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Title

**MAXIMIZATION OF RETURN ON INVESTMENT
(ROI) BY HYPER PRODUCTIVE SOFTWARE
DEVELOPMENT THROUGH SCRUM**

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ABSTRACT:

The Research paper concentrated on the Scrum and focused on how to maximize the return on investment while developing the software especially in the IT (Information Technology) industry of Pakistan. The purpose of the study was to propose improvements in the software development methods. A case study was performed by using two different methods for the development of the project in the computer Centre of Faisalabad Electric Supply Company Faisalabad. The existing method of development in FESCO computer Centre was Lwei-Scrum having many flaws and drawbacks. In order to overcome these drawbacks a new approach of Scrum was applied in FESCO. The new approach was called as Modified Light Weight Scrum (MLwei-Scrum). The role of Scrum master and weekly scrum meeting was added in the Lwei-Scrum and then by obtaining the results in respect of the return on investment some conclusions were drawn. MLwei-Scrum gave better results than Lwei-Scrum. It is expected that the new approach will be accepted in Pakistan IT Industry as this will be helpful to maximize the return on investments.

Keywords: Scrum, Lwei-Scrum, MLwei-Scrum, ROI (Return On Investment), FESCO, Agile Manifesto.

INTRODUCTION:

There is a continuous revolution on the requirements and technologies in the under developed countries like Pakistan and this causes a huge market pressure on rapid development of software. In order to develop useful, reliable and maintainable software in a very short time we here in Pakistan need to introduce a methodology which should fulfill all the user requirements and face the market pressure. This technology should maximize the return on investment which is ultimately the major task of any software house. Return on investment is a good performance measure for the evaluation of the efficiency of an investment. It can be used to evaluate the efficiency of different investments also. Computation of the return on investment is done by adding up all the benefits of investments, subtract the cost and then compute the ratio of the cost:

$$ROI = \frac{\textit{Benefit} - \textit{Investment}}{\textit{Investment}}$$

Return on investment is a well known and popular metric due to its adaptability and simplicity. Numerous approaches to improve the systems development process have been tried. Each has been said as providing significant productivity improvements. All have failed to produce dramatic improvements (Brooks, 1987).

There are many methods of working agile as Scrum, extreme Programming, Feature Driven development and dynamic system development method but I have chosen Scrum because it is the only agile methodology that has been formalized and published as an organizational pattern for software development (Beedle and Devos, 1988).

The scrum approach is being used at leading edge software companies with significant success. Industry analysts believe scrum may be appropriate for other software development organizations to realize the expected benefits from Object Oriented techniques and tools (Aberdeen Group, 2005).

Just like global software industry, Pakistan's software industry is also trying to adopt Scrum for addressing current challenges of software development. It is concluded that Scrum is slowly getting confidence in the local software industry. Scrum would prove to be very helpful for Pakistan's software industry in order to compete with international markets (M.J.Akhtar, 2010).

Lwei- Scrum is a light weight scrum and Pakistan's software industry is also adopting Scrum for acquiring utmost benefit from this methodology (Bushra Zafar, 2010).

The primary rationale of this research was to get an insight into Lwei-Scrum adoption, implementation and acceptance in Pakistan's software industry. Another purpose was also to understand the problems and give the solution which will be feasible; particularly for Pakistan's IT industry. Conclusions derived from this research effort would be helpful for overall Pakistan's software industry for making an accurate decision for Scrum adoption, implementation and acceptance.

The main objectives of the research were following:

- Review the existing Lwei-Scrum (Light Weight Scrum), based on Return on Investment.
- Propose effective and adaptable practical modified Lwei-scrum which should cover all the drawbacks of the Lwei-Scrum.

- The proposed approach should be simple to implement in Pakistan and require minimal upgrades.
- Implement the MLwei-Scrum (new approach) in any well known organization to analyze its feasibility keeping in view the environment of Pakistan's Software Industry.
- To know about the various opinions of the roles regarding development processes?

Methodology:

Scrum development approach has enjoyed success in high profile companies such as Fuji-Xerox, Canon Honda, NEC, Epson, Brother, 3M, Xerox, and Hewlett-Packard. This approach was primarily used in non-software products at Honda, Canon and Fujitsu. Inspired by this method to software development at Easel Corp. in what would eventually be known as Scrum (Schwaber and Beedle, 2004).

Scrum does not require or provide any specific software development methods/practices to be used. Instead, it requires certain management practices and tools in different phases of Scrum to avoid the chaos by unpredictability and complexity. Scrum ensures timely delivery of product. The team can reduce delivered functionality during the sprint, but the delivery date cannot change (Rising and Janoff, 2000).

The methodology used in research is critical to the nature of understanding gained. There is a wide range of methodologies appropriate in information systems (IS) research. Research in IS has historically been biased towards traditional, empirical and quantitative research. Galliers criticize this bias which consider IS as purely within the province of technology, and argues that it is more appropriate to extend a study also into behavioral and organizational considerations (Galliers and Land, 1987).

Light Weight Scrum (Lwei-Scrum) implemented in Fesco Computer Centre by the previous research reported several problems and demerits. In that approach role of Scrum Master has been eliminated and this causes the delay of the software and projects. In Lwei-Scrum it was supposed that all the meetings, backlogs and problems will be automatically managed. Daily Scrum Meeting was eliminated which was creating so many problems among the developers.

Keeping in view the above facts this research focused on the Lwei-Scrum and some modifications were done in this scrum. The new approach was called as Modified Light Weight Scrum (MLwei-Scrum). In MLwei-Scrum the role of Scrum Master was added and weekly scrum meeting was introduced. The role of Scrum Master was redefined and some extra responsibilities like testing, documentation etc were assigned. This MLwei-Scrum was implemented in the FESCO in one software development and compared the results with of the software developed by the previous method. Both the software applications were of same functionalities and architecture.

Project-PMI:

The project-PMI (“FESCO Payroll”- actual name of the project) was an application developed in Visual studio especially Visual Basic. It was called project-PMI as it was based on method MI (Lwei- Scrum). The Product owner for project-PMI was the Director General of PEPCO Information Technology Company (PITC) Lahore, Pakistan.

The first sprint comprised of specifying the necessary requirements, development was in the second sprint and testing of software was in the 3rd Sprint of Scrum.

The Scrum stuff in the various parts of the project-PMI is as under:

- Sprint backlogs and Product backlogs
- Sprints (not always exactly 30 days)
- Burndown charts
- Iterative development

For better understanding about the technique exercised in the project-PMI it is indispensable to understand the Light Weight Scrum (Lwei-Scrum), the diversity and resemblance of it with actual Scrum approach. The underlying slice is a supplementary complete vision of the project methodology and characters which were utilized in the project-PMI:

LWEI-SCRUM (LIGHT WEIGHT SCRUM) METHODOLOGY:

The methodology of project exercised in the project-PMI was light weight and in this technique there was an effort to meet the organizational requirements by keeping in view the organizational resources.

As the project at FESCO typically 3 (three) developers were occupied for the implementation of Lwei-Scrum (light weight Scrum) referred to as PMI.

There was elimination of the certain basic things of Scrum approach which are as under:

EXCLUSION OF SCRUM MASTER ROLE:

The Scrum Master is answerable for the achievement of the process and the productivity and health of the Scrum Team members. The Scrum Master is accountable for the success of Scrum process." Further, the "Scrum Master is responsible for making sure that Scrum practices, values and rules are performed and enforced (Ken Schwaber,2004). The following are the responsibilities of the Scrum Master:

- To keep the process affecting
- To Enforce the framework of Scrum
- In all Scrum meeting Scrum Master is present to Facilitate and make sure the participation of full-team in all meetings.
- To maintain the whole lot evident.
- Communication and information sharing is responsibility of Scrum Master in case of bigger associations.
- Scrum Master is for defending the team members from exterior intrusion.
- To remove the barrier delaying the Sprint Goals achievements by Scrum Team.
- Arguing about the superior practices by following progress.

In Lwei-scrum in the first Sprint one of the developers was appointed as Scrum Master for some times and after that the developers decided the destiny of Scrum master which was not required,

the developers were fully occupied in all parts of the project. Their meetings were closed and this resulted in different directions of the developers regarding the project. Most of the sprints were failed due to non organization of the team and two sprints were terminated abnormally as the setup of the team could not be made and all this happened due to the absence of the role Scrum Master.

EXCLUSION OF DAILY SCRUM MEETING:

In the actual Scrum as from the name it is clear that the Daily Scrum (daily gathering) holds every day at the unchanged time. All the team members must be there and contribute but any person is free to examine. Here the team members confer progress toward the current Sprint's goal using three inquiries:

1. What did I do since the last Daily Scrum?
2. What am I doing until the next Daily Scrum?
3. What are my obstructions?

After some days the Daily Scrum meetings were eliminated removed from the Sprint. These were detached because in the project only three developers were occupied and the communication was completed.

It is very vital thing that if the Scrum Master doesn't cheer the vigorous discussion, there is the threat that the Daily Scrum will become of low-value status report. The Scrum Master is to support the team to converse with each other and employ whatever practices will be suitable to keep every person occupied.

From the above excluded items in the Scrum, and this scrum was named as Lwei-Scrum it is obvious that elimination of these basic things from scrum caused many problems and the researcher thinks so that this Lwei-Scrum is not a form of Scrum. This is just a home programming not following the specific approach. This type of Scrum can not be adopted by any organizations. This approach is already implemented in every programmer's mind but he did not know that he is practicing the Lwei-Scrum. This is not an advanced technique.

PROJECT-PMII:

The project-PMII (“FESCO Consumer Census”- actual name of the project) was an application developed also in Visual studio especially Visual Basic. Modified Light Weight scrum (MLwei-Scrum) applied on Project-PMII is the enhancement and modification of the Lwei-Scrum and this approach is a try to give a hyper productive software development technique keeping in view the maximization of return on investment. Return on investment play a vital role in any business. All the researchers agree on the thing that “If ROI (Return on investment) does not increase then it will be difficult to move the business ahead”.

There were different problems prior to the accomplishment and implementation of new approach named as MLwei-Scrum (Modified Light Weight Scrum):

- The developers of the team did not familiar with the Scrum true practices.
- Because the customer is participating in project, the developer’s think that they do not know about ending the definition stage step.
- It is complicated to give the priority in the product and Sprint backlog because the client believes that all requirements are of the same importance.
- The team members in the Scrum are not specialist in all parts; this formulates the non self organized team.
- The Scrum meetings are not conducting because the Scrum master role has been removed from Lwei-Scrum.
- The team is suffering from the exterior intrusions; nobody was there to deal with them.
- Project is delaying due to non organization of the practices and team members.

SPRINT-1:

All questions from the project-PMI were under consideration and made a file where the project methodology, documents, roles/characters and definition were described. This file document was called the project document file and would be considered and observed when queries were arisen during the Sprint meeting.

In the first meeting of the first sprint it was decided to conduct the meeting on weekly basis not on daily basis. The role of scrum master was well defined and he played an important role in the entire project including testing of the product. The first day of the Sprint the customer required a document file of requirement. Because this document was not planned the client had to eliminate some activities from the Sprint backlog to make room for document.

The data in table 2.1 shows that the first sprint lasted for 15 days instead of 30 days because it was decided that the working estimated as of 30 days was completed in 15 days. Next sprint should be started rather than to waste the time in first sprint. Scrum Master was assigned the duty to make arrangement of the next sprint and to deal with the external resources.

SETUP OF SPRINT-1	
Duration	15 days (completed before time)
No. of persons involved (Developers+ Scrum Master)	4
Tools in Sprint	MS Excel, MS Word
Development Tools	Visual Studio
Programming Language	Visual Basic 6.0

Table 2.1:- Data from Sprint 1

SPRINT-2:

The observations getting from Sprint first made the second Sprint more effective and efficient. The conclusions from the MLwei-Scrum meeting were as under:

- All documents that are produced should be written by Scrum Master and reviewed by the other team member.
- The Software document file had a function and should be utilized in the second Sprint.
- The weekly meeting was very effective instead of daily meeting because daily meeting is more time consumptive as compared with work.
- The day of the Sprint like 1,2,3, etc. was changed with the dates because this was easier to understand the reporting dates rather than number.

After the completion of the design phase of the project the development of the project began. During the Second Sprint following results were found:

SETUP OF SPRINT-2	
Duration	15 days (completed before time)
No. of persons involved (Developers+ Scrum Master)	4
Tools in Sprint	MS Excel, MS Word
Development Tools	Visual Studio
Programming Language	Visual Basic 6.0

Table 2.2:- Data from Sprint 2

2nd Sprint lasted for 15 days as due to weekly meeting a lot of time saved and no interruptions in developers work by the exterior intrusion.

SPRINT-3:

The conduction of retrospective meeting after Sprint 2 resulted in the following:

- Because a lengthy and well achieved planning meeting was held, the second Sprint resulted as it was required. No doubts there were some hurdles and barriers but all these covered by the Scrum Master and this protected from delay in the Sprint.
- The developers believed that there was more information and experience of MLwei-Scrum in the second Sprint and this resulted in the effective and efficient working environment.

SETUP OF SPRINT-3 (Last Sprint)	
Duration	30 days
No. of persons involved (Developers+ Scrum Master)	4
Tools in Sprint	MS Excel, MS Word, Scrum Works Pro
Development Tools	Visual Studio
Programming Language	Visual Basic 6.0

Table 2.3:- Data from Sprint-3

The 3rd Sprit proved as final Sprint because this resulted in the final and full fledges release of the software after testing the all features and functions according to the client requirements.

All the projects included in this research study, project-PMI (using Lwei-Scrum) and project-PMII (using MLwei-Scrum), were using same language for development and tools for testing and evaluation. The software developed by these techniques had the same architecture and work load. Visual Basic based applications were developed and SQL Server 2000 was used for database. By this thing it was feasible to evaluate the efficiency and productivity of projects on the basis of function points. Moreover, in all projects, same standard framework was followed for testing, which was specified by management of FESCO computer center, Faisalabad which acted as client also.

Project-PMI lasted for over a period of four months. And the project-PMII lasted for a period of two months. No of persons in project-PMI comprised of three (3) developers only. While in project-PMII four persons (three developers and one Scrum Master) were involved. Assistance of three experts and role of customer were included in both the projects therefore will not be a useful for comparison.

RESULTS AND DISCUSSIONS:

COMPARISON OF MLWEI-SCRUM (Modified Light Weight Scrum) WITH LWEI SCRUM:

The projects were evaluated in terms of return on investment (ROI) and assessed that whether the goal of achieving higher quality and increased productivity was fulfilled with the implementation of MLwei-Scrum. Results from project-PMII (FESCO Census) utilizing MLwei-Scrum were compared with a project-PMI (FESCO Payroll) utilizing the Lwei-Scrum technique completed at FESCO computer center, Faisalabad in year 2010. The details of the project were acquired from the annual report of the project development maintained by FESCO Computer Center, Faisalabad

PRODUCTIVITY:

There are many project metrics to compare the project productivity but we chose the best standard metric of using Function Points as it straightly characterize the delivered features. It is the top measure to evaluate the teams organization wide. General tables for functions points on “per lines of code” for all major languages were published (Jones, 2003). The average lines of code for one function point in case of Visual Basic are 52 and this can be used for estimation the number of function points for both projects.

From the annual report of FESCO Computer Center, Faisalabad regarding the project development for the year 2010 illustrated that the project using Lwei-Scrum lasted 6 months and only 3 (three) developers were occupied for the whole project. The services of some experts from FESCO were also utilized from time to time during the project development. These three developers were responsible for gathering requirements from customers and for preparing the requirements document file. The FESCO report of project development also confirmed that the project of Lwei-Scrum was implemented and delivered two months late than the committed delivery date, while with MLwei-Scrum the project was implemented and delivered before the committed time.

Category	Project-PMI (Lwei-Scrum)	Project-PMII(MLwei-Scrum)
Person Months	156	54
Visual Basic LOC	5026	5321
FP (Function Points)	96.65	102.33
FP Per Developer/Month	0.61	1.89

Table 3.1: Comparison between productivity of projects

From the table results it is significant that with the MLwei-Scrum productivity boost was 3 (three) times more as compared with Lwei-Scrum process.

QUALITY OF PRODUCT (CUSTOMER SATISFACTION):

Agile adoption defines quality in respect of client's contentment. Research study pointed out that from 400 (Four hundred) Information Technology executives surveyed and found that 80% cited customer contentment is included in their top priority (Bolles and Kirkpatrick, 2003).

There is no specific testing mechanism in Scrum to maintain quality therefore, we used the existing standard testing framework in FESCO to make sure the quality of product implied in Lwei-Scrum project. Role of Scrum Master was extended up to the testing of the project in each sprint. In this segment the quality gave emphasis in respect of getting customer's satisfaction.

<u>Project Name</u>	<u>KLOC</u> (thousands of lines of code)	<u>Defects</u> (Acceptance Test)
Project-PMI	5.026	16
Project-PMII	5.321	5

Table 3.2: Defects in Acceptance test

The defects in the acceptance test for project-PMII are 5 defects per KLOC which is acceptable by the industry ratio because industry average is around 5 defects per KLOC (Humphrey, 2005). And almost 3 times less than reported in the Project-PMI by Lwei-Scrum.

When the final release of the project was done then, to access client contentment at FESCO computer center, the client was asked to fill the satisfaction form developed by the researcher. The results of the two projects were compared and here showed graphically.

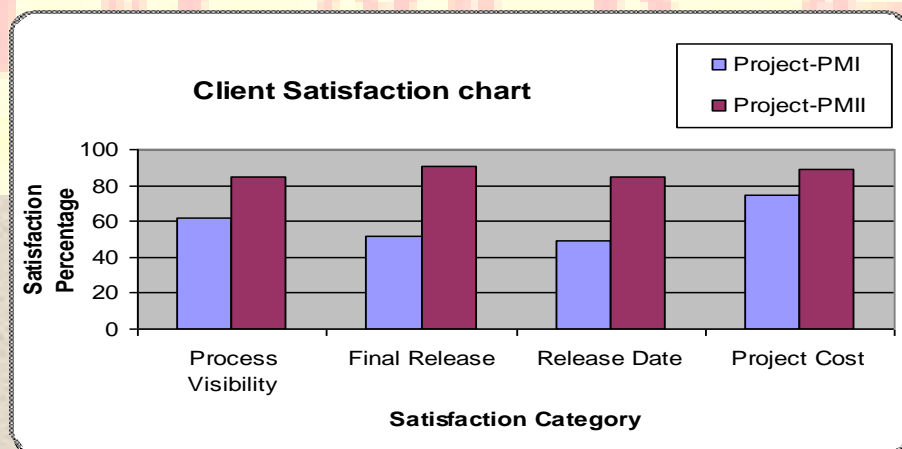


Figure 3.1: Customer Satisfaction Chart

In Lwei-Scrum project overall customer satisfaction was about 60 % and for MLwei-Scrum it was 88%. This proved an improvement in the client satisfaction up to 28%.

RESULTS FROM SCRUM METRICS:

As both PMI and PMII were on the foundation of Scrum so both can be compared on basis of Scrum metrics for evaluation and getting conclusion of which one is superior.

MEASUREMENTS FROM ALL SPRINTS:

We can observe that the PMII gave the superior estimates

Category	PMI (Lwei-Scrum)	PMII (MLwei-Scrum)
Sprint Backlog Items	95	120
Average Estimate Per Item	10	7
Min. estimate	1	1
Max. Estimate	85	22
Median Estimate	5	4
Variance (Estimate)	147	50.3

Table 3.3: Measurements of Metrics from All Sprints

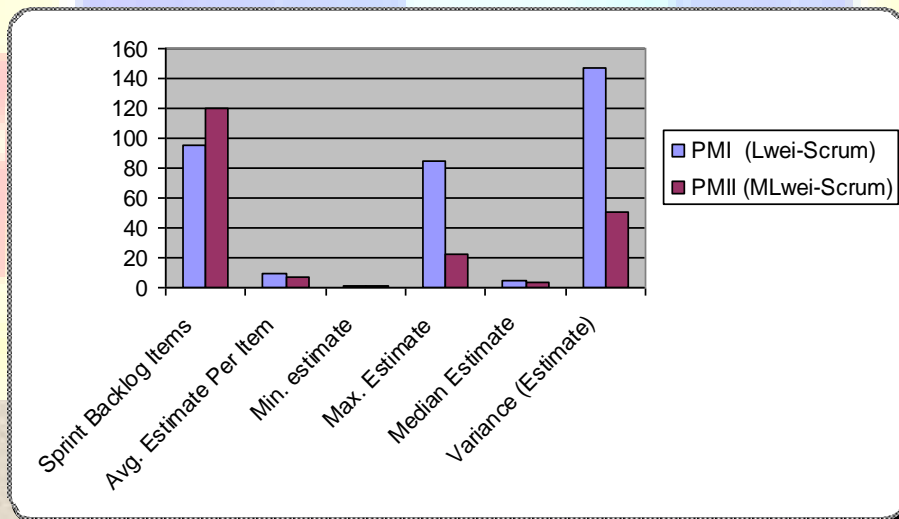


Figure 3.2: Measurement from All Sprints

METRICS FOR SOURCE CODE

Metrics regarding the source code were collected from the project PMI and PMII. Here it is explained that the final source code of the final project was integrated only for measurement and the source code for testing purpose was not considered.

Category	Project PMI (Lwei-Scrum)	Project PMII (MLwei-Scrum)
Files	45	38
LOC	5026	5321
Statements	2515	2217
Comments (%age)	12.5	9.1
Docs (%age)	4.6	8.7
Classes (No.)	30	23
Methods per Class	9.3	5.8
Calls per Method	6.2	3.1
Statements per Method	8.45	4.29
Complexity Max.	25	15
Depth Max.	8+	5
Depth Average	2.52	1.41

Table 3.3:- Metrics from source code

The fig 3.3 showed that the complexity in case of project PMII is less as compared to that of project PMI. This may happen due to the presence of the Scrum Master who was responsible for all the planning and review meetings and also useful for testing of the code.

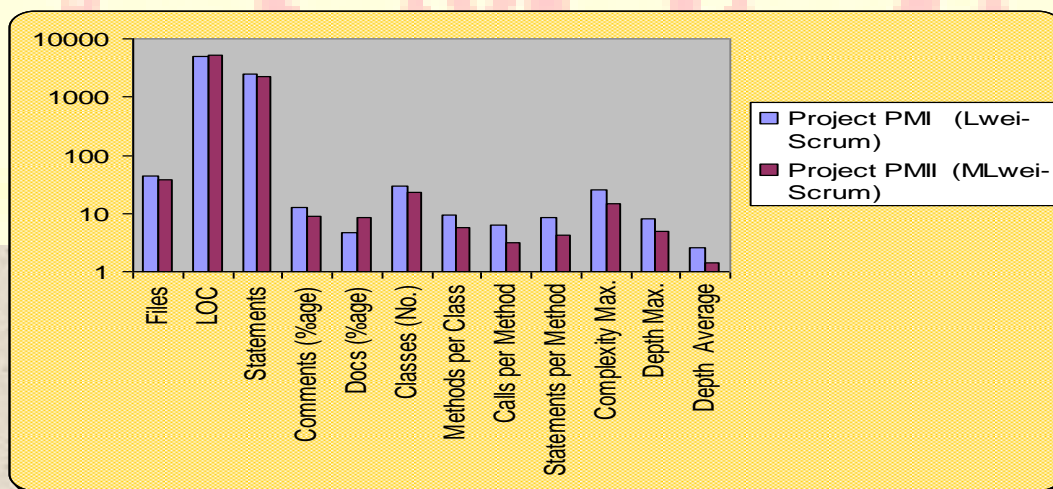


Figure 3.3: Graphically Representation of source code Metrics

PROJECT MANAGEMENT METRICS:**EFFORT METRIC**

The effort metric was conducted and described in man-months. A man-month is the total effort which was occupied to complete work of the project in a month. The effort was measured of all the projects and all the stages of the software.

Metric (s)	PMI (Lwei-Scrum)	PMII (MLwei-Scrum)
Planned effort (man-months)	105	42
Actual effort (man-months)	156	54
Percentage of increase in effort	49	16

Table 3.4:- An Effort Metric

In PMII the effort is three times less than that of the PMI as shown in figure 3.4. This will be helpful in the maximization of the return on investment in any project. In Project PMII role of Scrum master played a vital role in lessening the effort.

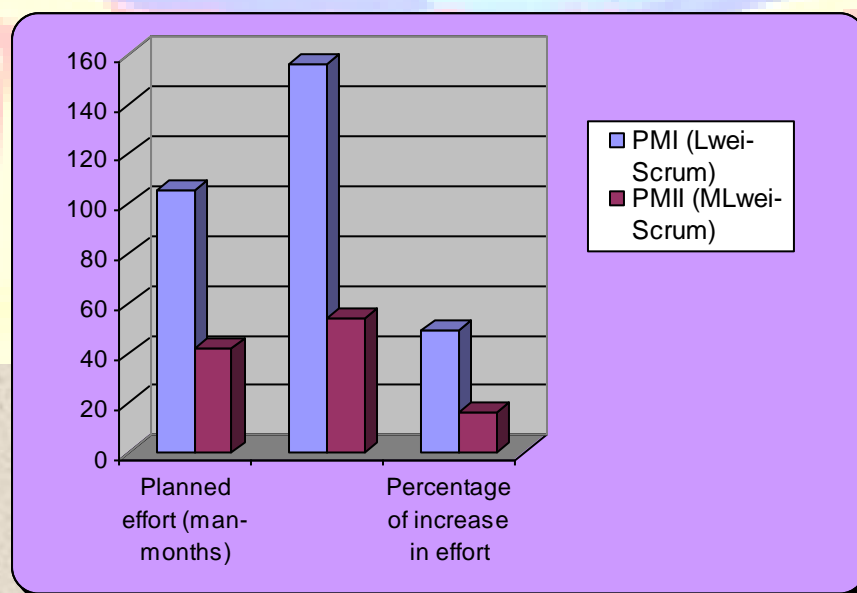


Figure 3.4:- Graphically Representation of Effort Metrics

COST METRIC:

The cost metrics is very vital component of the business organization. A cost metric measured the planned versus actual expenditure sustained in a software project. The cost mentioned in the table comprised of the cost of journey and all type of communication for both the project purposes.

Metric		PMI	PMII
Cost in Pak Rupees (Rs.)		(Lwei-Scrum)	(MLwei-Scrum)
Resources	Planned (estimated)	3,50,000	1,95,000
	Actual	5,00,000	2,50,000
Communication	Planned (estimated)	15,000	10000
	Actual	35,000	25000
Total Planned		3,65,000	2,10,000
Total Actual		5,35,000	2,75,000
Total Deviation in percentage (actual-planned/planned *100))		47	34

Table 3.5:- A Cost Metric

From the above table it is clear now that the actual cost of the project PMI is 49 % more than that of project PMII.

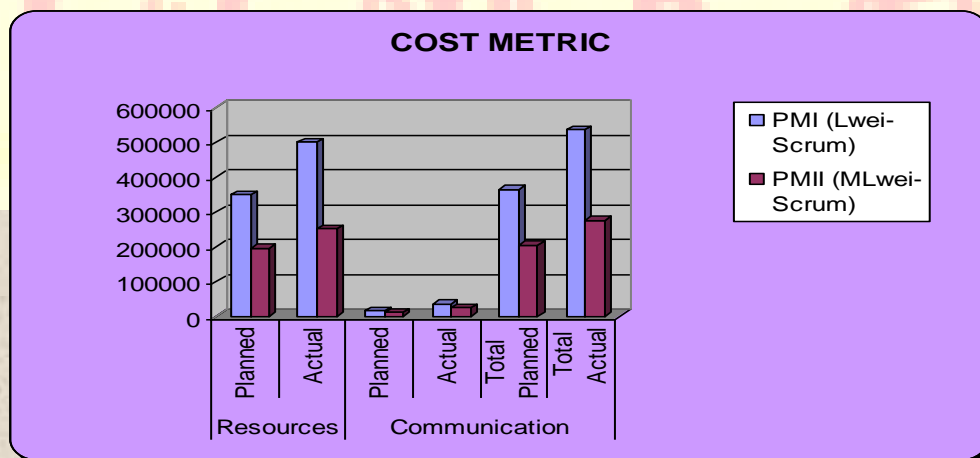


Figure 3.5:- Graphical Representation of Cost Metric

TESTING METRIC:

The testing metric was exercised to calculate the number of test cases required to test the project. Test case can be defined as a specification that is required to be implemented to test a particular component of the software.

The below table is depicting the situation of the test cases in both the projects.

Metric(s)	PMI	PMII
Test cases per FP		
Planned	2	4
Actual	8	5

Table 3.6:- Testing Metric Table

From the above table it was observed that the test cases in PMI was planned very less but actual when the project was not fulfilling the requirements of the clients then the team of Lwei-Scrum had to increase the test cases and this concluded in the delay of the project. While when we observed the test cases position in the PMII then it was concluded that all the things were planned and due to the weekly meeting the test cases position were discussed and decided. There was no delay in PMII because the role of Scrum Master was also responsible for the testing of the projects. The project of FESCO Consumer Census was proved to be very superior as there were no defects in the said project.

CONCLUSION:

The new methodology was introduced which is the solution of the issues faced in the Lwei-Scrum approach by the organization FESCO keeping in view the improvement of return on investment and hyper productive software development. Faisalabad Electric Supply Company (FESCO) has a Computer Center providing information technology related facilities and projects to enhance the productivity of the employee's working and make them efficient. The IT management in FESCO computer center was strongly focused on Lwei-Scrum method and was facing various issues like high ratio of failures of project, productivity less, reduced ROI

delaying of projects over long times, high cost of amendments and deprived of client contentment.

MLwei-Scrum was applied with four developers including one Scrum Master, some problems prior to implement were recognized and MLwei-Scrum (PMII) was defined to meet the organization demands.

Weekly Scrum meetings were conducted for time saving. The role of Scrum Master was well defined to get maximum output. MLwei-Scrum provided 3 times increase of productivity and 28 % increase in the customer satisfaction and 49 % decrease in the cost of the project. The defects in project-PMI (Lwei-Scrum) were about 3 times more than that of project-PMII (MLwei-Scrum).

From all the results and discussion it was concluded that MLwei-Scrum will be the best practice in the software industry of Pakistan. As there is need of improvement in the assets and exports of Pakistan especially in Software Industry, MLwei-Scrum project methodology can be helpful as it is useful in hyper productive software development and maximization of return on investment (ROI).

REFERENCES:

- Aberdeen Group. 2005. Upgrading To ISV Methodology for Enterprise Application Development. Lisa Press., Gartner.
- Akhtar M.J., A.Ahsan and W.Z. Sadiq. 2010. Scrum Adoption, Acceptance and Implementation (A Case study of Barriers in Pakistan's IT Industry and Mandatory Improvements). IEEE Computer Society.
- Beedle M.A, M. Devos, Y. Sharon, K. Schwaber and J. Sutherland.1988. SCRUM: An extension pattern language for hyper productive software development. Washington University Technical Report., pp:98-125.
- Brooks F.P. 1987. No silver bullet-----essence and accidents of software engineering. IEEE Computer Society, Addition-Wesley.

- Galliers R.D and F. F. Land. 1987. Viewpoint: choosing appropriate information systems research methodologies. European journal of information systems.,30(11):151-164.
- Humphrey W.S. (2005), "Introduction to the Personal Software Process", Addison Wesley.
- Jones C. (2003), "Software assessments, benchmarks, and best practices", Addison Wesley, Boston, Mass.
- Rising L. and N.S. Janoff. 2000. The Scrum software development process. Software IEEE.,17(4):26-32.
- Schwaber K. and M. Beedle.2004. Agile Project Management with Scrum, Prentice Hall.
- Schwaber K. (2004), Agile Project Management with Scrum, ISBN: 073561993X., Microsoft Press.
- Zafar B., A.R.Sattar and T. Mustafa. 2010. Towards Enhancement in the Traditional Processes upshots by the Implication of Scrum Process. European Journal of Scientific Research.,40(2):172-176