. Linear economy:

The pellets and pig iron plants are departmentally capitalized assets before closure of captive mine. Consequently, the problem scenario has tagged the pellet and pig iron plants as "Probability for loss making value addition plants". The capitalized assets act as liability for value realization.

2.2. Non - suitable Technology*:*

The top end agglomeration (pelletizing) and reduction by blast furnace for pig iron value addition processes are unable to be economic efficient when outsourcing of all resources. Since outsourcing is considered as part of constraints, the capitalized value addition processes works against the principle of value addition. So the enterprise that depends on these processes unable to be sustainable under the clouds of problem scenario due to:

(1)Technological and Economical Inability for coexistence of pellet and pig iron plants at port location (Capital assets) (2) Outsourcing iron ore resources as no iron ore captive mine (inevitable logistics) (3) Non alignment of Functional contributions (act as departmental silos for linear economy)

III. Literatures Review

The Challenges for Indian Iron and Steel Industries (FICCI -2018) are Regulatory Bottlenecks, Dumping from other countries, Quality Issues, Logistics Constraints and Raw Material Constraints. These challenges are addressed by (NSP 2017) National Steel Policy – 2017- Ministry of steel and "Sagarmala" to address the challenges facing by coast based industries.

When Iron and Steel industries are struggling for sustainable with its capital assets, the following standards are used as guidelines to be sustainable. The sustainable matrices are: 1.Social – OHSAS- 18000), 2.Environmental (ISO -14000), 3. Economical (ISO 9000), 4.Intuitional (Longevity) – Equivalent to ISO 55000/55001 - 2014 –Assets Management Requirements. The satisfaction of sustainable matrices depends on ISO 55000 - Assets management system. The capital assets are: 1.Pellet and pig iron plants (metallurgy plants) at Port location, 2.Manpower, 3. High grade captive mine (to obtain in future). ISO 55000 is a framework for an asset management system that will help business to pro-actively manage the lifecycle of your assets, from acquisition to decommission. This system helps to manage the risks and costs associated with owning assets, in a structured, efficient manner that supports continual improvement and on-going value creation. One of the clauses of ISO 55001 -2014 stipulates that: "Alignment of processes, resources and functional contributions (instead of departmental silos and competing, short-term priorities)" (4). Methods of Alignment are discussed below.

In most of the literatures the term "sustainability" deals about conservation of resources for future while consuming optimally at present and satisfy three bottom-line indicators such as social, environmental and economical (SEE) .Longevity (L) is for life span of institution or enterprise. Sustainability and longevity are the same coin with different perspectives. Therefore sustainable is expressed in this paper as:

Sustainable = Sustainability + Longevity and abbreviated as $\square_{SEEL}$

The United Nations Commission on Sustainable Development (CSD) devised a framework for sustainability indicators. The structure of framework comprises four dimensions via: Social, Environmental, Economic and Institutional.

The Wuppertal institute also developed framework of sustainability by addressing the four dimensions of sustainable development as defined by UNCSD. Sustainability and longevity are clubbed together by Structural Equation Modelling as shown here.

IV. Structural Equation Modeling (SEM)

4.1. Input and Output Equations:

When an enterprise operates Geometallurgical Intermediate Value Addition Process (GIVAP) like merchant pelletizing and pig iron processes at port location and the processes can be mathematically expressed by SEM as:

$SEM = E = GIVAP = Q_{PRI} \times VAMs = Q_{o\,(P\,1,\,2\,+\,P\,3)} =$

$(P_{1,\,2\,(CV)} > MR_1)$ and $(P_3 = MR_1) \neq (\square_{EL\ LOW} \longrightarrow \square_{SEEL})$ as

$((P_{1,\,2\,(CV)} > MR_1)$ instead of $((P_{1,\,2\,(CV)} < MR_1)$

SEM = Input function (E) ≠ Output function $(\square_{SEEL})$

$(P_{1,\,(CV)} \geq MR_1)$ – Pelletizing - Probability

$(P_{2,\,(CV)} > MR1)$ – Pig iron – Loss Making

The port based pelletizing and pig iron processes may be called as “Probability to Loss Making value addition processes”.

When constraints are embedded, the product’s cost value and sustainable level of the enterprise depends on*:*

$P_{CV} = Q_{PRI} \times VAMs = Q_{o\,(P\,1,\,2\,+\,P\,3)}$ *or*

$P_{CV} = (Q_{HVRI-CV} + TP_{CV}) = (P_{CV} < MR_1)$

$\square_{SEEL} = (\Delta\ E = \Delta\ GIVAP) = LALM_{E\,E}$ *when* eco efficiency > 1 and

$(\square_{EL} \rightarrow \square_{SEEL}) = (\Delta\ E \neq \Delta\ GIVAP) \neq LALM_{E\,E}$ when eco efficiency < 1

Therefore, it is necessary to find LALM that can satisfy equilibrium condition by eco efficiency

4.2. Equilibrium of the enterprise and Geoemetallurgy:

The equilibrium of the enterprise (**Δ E)** as per literatures is, “The enterprise “requires neither extension nor retrenchment. It wants to earn maximum profits in by equating its marginal cost with its marginal revenue, i.e. MC = MR, as per Investopedia (2018)

Δ E = Marginal Revenue (MR2)

Δ GIVAP = Marginal Cost (MC) = $LALM_{EE}$ = Eco efficiency $_E$ > 1

V. Sustainable Optimization

Many organizations in India especially in iron and steel sector are currently strategizing towards sustainability and ultimately longevity. The enterprises that exclusively involved in secondary value addition processes are extremely finding difficult for iron resources and its transportation. The steel companies with captive mine are able to survive for longer time than secondary value addition entrepreneurs as more problems have to encounter due to marketing. However, not many companies have managed to survive and relevant in the current market. The study therefore focuses on creating a framework which illustrates the main factors that are an imperative for any company to survive for a long period of time (Khan MSS (2015) and Abbas (2018),

5.1 The necessity for sustainable framework:

The necessity for sustainable framewo4rk are (1) Optimum resource utilization by technologies (2) Resource verses products maximization(3)Internal customer culture (4)Port facility location as manufacturing and distribution *centre* for southern India and off shore business (5)Local society livelihood

5.2: Economic Variables or parameters:

The sustainable framework includes four main variables which are responsible for sustainability and longevity as 1. Resources – primary and secondary – y, 2. Value Addition Methods – VAMs - (m) 3. Products portfolio ($P_{1,2...}$), 4. Risks, (ρ),

VI. Economic Models and Empirical Tools

6.1: Economic Model:

There is no much scope to minimize the cost of pellets and pig iron, it is proposed for wider products portfolio that can be manufactured at the same port location for equilibrium of enterprise and value addition processes.

The geometallurgy is the combination of Mining, mineral processing and metallurgy termed as LALM is shown Fig: 1 Information Capacity on geometallurgy (IC_G)

$$=\int^{P \geq 1} \log_y m^{\rho} \, d(m) / d(RA)$$

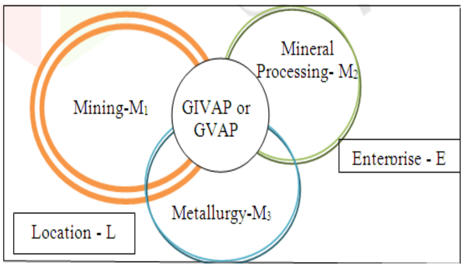

Fig1; LALM of present operation

6.2: Empirical tools

Marginal Cost (MC) = Marginal Revenue (MR_2) are determined by (1) Pareto Sets (1,2,3,4) – Value stream mapping by life cycle engineering verses payoff functions as shown in table -1 and (2) Risk Assessment ($RA_{1,2,3,4}$) by Life Cycle Analysis(LCA).

6.2.1Information Capacity (IC_G): The information capacity is a three dimensional property on resources quantity, life cycle engineering cost and market rate. The enterprise uses its ingenuity to find out marginal revenue by product – demand condition.

A rational company always seeks to maximize its profit, and the relationship between marginal revenue and the marginal cost of production helps to find the point at which this occurs. The point at which marginal revenue equals marginal cost maximizes a company's profit as per Wikipedia-(2016) shown in Fig -2. Increasing the value of the product is the way when the constraints are inevitable.

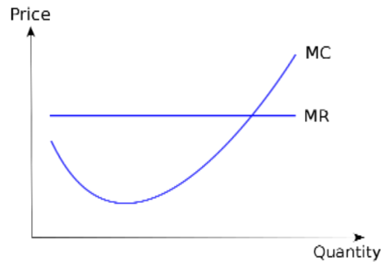

Fig 2; maximising profit with marginal revenue and cost

6.3; Pareto sets (1, 2,3and 4);

Pareto sets (0, 1, 2, and 3) are Value stream mapping verses Pay off functions. Value stream mapping is based on Life cycle engineering (Joseph (2015)).

Table 1; Pareto sets (1, 2, 3 and 4)

Pareto Sets	Value stream mapping	Pay off function	Path flow
RA_1	Top endAgglomeration and Reduction process	Outsourcing of iron ore	Parallel short path
RA_2	Top endAgglomeration and Reduction process	Iron ore captive mine resources	Parallel short path
RA_3	Sintering, Reduction , Oxidation	Iron ore captive mine resources	Linear path
RA_4	Top and bottom end agglomeration Reduction by blast furnace, Oxidation ,Cement , 365 x 24 wind power	Enterprise optimization -Captive mine , outsourcing	Parallel, Linearand parallel path flow

6.4: Path flow and Life Cycle Analysis (LCA)

LCA is used to count manually the values of variables such as y m, P, ρ on each life cycle as shown in Fig 3.

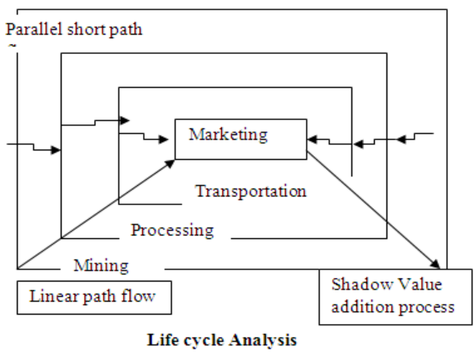

Fig 3: Path flow and life cycle analysis of variables

6.4: Metrics Marginal Revenue (MR2)

Marginal Revenue (MR_2) is the rationality factor and expressed as:

$$MR_2 = \frac{P_{CV}}{P_{SV}} < 1 \quad = \frac{(MR_1)}{(P_{CV})} > 1$$

P_{SV} - Product sale value and P_{CV} – product cost value

7.0: Procedures for Sustainable Process Algorithm Development

As per the structural equation modelling (George (2009), the sustainable matrices are expressed as:

$(\square_{EL} \rightarrow \square_{SEEL}) = (\Delta E \neq \Delta GIVAP) \neq LALM_{EE}$

$(\Delta E \neq \Delta GIVAP) = (MC = MR_2) = LALM_{EE}$ where

$LALM = IC_G$ and $EE = \eta_{eco} > 1$

$(\square_{EL} \rightarrow \square_{SEEL}) = \boldsymbol{LALM_{EE}} =$

$\boldsymbol{RA}_{1,2,3,4} = RIV = \int^{P \geq 1} \log_y m^{\rho} d(m)/d(RA)$

Where RIV - Risk Index Value

Sustainable level SL = 100% - RIV

Eco efficiency - $\eta_{eco} => 1$ = thermodynamically more Equitable value addition

$= < 1$ = Thermodynamically Less Equitable process

1. $LALM_{EE} = (IC)_{RA} = RA_{1,2,3,4}$ = VSM vs. POF
2. $RA_{1,2,3,4} = NV(y, m, P_{1,2..}, \rho)$- NV – numerical values
3. $(IC)_{RA} = RA_{1,2,3,4} = RIV$

   $= \int^{P \geq 1} \log_y m^{\rho} d(m)/d(RA)$
4. $LALM_{SL}$ = 100% - RIV
5. η_{eco}= sum of (η_{HVRI}, η_X η_A)> 1
6. SP = (η_{eco}> 1) and maximum
7. $Q_{IO} = e$
8. $\log_y m = \eta_y$ – Resources efficiency < e
9. $\int^{P \geq 1} \log_y m = \eta_X$– Allocation efficiency > e
10. $\int^{P \geq 1} d(m)/d Z_j = \eta_A$ – Allocative efficiency > e

VII. Results and Discussion

The problem scenario has changed the value addition processes as "Probability for loss making" as against the concept of value addition. The slurry transportation facilities is not viable option between mine and port as the distance is more than 450Km and assumed that there will be hurdles for land.

There are challenges and Opportunities as proposed in the National Steel Policy – 2017 where it is suggested for high value products manufacturing at strategic locations like port to improve coastal area development under Sagarmala proposed by Got Of India (2018)

The geometallurgy is depending on: Genetic properties of iron ore and Life cycle engineering Genetic property and Technology should be compliment to each other. Still economics of geoemtallurgy lies on the multiplicity of the flow sheet. The geometallurgy is depending on Genetic properties of iron ore and Life cycle engineering. When constraints are inevitable, the flow sheet reflects for multi-functional as shown in Fig – 4

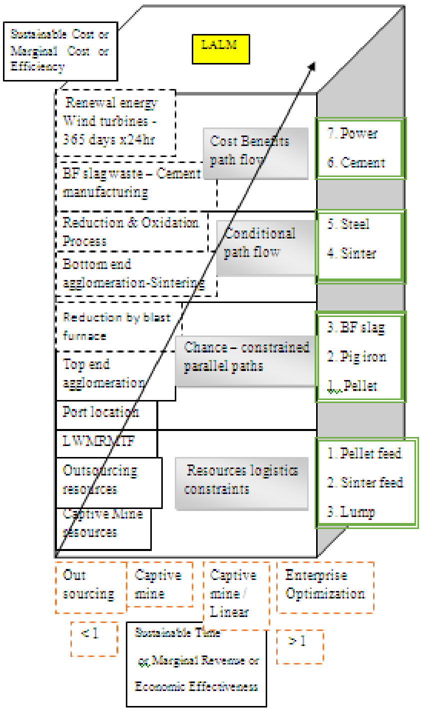

Fig.4 : Geometallurgy and Multiplicity of Flow sheet

The sustainable of scenario constrained pellet and pig iron plants at port location is depending on three factors such as (1) Cubical differentiations of iron ore as pellet, lump and sinter feed t (2) Inclusion of products based value addition processes as entropy equalization (3) Cost benefits value addition processes High grade captive mine assures ore security whereas profitability depends on coke value and products marketability.

Linearization of value addition processes are capital intensive and involve Risk. Without capital investment, the capital assets are sceptitical for the risk and uncertainties continue to flock the enterprise.

LWMRMTF is an external agency controlled operations and prone for risk

VIII. Conclusions

There is a limitation for cost minimization by pelletizing and pig iron processes for profits. The entropy imbalance is due to parameterization and its optimization depends on Integral power logarithm methodology to attain eco efficiency condition. Parameterization for sustainable lies on Characterizations of geometallargy flow sheet from "Primary Iron manufacturing process" (Chance Constrained path) to " Integrated iron and Steel manufacturing processes" (Premium value added path) when constraints are inevitable.

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