Innovative Project Management

'A project is conceptualised due to the necessity felt on ground.'

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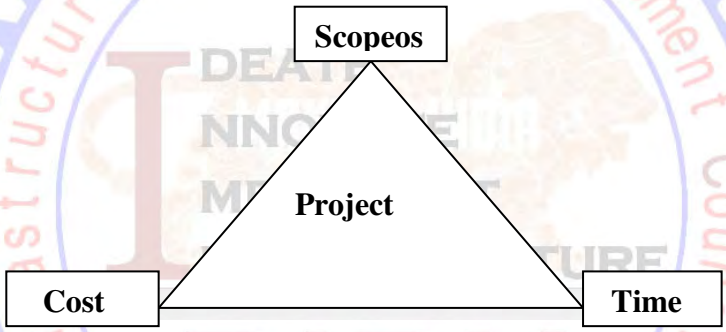
1. INTRODUCTION

A project is an endeavor that is undertaken to produce result that are expected from the requesting party. A project is a single, non repetitive enterprise. Each project is unique, its outcome can never be predicted with absolute confidence. A project consists of three components i.e. (i) scope (quantity), (ii) budget (cost) and (ii) schedule (sequencing & timing). These components are to be achieved within accepted quality, risk, safety and security. Management consists of Man + Age + Men + T. This signifies that the art or science in which a Man with Age is capable of controlling Men and Time is Management. Here Age is sum total of knowledge, experience and maturity. Also, control of men and Time can't be achieved without control on resources which is in the form of material, money, market, machineries and methods. The three basic components of a project are depicted by an equilateral triangle as below;

Project Management procedure vary from company to company and from individual to individual. Although each project is unique, there are basic principles that apply to all project managers and projects. Project Management efforts depend on the size, type and stage of the project.



What we observe in the project is that everyone sees the project externally, as a lifeless object i.e. without brain, body, heart or soul. Our all activities regarding its study or analysis are guided by the fact that it should be completed in time if we put adequate resources. Infact a project is an entity with attribute like a living being. We know there is involvement of architects, engineers, builders, contractors, labour force, manufacturers, suppliers, money, machineries and so on and so forth. Thus, although project may not look like a two or four legged animal moving from one end to the other yet these can be experienced by our deeper connect with it. Soul of the project can be connected with the architect who burns his midnight oil to realise concepts on drawings and thereafter on ground. Once the drawings are received it is the engineer who works as mind of the project and makes all out efforts to implement the ideas on ground. On ground it is the entire team effort. The contractor or the builder, labour force, managers, money, machineries, manufacturers all work in close co ordination with one another to finish the given tasks.

We may bring this living like project's study as below :

Soul	Architect
Brain	Engineer
Body	Labour force, material, machinery
{ Heart, Arteries, veins & support system	Money, contractor

With this in our thinktank we are very close to make a very rough sketch of the structure of the project.

Thus, we are able to bring some life to the project by such involvement. The question however remains as to how to make an objective analysis of the project. How we can be sure that the project is on track or otherwise ? What main ingredients should be taken into consideration for it ?. How much weightage is to be given to such factors ? There are so many questions those immediately come to our mind. But we very well know that all such wishful thoughts can not be considered due to obvious reasons. The fact remains that each individual may see at the project as per his priorities and thus it will become a subjective study. We have to dissociate from such subjective study and move to an objective analysis. To come to such logical end let us decide the main parameters those in general mainly affect the progress.

2. "TEMPLS" STUDY AND PROJECT ANALYSIS

To make an objective study, it is important that we select the most important factors those are main determinants for its progress. These factors if studied rationally, one can conclude at the face of it whether the project is in healthy state or not. If the project is in healthy state efforts can be made to make it healthier and in the case of its sickness remedial medicines can be given to ensure its healthy status with an eye on timely completion.

The study is similar to a patient going to a doctor. When we fall sick doctor by measuring BP, pulse rates, body temperature etc. recommends certain pathological tests. What we see in the pathological tests of the patient that limits are prescribed for various parameters of the patient. We frequently come across such prescriptions and permissible limits as below :

Sugar (Fasting)	70 – 110 normal / < 70 low/ >110 high
BP	80-120 normal / 90 -140 high / 100 -160 very high

Surprisingly, never ever we have come across such study of a sick project. After all, we have given a thought that a project is not a lifeless entity but an entity with lifelike parameters. Notwithstanding this fact, we shall make our study central to such patient care mechanism for our objective analysis. Following main factors have been considered for this study.

2.1 Time - Progress % age relationship (T)

This graph represents the progress percentage and time percentage relationship. Such graph is to be drawn collectively by the client and contractor and make sincere efforts to achieve the progress as per this graph. For a typical project following T – P relationship is drawn.

TABLE 1

Time %	0	10	20	30	40	50	60	70	80	90	100
Progress %	0	5	10	25	40	55	75	80	90	95	100

Following will be criteria for 'T' values.

(a) T ≥ Target Progress %	=> Project is in good health
(b) T is within (-) 5 % of Target Progress %	=> warning sign i.e. reshuffle of resources required
(c) T < (-) 10 % of Progress %	=> Project is turning sick

2.2 Equipments and Machineries (E)

Equipments and machineries are integral parts of any project. In large projects, equipments and machineries form one of the ingredient of Technical Bid (T bid) and bidders are awarded marks on this account for finalising the T bids. For any building project a brief of such inventory may be concrete mixer, trucks, tractors, trailors, Excavator machine, bobcat, vibrators, generator set, water pumps, concrete pumps etc. We will classify their numbers for objective analysis as below :

E ≥ required qty	Project is in good health
E < Required qty	Warning sign, Project falling sick

2.3 Material Availability (M)

Material is again one of the most important resources. Nothing will move without this resource. A clear inventory of the items required is of paramount importance and then their timely procurement and delivery at work site give energy to the project. For our analysis we shall concentrate on the main materials at site and will check their availability for the project.

For an objective analysis of project we will classify material availability at site as below :

M ≥ or equal to actual requirement	=> Project is in good health
M < actual requirement	=> Sick Project

2.4 Predecessor Activity Status (P) :

While studying a project at any point of time, track history of the project during its previous activities definitely speak about its health. Since involvement of all predecessor activities and their analysis will be a complex task, therefore, for this study performance of the immediate predecessor activity shall be our focus. Thus, if the immediate previous activity had been completed in time or before the target date, there are fair chances that the current and subsequent activities will also be completed in time.

For our objective study we shall categorise the performance of immediate activity as below :

If P completed in time or before time	Project is in good health
If P not completed in time	Sickness sign

2.5 Labour Deployment (L):

It is an established fact that labour force is one of the most fundamental resources for the success of any project. Progress is directly proportion to the number of labour deployed at work. Here we make it a point that labour will be defined as the total manpower i.e. skilled and non skilled so as to make one common parameter for all such resource at site. To be correct in our study the number of labour shall be actually calculated as per the activities involved at site on a particular day. But to make our analysis simpler we will go by general formulae i.e. roughly 30 % of the total project cost is labour cost. For an objective analysis we categorise labour deployment as below:

L ≥ daily average of the labour	=> project is in good health deployment based on 30 % of project cost
L < daily average labour	=> Sickness sign deployment based on 30 % of project cost

2.6 Successor Activity (S):

Till now we had been discussing project study related to the concerned activity or its predecessor activity. Equally important is the concern for the successive activities. This concern should be in the form of material resources availability for successive activity.

For our study we will be taking stock of the immediate successor activity which may start within a day, a week or a month from the day of our making project analysis.

We will classify such availability as below assuming that successive activity will start after 14 days.

If material availability is 100 %	Project is in good health
If material availability < 100 %	Sickness sign

Values of TEMPLS parameters shall be taken 1.0 for healthy project and its fraction if the individual factor is on the higher side or lower side of healthy project.

Having given certain defined values based on the actual ground situation and resources availability we are very close to objective analysis of a project since not a single parameter has been left to subjective assessment.

3. HEALTH INDEX OF PROJECT (HI)

Having identified and defined the important parameters affecting project progress we now move to define its Health Index. This is as simple as referring a patient to doctor. The only difference is that the doctor – patient relationship is human to living being relationship whereas here the relationship shall be human to livinglike entity. Doctor is replaced by Engineer and patient by project. Thus, it becomes Engineer – project relationship.

Parameters considered under TEMPLS are the sole criteria for prescribing medicine to the sick project. Our efforts shall be to ensure correct identification of these parameters and giving them correct values based on actual ground realities. Since all the parameters are purely factual based, there is no subjective notion which may affect this study. Health Index is an effort to find a measurable indicator denoting the health of a project i.e. whether the project is progressing well or going out of track.

3.1 Research Methodology adopted for Health Index (HI) :

To decide as to what shall be relationship among these TEMPLS factors was really a challenging task since each one is important for the progress of work. To make such an efforts a value 'x' was assigned to each of the TEMPLS parameters and following possible combinations were checked. X^6, (x^5+x), $(x^4 + x^2)$, $(x^4 + x + x)$, $(x^3 + x^3)$, $(x^3 + x^2 + x)$, $(x^3 + x + x + x)$, $(x^2 + x^2 + x^2)$, $(x^2 + x^2 + x + x)$, $(x^2 + x+ x + x + x)$, $(x + x + x + x + x + x)$ i.e. total 11 combinations were tried. Thereafter different values were assigned to x and following result was obtained.

TRIAL – 1 : TABLE -2

X	X^6	X^5+x	X^4+x^2	X^4+x+x	X^3+x^3	X^3+x^2+x	$X^3+x+x+x$	$X^2+x^2+x^2$	X^2+x^2+x+x	$X^2+x+x+x+x$	$X+x+x+x+x+x$
1.0	1	2	2	3	2	3	4	3	4	5	6
0.9	0.53	1.49	1.47	2.46	1.46	2.44	3.43	2.43	3.42	4.41	5.4
0.8	0.26	1.13	1.05	2.01	1.02	1.95	2.91	1.92	2.88	3.84	4.8
0.7	0.12	0.87	0.73	1.64	0.69	1.53	2.44	1.47	2.38	3.29	4.2
0.6	0.05	0.68	0.49	1.33	0.43	1.17	2.02	1.08	1.92	2.76	3.6
0.5	0.02	0.53	0.31	1.06	0.25	0.87	1.63	0.75	1.51	2.25	3.0
0.4	0	0.41	0.19	0.83	0.13	0.62	1.26	0.48	1.12	1.76	2.4

These results were not taking towards any conclusion. Therefore another attempt was made i.e. to find out the ratio between two consecutive values of 'x - combination' in each column and the result were as below :

TRIAL - 2 : TABLE - 3

X	X^6	Ratio	X^5+x	Ratio	X^4+x^2	Ratio	X^4+x+x	Ratio	X^3+x^3	Ratio
1.0	1		2		2		3		2	
0.9	0.53	1.88	1.49	1.34	1.47	1.36	2.46	1.22	1.46	1.37
0.8	0.26	2.04	1.13	1.32	1.05	1.4	2.01	1.22	1.02	1.43
0.7	0.12	2.17	0.87	1.30	0.73	1.44	1.64	1.22	0.69	1.48
0.6	0.05	2.4	0.68	1.28	0.49	1.49	1.33	1.23	0.43	1.60
0.5	0.02	2.5	0.53	1.28	0.31	1.58	1.06	1.25	0.25	1.72
0.4	0		0.41	1.29	0.19	1.63	0.83	1.28	0.13	1.92

Trial – 2 Contd :

X^3+x^2+x	Ratio	$X^3+x+x+x$	Ratio	$X^2+x^2+x^2$	Ratio	X^2+x^2+x+x	Ratio	$X^2+x+x+x+x$	Ratio	$X+x+x+x+x+x$	Ratio
3		4		3		4		5		6	
2.44	1.23	3.43	1.17	2.43	1.23	3.42	1.17	4.41	1.13	5.4	1.11
1.95	1.25	2.91	1.18	1.92	1.26	2.88	1.18	3.84	1.14	4.8	1.12
1.53	1.27	2.44	1.19	1.47	1.30	2.38	1.21	3.29	1.16	4.2	1.14
1.17	1.30	2.02	1.20	1.08	1.36	1.92	1.24	2.76	1.19	3.6	1.17
0.87	1.34	1.63	1.24	0.75	1.44	1.51	1.27	2.25	1.23	3.0	1.2
0.62	1.40	1.26	1.29	0.48	1.56	1.12	1.34	1.76	1.27	2.4	1.25

From the above table nothing substantial could be established about the relationship of these x values and TEMPLS parameters.

Therefore, another trial was made to check the percentage of x - combination values in terms of the total value of the coefficient under that column. Following results were obtained :

TRIAL – 3 — TABL: 4

X value	X^6	%	X^5+x	%	X^4+x^2	%	X^4+x+x	%	X^3+x^3	%
1.0	1	100	2	100	2	100	3	100	2	100
0.9	0.53	53	1.49	75	1.47	74	2.46	82	1.46	73
0.8	0.26	26	1.13	57	1.05	53	2.01	67	1.02	51
0.7	0.12	12	0.87	44	0.73	37	1.64	55	0.69	35
0.6	0.05	5	0.68	34	0.49	25	1.33	44	0.43	22
0.5	0.02	2	0.53	27	0.31	16	1.06	35	0.25	13
0.4	0	0	0.41	21	0.19	10	0.83	28	0.13	7

Trial – 3 Contd :

X^3+x^2+x	%	$X^3+x+x+x$	%	$X^2+x^2+x^2$	%	X^2+x^2+x+x	%	$X^2+x+x+x+x$	%	$X+x+x+x+x$	%
3	100	4	100	3	100	4	100	5	100	6	100
2.44	81	3.43	86	2.43	81	3.42	86	4.41	88	5.4	90
1.95	65	2.91	73	1.92	65	2.88	72	3.84	77	4.8	80
1.53	51	2.44	61	1.47	49	2.38	60	3.29	66	4.2	70
1.17	39	2.02	51	1.08	36	1.92	48	2.76	55	3.6	60
0.87	29	1.63	41	0.75	25	1.51	38	2.25	45	3.0	50
0.62	21	1.26	32	0.48	16	1.12	28	1.76	35	2.4	40

From this table, we see there is some definite relationship in the % age of x value under all the permutations except for the first one that is x^6. For the last permutation the % ages is varying linearly like 100, 90, 80 due to obvious reasons i.e. linear progression. Therefore, these % have been brought together as below for further analysis.

TABLE: 5

X value	X^6	X^5+x	X^4+x^2	X^4+x+x	X^3+x^3	X^3+x^2+x	$X^3+x+x+x$	$X^2+x^2+x^2$	X^2+x^2+x+x	$X^2+x+x+x+x$	$x+x+x+x+x+x$
1.0	100	100	100	100	100	100	100	100	100	100	100
0.9	53	75	74	82	73	81	86	81	86	88	90
0.8	26	57	53	67	51	65	73	65	72	77	80
0.7	12	44	37	55	35	51	61	49	60	66	70
0.6	5	34	25	44	22	39	51	36	48	55	60
0.5	2	27	16	35	13	29	41	25	38	45	50
0.4	0	21	10	28	7	21	32	16	28	35	40

To further refine this, average of all these permutations was taken and thereafter the highest and the lowest values (outliers) were taken out from each permutation and average of balance permutation was done. We got following figures :

TABLE: 6

X value	Average of all %ages	Average of % ages after removing outliers	Average of % for this study
1.0	100	100	100
0.9	79	81	81
0.8	62	64	64
0.7	49	51	49
0.6	38	39	36
0.5	23	29	25

Therefore, from here we see that whatever be the permutation and the combination of the variables (TEMPLS), a pattern as above shall be followed while taking the percentage of the total value of the parameters. This gives us a clue that if all the TEMPLS parameters are having value as 1.0, the project will be completed in time or the health of project is fine. Since average is 100 % we call that Health Index (HI) =100 for such a permutation. On the similar pattern if all the TEMPLS parameters are 0.9 then project's HI = 81 i.e. project is delayed by 19 % time. Similarly, the same analogy shall follow for other permutations.

Having established HI, the next step was to define HI when there will be other permutations of TEMPLS.

Hit and trial approach was followed and after a lot of efforts a general equation as below has been derived :

$$\mathbf{HI = 101\ (M^2 + L^2 + E^2 + 0.5(S + P + T) + S \times P \times T)/5.5 - 1/(M \times L \times E + 0.001)}$$

This equation was tested for various combinations of the TEMPLS parameters and the results were as hereunder ;

TABLE : 7

T	E	M	P	L	S	HI
1	1	1	1	1	1	100
0.9	0.9	0.9	0.9	0.9	0.9	81
0.8	0.8	0.8	0.8	0.8	0.8	65
0.7	0.7	0.7	0.7	0.7	0.7	50
0.6	0.6	0.6	0.6	0.6	0.6	36
0.5	0.5	0.5	0.5	0.5	0.5	22
0.4	0.4	0.4	0.4	0.4	0.4	6
0.365	0.365	0.365	0.365	0.365	0.365	0
0.3	0.3	0.3	0.3	0.3	0.3	- 22

4. SICKNESS COEFFICIENT (SICOF)

Having established the equation for Health Index (HI) of the project, the task of a project manager becomes comfortable. 'HI' will reveal the correct ground facts and one can assess the likely time of completion of project. Higher HI reflects better progress on ground whereas lower HI means poor health or the project is going to sickness. In simplest terms value of HI below 100 means project is moving to sickness and therefore, engineer has to give medication to it to keep it healthy. SICOF is sickness status of the project. Following relationship has been derived between these two.

$$\mathbf{SICOF = 1 - HI/100}$$

This reveals that if HI = 100 i.e. project is healthy, thus SICOF = 0.0. Similarly, for HI = 0, SICOF = 1 i.e. project is extremely sick. In tabular form following values are derived from above equation :

TABLE : 8

X	1	0.9	0.8	0.7	0.6	0.5	0.4	0.365	0.3
HI	100	81	64	49	36	25	6	0	(-) 22
SICOF	0	0.19	0.36	0.51	0.64	0.75	0.94	1.0	1.22

In the HI equation denoting HI we notice that at 0.365 level of all the parameters, value of HI =0. Infact there are many other permutations and combinations of TEMPLS parameters those bring value of HI =0. What do we derive out of this HI =0. Since we have no established norms or data for such a situation, it is derived that at HI =0, contractor is not at all concerned for the progress of work and therefore, client should take a decision to cancel the contract and enter into fresh contract. Technically and contractually, we may call that the project is at the verge of collapse. Beyond this point there is no possibility of recovery or revival.

5. CASE STUDIES

5.1 CASE STUDY 1 :

OTM ACCN AT BAGRAKOTE (PH –I) : Cost Rs 10 Cr

Start Dt – 19.8.13. Stipulated Compln Dt – 18.8.15. (24 months).

Actual Compln Dt – 31.3.15 Contractor : M/S Varni Constructions

Following values were assigned to TEMPLS parameters ;
Time – Progress Relationship 'T' - For T-P graph following was decided and achieved ;

TABLE : 9

Time %	0	10	20	30	40	50	60	70	80	90	100
Target Prog %	0	5	10	25	40	60	75	85	90	95	100
Actual Prog %	0	7	19	41	53	65	75	85	100		
Var %	0	2	9	16	15	5	0	0	10		

The Table shows that Actual progress has always been more than Target progress.

Equipment / Machineries 'E' : All T & P, Equipment / Machineries were always at site. Therefore, value of 'E' = 1.10 for our analysis i.e. considering values of 'M' & 'L' as below.

Material Inventory 'M' : Material inventory was never any problem. It was always more than 110 % of the requirement. So value of M > 1.0, but had to be restricted to 1.10 since labour coefficient was 1.10 as shown below.

Predecessor activity status 'P' : From the above table it is evident that Predecessor activities had been attained ahead of the schedule. So P shall be considered same as T

Labour 'L' : Work diary reveals that average nos of labour at site was 200 to 210 appx (avg 205). Assume 30 % labour component i.e. Rs 3.33 Cr. @ Rs 14 lakh per month. Average wages @ Rs 300/- and working days 25 i.e. 187 labours/day. Therefore, for L fraction shall be 205/187 = 1.096 say 1.10 **Successor Activity inventory 'S'** : Material inventory for successor activity was never any problem. So 'S' = 1.0

From TEMPLS analysis, following HI and SICOF were derived ;

TABLE: 10

Time	0	10	20	30	40	50	60	70	80	90	100
HI	0	113	117	121	119	115	112	112	118	NA	NA
SICOF	1.0	- 0.13	- 0.17	- 0.21	- 0.19	- 0.15	- 0.12	- 0.12	- 0.18	NA	NA

Average HI = (113+117+121+119+115+112+112+118)/8 = 115.875

Say 116 This reflects that the work is likely to be completed 16 % ahead of schedule date. i.e. 24 X 0.16 = 3.84 = 115 days Actual compln date = 31 Mar 2015 i.e. 4 months 18 days (before 18.8.15) = 138 days % Variation = 16.67 %

5.2 CASE STUDY 2 :

MAP ACCN AT DARJEELING : Cost Rs 23.02 Cr Start Dt – 08.12.2011. Stipulated Compln Dt – 07.6.2014. (30 months).

Actual Compln Dt – Wk still in progress Contractor : M/S India Builders

Following values of TEMPLS parameters were assigned ; **Time – Progress Relationship 'T' -** For T-P graph following was decided and achieved;

TABLE: 11

Time %	0	10	20	30	40	50	60	70	80	90	100	110
Planned Prog %	0	5	10	20	40	60	75	85	90	95	100	
Actual Prog %	0	0	4	8	12	20	25	40	50	58	64	
% Var	0	-5	-6	-12	-28	-40	-50	-45	-40	-37	-36	

The Table shows that Actual progress has always been far behind the Target progress.

Equipment / Machineries 'E' : All T & P, Equipment / Machineries were always at site. But labour was not commensurate with the requirements. Therefore, value of 'E' = 0.47 for our analysis i.e. considering values of 'M' & 'L' as below.

Material Inventory 'M' : Material inventory was at site but its utilisation is directly proportional to nos of labour force at site. So value of M = 0.47 i.e. equal to 'L' as shown below.

Predecessor activity status 'P' : From the above table it is evident that Predecessor activities had been attained ahead of the schedule. So P shall be considered same as T

Labour 'L' : Work diary reveals that average nos of labour at site was 140-150 appx (avg 145). Assume 30 % labour component i.e. Rs 6.9 Cr. @ Rs 23 lakh per month. Average wages @ Rs 300/- and working days 25 i.e. 306 labours/day. Therefore, for L fraction shall be 145/307 = 0.47

Successor Activity inventory 'S' : Material inventory for successor activity can not be interpreted under such uncertainties. So 'S' =0 or we can put S = 0.47 i.e. M. For this study S = 0.47.

From TEMPLS analysis, following HI and SICOF were derived;

TABLE : 12

Time %	0	10	20	30	40	50	60	70	80	90	100
HI	0	20	20	19	16	13	12	11	10	9	9
SICOF	1.0	0.8	0.8	0.81	0.84	0.87	0.88	0.89	0.9	0.91	0.91

Average HI = (20+20+19+16+13+12+11+10+9+9)/10 = 13.9 Say 14
HI has been ≤ 20 from the very beginning. Therefore, there is no chance of revival and the work should be terminated.

6. TREATMENT OF SICK PROJECT

Having identified the Health Index (HI) of the project and its Sickness Coefficient (SICKOF) we are now well equipped to give treatment to the sick project. It is a fact that all factors shall not be equal to each other. PM should render treatment to the project such that 'HI' always remains ≥ 100. During the course of the project there may be instances when HI may fall below 100 but such instances should not be allowed to continue for more than a week's time and immediate actions shall be required to bring HI ≥ 100. Also, if situation becomes critical that certain parameter has fallen below 1.0, then the project manager shall ensure that there is enhancement in the value of some other TEMPLS parameter to bring project back on the track.

Some of such permutations which bring value of HI =100 are as shown below :

TABLE : 13

T	E	M	P	L	S	HI
0.6	1.1	1.1	0.8	1.17	1	100
1	0.7	1.11	0.9	1.2	1	100
1	1.15	0.8	1	1.03	1	100
1.05	1.1	1.1	1	0.7	1	100
1	1.05	1.07	1.05	1.07	0.7	100

7. LIMITATION OF STUDY

Although all efforts have been made to come to a logical conclusion regarding status of progress at any time during the currency of project, yet the study does suffer from certain limitations as below;

(i) HI has been derived out of pure hit and trials methods therefore, its scientific correctness can not be verified. The results however can be verified on the actual case studies.

(ii) Values of HI are varying in proportion to the square of the indices if they are equal to each other. For example for all parameters of TEMPLS if value is 1.0, HI =100. Similarly for 0.9, HI = 81, for 0.8, HI = 64 and so on. But for a value of 0.4 and below there is variation in the values. Similarly for values more than 1.0 upto 1.30 it varies as per square terms but beyond 1.3 there is some minor variations.

(iii) As observed in Table -12 above, if M < 1 i.e. 0.8 in this case, even then we are able to achieve HI = 100 by putting values of L = 1.03, E = 1.15 and T = P = S = 1.0 despite the fact it is well established that if there is no material availability, there is no point of putting extra labour or equipments.

Therefore, area is wide open for future research in this field.

8. CONCLUSION

Notwithstanding all these limitations, SMART equation is definitely a revolutionary step in the direction of scientific analysis of project management and it will go a long way in guiding all the future researchers in this field to come to a logical conclusion.