

# IMPLEMENTATION OF SIX SIGMA METHODOLOGY (DMAIC) FOR THE ENHANCEMENT OF LEARNING & MOTIVATION LEVELS OF STUDENTS

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**Abstract:** Our aim of this study is to evaluate the relationships of dependant variables i.e. learning levels (based upon Bloom's taxonomy), motivation & results of students against the factors of Batch #, Semester #, time for study at home, program, subjects, topics, age, gender, graduation background, selection of topic for research from this course, application of this course in job and relevance of topic to career in general. Learning levels include Knowledge, Comprehension, Application, Analysis and Synthesis. The marking to these levels signify 1,2,3,4 & 5 respectively. The motivation, learning and result levels were measured through Likert scale of 1 – 5 (1 being the least and 5 the highest). The result levels were also converted to a scale of 1 – 5 (by dividing the marks obtained in a subject by total marks and then multiplying by 5). The process included obtaining feedback from the students of relevant programs on prescribed formats.

Abbreviations used: Motivation (M), Result (R) & Learning (L).

Six Sigma methodology (DMAIC) was utilized, in order to define and measure the existing sigma level and the steps which should be taken in order to enhance learning and motivation level of students which in turn will enhance Sigma level as well. This study embeds the concept of Bloom's taxonomy with Six Sigma methodology which was applied to the M.Sc & M.S programs of Quality and Human Resource Management.

After implementation of the proposed solutions, it is anticipated that the sigma level will be improved from 3.45 to 3.85 approx, the defect rate would be reduced from 13.36 % to 4.39 %. After implementation of the proposed solutions, in the next academic session 9.0 % enhancement in the present revenue (in the form of fees) is expected because of the increased number of intakes (students) due to enhanced level of learning and motivation levels of students.

## INTRODUCTION

Emergence of interdependent global economy is creating new challenges. Several management tools and techniques are developed to help maintain or achieve a higher excellence level. Six Sigma methodology is one of the most famous problem solving tool.

Six Sigma is a business management approach, formerly established by Motorola, USA in 1986. Six Sigma became well known after Jack Welch made it a dominant emphasis of his business approach at GE in 1995, and today it is widely being utilized in many processes / sectors of organizations.

Six Sigma pursues to progress the quality of practice outputs by categorizing and eliminating the reasons of deficiencies (errors) and minimizing variability in business processes.

This research project is about the enhancement of learning and motivation levels of students of M.S. & M.Sc (Quality Management & Human Resource Management).

**Bloom's Taxonomy** is a grouping of learning goals within education proposed in 1956 by a team of educationalists chaired by Benjamin Bloom. Although named for Bloom, the publication followed a series of conferences from 1949 to 1953, which were planned to progress communication between educators on the design of curricula and examinations.

Bloom's Taxonomy distributes educational objectives into three "domains": Cognitive, Affective, and Psychomotor. Within the domains, learning at the higher levels is dependent on having attained prerequisite knowledge and skills at lower levels. In this research, we will be using the Cognitive domain. Bloom's Taxonomy is well-thought-out to be a introductory and indispensable component within the educational

community as evidenced in the 1981 survey *significant writings that have influenced the curriculum: 1906-1981*, by H.G. Shane and the 1994 yearbook of the National Society for the Study of Education.

Learning & Motivation level are directly proportional to the success of any professional institute and these directly concerns with the business growth of the institute.

Well learned & motivated students of our programs when pass out from this institution to serve in a different organization, their learning capabilities and motivation speak about the success of our programs and the organizations will get the benefit of their strengths.

Students can apply knowledge to solve related problems, analyze the data to see co-relations among factors involved in the topics, as well as understanding of problems faced by organizations and they will be able to design/develop appropriate systems related to the topic within the context of different organizations. So our success means nothing but inculcating in the students the required perception levels, which will further attract more students based on a competitive edge of learning. And we will also be able to have a leading role in the market competing with other national and international level institutes offering the same programs. And ultimately the business will increase.

As per Cognitive model of taxonomy, subsequent is the description of levels which includes:

**Level 1: Knowledge Level** (Remembering data or information)

**Level 2: Comprehension Level** (Understanding the sense, paraphrase, utterance, and explanation of directions and complications.

**Level 3: Application Level** (Using a perception in a new state of affairs or impulsive use of an concept. Relates what was learned in the classroom into different circumstances in the work place.

**Level 4: Analysis Level** (Divorces ideas into component parts so that its organizational structure may be implicit.

**Level 5: Synthesis Level** (Shapes a construction or design from various elements. Put parts together to form a whole, with prominence on producing a new sense or structure.

**Level 6: Evaluation Level** (Present and protect thoughts by making decisions about evidence, rationality of concepts or quality of work based on a set of principles). The researchers believes that the Evaluation level belongs to the Expert level. So we did not include it in our study which relates to the enhancement in the learning and motivation level of students and this study relates up to the Level 5.

**The structure of the Paper:** The report is structured into the following phases of (DMAIC) methodology:

Define phase

Measure phase

Analyze phase

Improve phase

Control phase

### Theoretical framework of the study

In this theoretical framework, Learning levels, Motivation levels and result levels in each and every individual subject of the previous semester are dependant variables and will be measured against the following independent variables Program, Subject, Gender, Age, Study Hours at home, Graduation Background, Semester, Batch and application of course in job.

### DATA & METHODOLOGY:

Learning levels include Knowledge, Comprehension, Application, Analysis and Synthesis. The marking to these levels signify 1,2,3,4 & 5 respectively. The motivation, learning and result levels were measured through Likert scale of 1 – 5 (1 being the least and 5 the highest). The result levels were also converted to a scale of 1 – 5 (by dividing the marks obtained in a subject by total marks and then multiplying by 5)

The process included obtaining feedback from the students of relevant programs on prescribed formats. The data collected through this feedback was measured in application of MS. Excel, Pivot Chart.

**Define Phase:**

**Table 1: AVERAGE MOTIVATION AND LEARNING LEVELS OF STUDENTS**

Program	M	L
M.Sc-HRM	3.90	2.84
M.Sc-QM	2.89	2.10
MS-HRM	3.80	3.18
MS-QM	3.91	2.17

**Measure Phase:**

**In this phase we will measure the (Y's), Learning levels, Motivation levels and result levels in each and every individual subject of the previous semester against the following factors (X's) including Program,**

Subject, Gender, Age, Study Hours at home, Graduation Background, and application of course in job. In order to collect the data, a format for each individual subject of each program was designed (specimen attached in the annexures). All of the students were explained about learning levels (based upon Bloom’s taxonomy) so that they can easily understand the relevant terminology because they have to fill out the forms accordingly. Motivation levels against each topic were to be determined on the likert scale of 1 – 5 (1 being the least and 5 being the highest).

After that all of the students were circulated the specific formats of their relevant subjects which they have studied in their previous semester and of which the results were also available.

**Descriptive Statistics of Learning, Motivation and Result Level of Students**

Variable	N	Mean	St. Dev	Median
<b>L</b>	1115	2.9839	1.3879	3.0000
<b>M</b>	1115	3.7892	1.2094	4.0000
<b>R</b>	1115	3.8145	0.7767	4.0000

**Measuring and displaying the current Baseline**

We are considering the value 2 and below as the defect in case of learning as well as motivation level. So on the basis of the data available, following is the calculation for sigma level.

**Base Line**

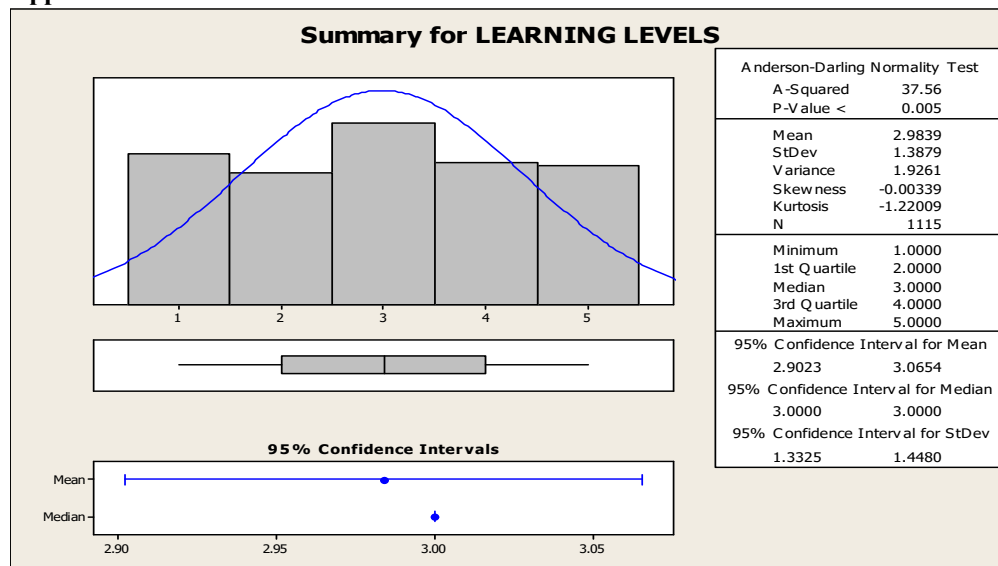
DPU:  $149 / 1115 = 0.1336$

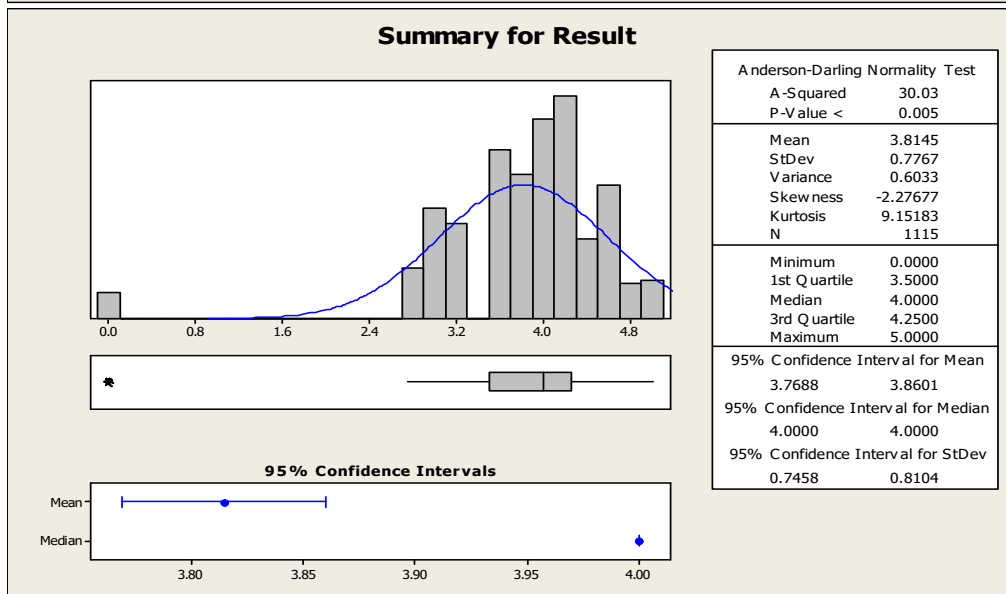
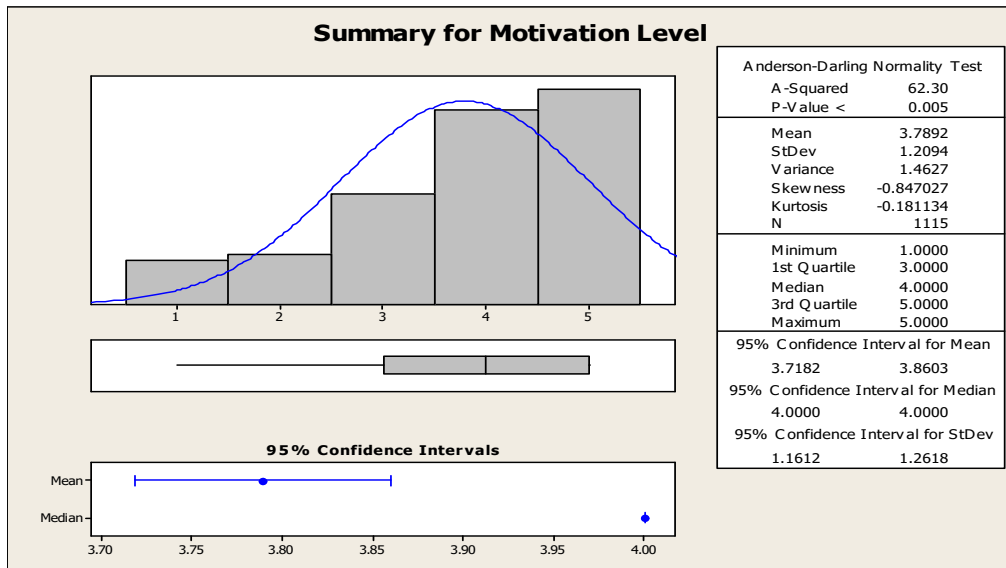
DPO=  $149/(1115 \times 5) = 0.02672$

DPMO=  $0.06892 \times 10^6 = 26720$

Sigma Level = 3.45 approx.

**Application of ANDERSON – DARLING NORMALITY TEST:**





**Analysis Phase:**

After the measurement stage and establishing the baseline and target levels, we analyzed the causal relationships in detail by using the following techniques:

1. While analyzing the data the significant difference of 0.5 is considered.
2. Mood median test for Learning as well as Motivation level.

This phase involve identifying and validating possible X's. Analysis through the use of Pivot Chart

**Table 3: Overall Learning, Motivation & Result Level of Students**

M	R	L
3.76	3.81	2.94

**Table 4: Programwise Learning, Motivation and Result Level**

Program	M	R	L
M.Sc-HRM	3.90	3.90	2.84
M.Sc-QM	2.89	3.57	2.10
MS-HRM	3.80	3.83	3.18
MS-QM	3.91	3.75	2.17
<b>Grand Total</b>	<b>3.76</b>	<b>3.81</b>	<b>2.94</b>

**Table 5: Subjectwise Learning, Motivation and Result level**

Subject	M	R	L
Compensation & Performance Management	3.57	3.87	2.87
Learning & Organizational Behavior	4.15	4.14	3.27
Metrology	3.12	4.32	2.08
QMS	3.98	3.82	2.29
Recruitment & Selection	3.75	3.50	3.27
SPC	3.31	3.07	2.05
<b>Grand Total</b>	<b>3.76</b>	<b>3.81</b>	<b>2.94</b>

**Table 6: Genderwise Learning, Motivation and Result level**

Gender	M	R	L
Female	4.40	3.96	3.50
Male	3.68	3.79	2.86
<b>Grand Total</b>	<b>3.76</b>	<b>3.81</b>	<b>2.94</b>

**Table 8: Learning, Motivation & Result level vs. Time for Study at home per week**

Time for study	M	R	L
10-15 hrs	3.36	3.5	1.45
3-6 hrs	4.12	3.72	3.02
6-10 hrs	3.04	4.06	2.61
Less than 3 hrs	3.48	3.88	3
More than 15 hrs	3.54	3	3.54
<b>Grand Total</b>	<b>3.76</b>	<b>3.81</b>	<b>2.94</b>

**Table 9: Learning, Motivation & Result level vs. Graduation Background**

Graduation Background	M	R	L
B.Com (Hons.)	3.09	3.74	2.93
B.Sc	3.13	3.78	2.18
BA	4.14	3.69	3.12
BBA (Hons.)	3.99	3.19	2.96
M.Com	3.72	3.93	3.71
MA	4.5	4.19	3.5
MBA	3.76	3.98	2.94
Others	3.92	3.86	2.90
<b>Grand Total</b>	<b>3.76</b>	<b>3.81</b>	<b>2.94</b>

**Table 13: Learning, Motivation & Result level vs. Application of Course in Job**

Application of course in job	M	R	L
May Be	3.17	3.89	2.21
No	3.60	4.00	2.59
Yes	4.03	3.77	3.29
<b>Grand Total</b>	<b>3.76</b>	<b>3.81</b>	<b>2.94</b>

**Conclusions of Analysis Phase:**

- Average learning level of the students is lower as compared to their results and motivation.
- The learning and motivation level of students of M.Sc (QM) program is lowest as compared to students of other programs whereas motivation level of students of M.Sc (HRM) is highest. The learning level of students of MS – HRM is higher as compared to students of other programs.
- The motivation and learning level of students of Leadership & Organizational Behavior is higher as compared to other subjects. Learning level of students in case of SPC is lower as compared to other subjects. The result level of students of SPC is lesser as compared to students of other courses.
- Motivation, learning and the result level of Female students are higher as compared to the male students.
- Motivation level & results achieved in case of 41 – 50 years age group are best amongst all. There is no significant difference between the learning levels of different age groups
- The motivation and result level of students with graduation background (M.A.) is highest whereas the learning level of graduates with M.Com background is highest. The learning level of students with B.Sc background is lowest in both of the programs.
- With regards to application of course in job the motivation level, of students who opted for YES, is highest.

**After application of Mood Median Test, following Key Process Input variables have been identified**

**Table 14: PROGRAM WISE KEY PROCESS INPUT VARIABLES OF LEARNING AND MOTIVATION**

Sr. No.	Program	KPIVs in case of Learning	KPIVs in case of Motivation
1.	M.Sc – HRM	<ul style="list-style-type: none"> <li>• Graduation Background</li> <li>• Time for Study at home</li> </ul>	<ul style="list-style-type: none"> <li>• Gender</li> <li>• Graduation Background</li> <li>• Time for Study at home</li> </ul>
2.	M.S. (HRM)	<ul style="list-style-type: none"> <li>• Gender</li> <li>• Age Group</li> <li>• Graduation Background</li> <li>• Subject</li> </ul>	<ul style="list-style-type: none"> <li>• Gender</li> <li>• Graduation Background</li> <li>• Time for Study</li> </ul>
3.	M.Sc. (QM)	<ul style="list-style-type: none"> <li>• Age</li> <li>• Time for Study</li> <li>• Subject</li> </ul>	<ul style="list-style-type: none"> <li>• Graduation Background</li> </ul>
4.	M.S. (QM)	<ul style="list-style-type: none"> <li>• Graduation Background</li> <li>• Subject</li> </ul>	<ul style="list-style-type: none"> <li>• Age</li> <li>• Subject</li> </ul>

**Improve Phase:**

Following key process input variables which have been derived from Analysis phase:

- Graduation Background
- Time for Study at home
- Age
- Gender
- Subject

If we look at the present data of learning & motivation level vs. Gender, data is not sufficient to study this factor and there is no practical significance in relation to this factor. Practical significance of Age group is also impractical as far as learning and motivation level in various subjects of different programs. If we also look at the data of graduation background, the organization we can not fix specific graduation backgrounds because of the very fact that the intake (number) of students will be affected.

So Time for study at home and subject are the Key Process Input variables which have been shortlisted.

In order to improve upon the learning and motivation levels of students, following are the proposed solutions in order to enhance these levels:

- Peer review of the Subject Course
- Case studies along with practical examples in order to enhance study time at home and to create motivation
- Professional Resource Persons / Instructors from Educational Institute or Private sector having practical exposure of the subject.

**Design of Experiments**

3 Factors were taken and a base design of 2<sup>3</sup> with 16 runs and two replicates was created and full factorial design was applied using Minitab software

Factors: 3 Base Design: 3, 8

Runs: 16 Replicates: 2

Blocks: 1 Center pts (total): 0

All terms are free from aliasing.

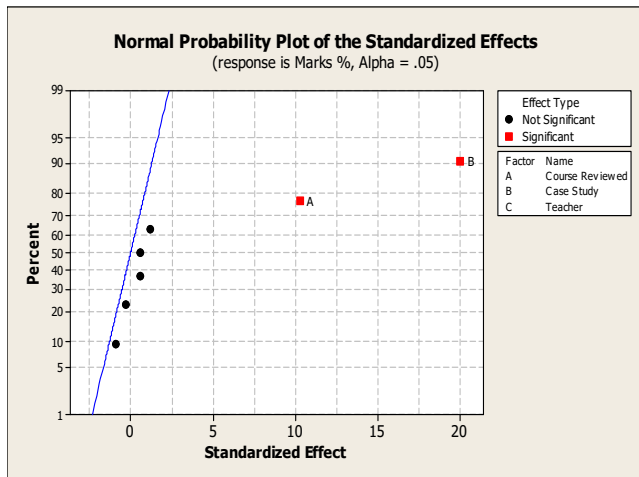
**Factorial Fit: Marks % versus Course Reviewed, Case Study, Teacher**

Estimated Effects and Coefficients for Marks % (coded units)

Term	Effect	Coef	SE Coef	T	P
Constant	76.6250	0.4239	180.76	0.000	
Course Reviewed	8.7500	4.3750	0.4239	10.32	0.000
Case Study	17.0000	8.5000	0.4239	20.05	0.000
Teacher	0.5000	0.2500	0.4239	0.59	0.572
Course Reviewed*Case Study	1.0000	0.5000	0.4239	1.18	0.272
Course Reviewed*Teacher	0.5000	0.2500	0.4239	0.59	0.572
Case Study*Teacher	-0.7500	-0.3750	0.4239	-0.88	0.402
Course Reviewed*Case Study*Teacher	-0.2500	-0.1250	0.4239	-0.29	0.776

S = 1.69558 R-Sq = 98.46% R-Sq(adj) = 97.11%

Peer review of the course and induction of case studies are the significant factors whereas the teacher either from Educational Institute or having practical experience of industry is insignificant. All other combinations are insignificant.



Normal Probability plot of the standardized effects shows that at 95 % confidence interval, Peer review of course and Induction of case studies are again the significant factors whereas the Resource Person either from Educational Institute or having practical experience of industry is insignificant.

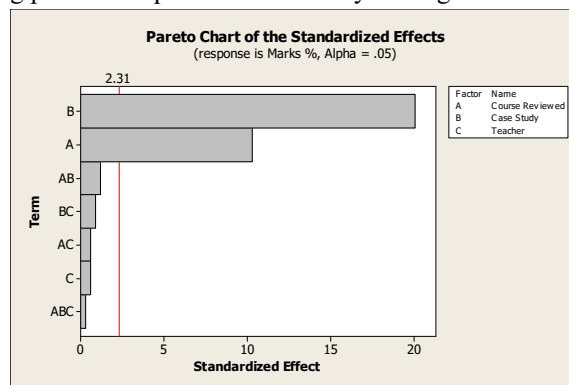
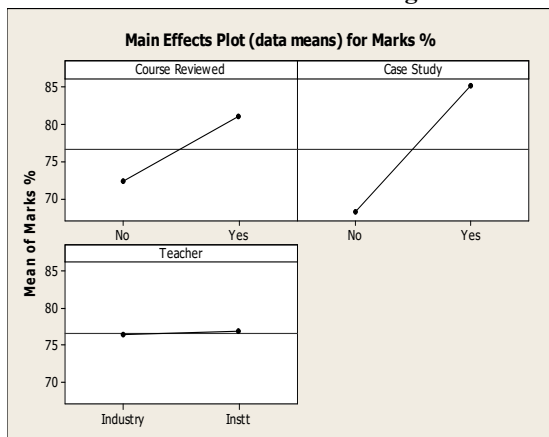


Fig. 16: Pareto Chart of the Standardized Effects:

Fig. 23: Main Effects Plot for Marks %:

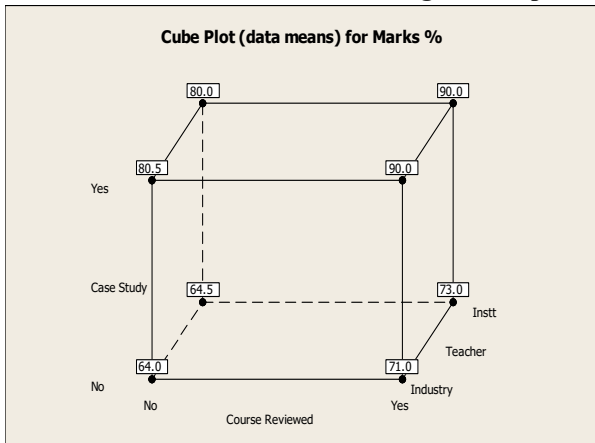


Paretochart of the standardized effects at 95 % Confidence interval & main effects plot shows that induction of case studies is highly significant, then is the Peer review of the course and factor of Teacher (either from industry or some educational institute) is least significant.



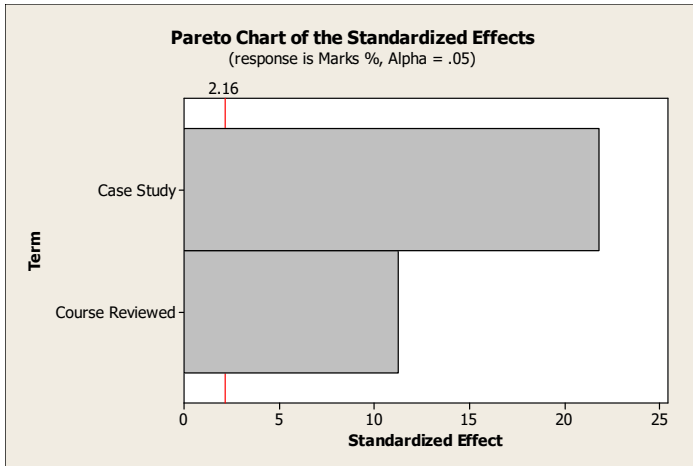
**Proposed Solution:**

**Fig. 24: Proposed Solution Cube Plot**

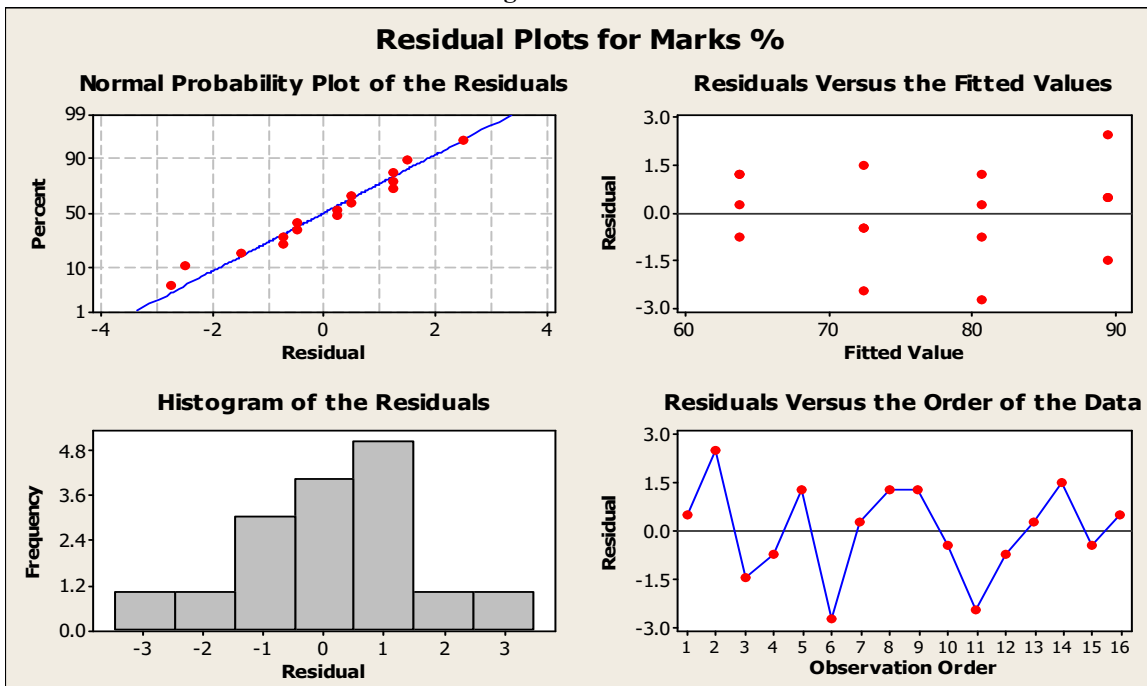


Combination of Peer review of course and induction of case studies in to each subject of the program and teacher either from the institutes or industry is showing the best result.

**Fig. 25: Pareto Chart of the Standardized Effects after Implementation**



**Fig. 26: Residual Plots**



As is evident from model diagnostics, the distribution of marks % is normally distributed.

**CONCLUSION OF IMPROVE PHASE:**

Peer review of the course and induction of case studies along with practical examples in to each subject of the programs are the best possible choices to address critical X's. Course objectives should be embedded with Bloom's taxonomy

**Control Phase / Discussions & Recommendations**

In the Control Phase, the emphasis is on successful implementation of and maintaining the goals / targets achieved:

- Peer review of the course. Course objectives should be embedded with Bloom's taxonomy
- Induction of case studies

The improvement can only be guaranteed if we consider the contents of course reviewed prior to its commencement and the teaching methodology has been changed from imparting knowledge through slides to case studies discussion and problem solving keeping in view the practical scenario in relation to Pakistan or Asian culture. Peer review of the course contents is being conducted in order to create its competitiveness with other well reputed public institutes. Both of the steps would be helpful in enhancing the learning and motivation level of students. Ultimately when the learning outcomes and motivation level of students will be enhanced, same will be the voice of our students and their parents in the market.

Data bases (Annexure 3 & 4) for Case Studies / Research Articles have been created for the facilitation of instructors and students as well. Incharge Academics will be responsible to ensure the proper delivery of case studies / research articles in each subject of the programs. Now the course outlines of all of the courses of all the programs have been revised (specimen attached as Annexure 5) and embedded with components of Bloom's taxonomy. Previous outlines have also been attached herewith (as Annexure 6) for comparison

Self Assessment sheet (Annexure 7) has been designed for students who will fill the same and submit to the course instructor after studying the case studies.

**EXPECTED GAINS BY APPLYING SIMULATION:**

After a year progress sigma level will be shifted as follows:

**Expected Sigma Level**

DPU:  $49 / 1115 = 0.0439$

DPO=  $49 / (1115 \times 5) = 0.008789$

DPMO=  $0.008789 \times 10^6 = 8789$

Sigma Level = 3.85 approx.

**Previous defect rate:**

$149 / 1115 = 13.36 \%$

**Expected Defect rate:**

$49 / 1115 = 4.39 \%$

**Difference:**

$13.36 - 4.39 = 9.0 \%$

- After implementation of the solutions, it is expected that the sigma level will be improved from 3.45 to 3.85 approx.
- After implementation of the solutions, the defect rate would be reduced from 13.36 % (previous based upon the data available) to 4.39 %. Defect rate would be reduced by approx.9.0 %. If the defect rate would be reduced by 9.0 %, same will be shown as improvement percentage.
- After implementation of the above mentioned solutions, in the next academic session 9.0 % enhancement in the present revenue (in the form of fees) is expected because of the increased number of intakes (students) due to enhanced level of learning and motivation levels of students.

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