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Validating the Application of COSMIC Approximation Model to Agile projects

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Abstract - **Many improvements and developments are made in the field of software Engineering. The major areas of concern in deciding success of any software project development lies on software size estimation and Project Management method. The development of software projects through Agile methodology [1] proves to be one of the best methodology in project management in today's scenario demanding dynamic changes with versions updated now and then. COSMIC (Common Software Measurement International Consortium) FSM (Functional Size Measurement) [2] is considered as the best solution for sizing the software requirements that are to be developed, since it gives a high level of accuracy to sizing with qualitative methods. There are many researches going on in using the COSMIC FSM in estimating the size of the requirements for Agile projects. The outcome of one research [6] where it has been attempted to trim the restrictions and constraints in COSMIC FSM measurement methods and the draw backs in the Agile Projects User story estimation methods by introducing Early and Quick Estimation using COSMIC methodology for Agile projects. The research paper has considered only the feasibility of applying this method by demonstrating with a real case study. The accuracy and level of deviation or significance of approximation are not studied for this method. Making these factors known for this method would give the software estimators a confidence in using this simple and comparative accurate method. This may be a great breakthrough in improving the success of Software development community as this could make the Project Managers and System Analysts aware of at what level of accuracy they are working in when they are using this new model for their estimation. This will give an understanding where this method could be used based on the criticality of the application and what should be level of contingency allowed when using this method. The statistic describing the variance of the new method over the absolute and accurate method using COSMIC FSM is showcased here by using the standard statistical tools.**

Keywords - **Agile Project Management, COSMIC FSM, Early and Quick Estimation Techniques, IBM SPSS, Analyzing a paired data.**

I.INTRODUCTION

The success of any software development project lies on choosing the right project management method.

All software in the Universe are of evolutionary in nature and no software domain has declared that they have reached their final version. The software community is always working on changes to an existing software. The changes may be new addition, new enhancement or error fixing. Hence the process of software development is treated as making changes to the current running version.

In this scenario the chosen project management method should be able to cater to the needs of handling the changes in a software system. The best project management tool which can give best service and performance in this context is Agile Project Management method [1].

The other major criteria which decide the performance of a project is seamless planning. The core input for proper planning are defining the Requirement specification unambiguously and providing precise size estimation of the functionalities that are to be developed. Having done a qualitative Requirement specification, the challenge the project planning personnel confronts is Estimating the size of the project. There are various methods available in estimating the size of a software project. Out of these methods COSMIC (Common Software Measurement International Consortium) [2] functional size measurement has a clear edge over the

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other methods in terms of accuracy and the preciseness.

Even though COSMIC has come out with a solution of using COSMIC measurement methods to Agile project management [3], the application of COSMIC Functional size measurement (FSM) involves detailed breaking up of the functionalities into a simple functional process to a level of their data movements which is a time consuming process.

COSMIC has released a manual detailing the procedures to be followed if estimation is to be made within a restricted time frame using Early and Quick Estimation Method [4] [5].

There was an attempt made in a publication to use this Early and Quick Estimation method using COSMIC FSM [6] to an Agile project. The new method has been explained with a business case from a real application using the Early and Quick Estimation using COSMIC FSM for an Agile Project Management. Even a detail demonstration of the method has been done, this paper has not come out with any validation procedure using strong statistical methods to give the level of accuracy that it gets compared to the absolute values of COSMIC measurement method.

Adaption of COSMIC method to Agile projects with this Early and Quick approach is a great break through for the software community, since the estimation is generally diluted in a planning phase due to lack of quick quantitative estimation techniques. It is needless to say that planning and project management success lies mainly on precise estimation and making a compromise on estimation takes the total project to a toss.

This paper makes an attempt to qualify the Early and Quick approach using COSMIC method to Agile Project Management with strong statistical Techniques using IBM SPSS [6].

This paper is organized in the following order. Chapter 2 gives the salient features of the Early and Quick estimation approach using COSMIC method to Agile project management as discussed in the publication [6]. Chapter 3 describes how the right statistical tool is selected to validate the results of the said method Chapter 4 demonstrates the process of statistical analysis using IBM SPSS and tabulating the result and chapter 5 discusses the inferences and conclusions that are arrived on the results.

2.0 EARLY AND QUICK ESTIMATION METHOD USING COSMIC FSM TO AN AGILE PROJECT

2.1 Agile Project Management

The Agile Project Management systems [1] go by iterations in developing the software. The requirements of the software are defined in the form of User Stories [1] from the End user point of view. These User Stories are added and accumulated to a list of deliverables which are maintained by the development team. The software development team picks out a set of high priority requirements based on their value it adds to the Software. Value of software is defined as the ability of the software to handle the major and critical functionalities from the end user point of view.

The number of User stories picked up for each iteration depends on the capacity of the team to handle user stories in within their defined fixed durations. The durations are normally fixed as two or three weeks. The software is delivered to the customers at these intervals. The customer goes through the delivered software after every iterations. It is based on the concept IKWISI, I know when I see it. The End user when starts using these new features comes up with new ideas, suggestions, improvements, modifications and enhancements on the delivered software. Again these changes are defined as User Stories which are added to the list of deliverables. The developers again pick up a new set of User Stories from the pending deliverables on priority basis and takes up to the next iteration. This process of continues and between every iterations with a list of new requirements are added to the software.

This is the basic process cycle of Agile projects. The size of the team should be designed in such a fashion that with the completion of about 10 to 15 iterations, the software should have reached a shape where most valuable and important functionalities are added to it as per the requirements of the End users and customers.

The success of any project Management method lies in the process of planning. A realistic planning can only give a right control in managing a project and yield more accurate levels of performance measures on the parameter of interest in the project.

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As far as Agile projects are concerned, planning has to be made for every iteration. The project Manager has the responsibility of managing and controlling the current iteration and at the same time has to pick up the priority User stories and make a plan for the next iterations simultaneously. A good planning is a result of good estimation on the sizes of the software to be developed. The traditional method of assessing the size of the User stories is subjective and cannot be taken as better input for a planning activity. The best objective method for measuring the size of the requirements to be developed is COSMIC Functional Size measurement method [2]. The COSMIC method of Functional Size measurement requires all the requirements are to be defined with high level of preciseness and completeness for accurate results and is a time consuming process. Hence the necessity for a simple and quick objective method of estimation pushes the project managers of Agile projects to look for a method which could give a quick estimate of the size of the requirements with reasonable accuracies for their planning activities. Such a crushing demand in Agile project management could be met by utilizing the Early and Quick Estimation model using the COSMIC measurement methodology [4] [5].

2.2 An Estimation Model For Agile Project Using COSMIC Early and Quick Estimation

The COSMIC method for Early and Quick Estimation model comes up with three approaches depending upon the nature of requirements [4]. Out of these three approaches, analysis is made on which approach could give a better solution in the Agile scenario. Any project team generally consists of one project manager with maximum of seven to nine developers with different levels of experience both in the software development and domain knowledge about the software to be developed. The duration of single iteration is not allowed for more than three weeks time, since the no end users can precisely define their requirements [1]. When the total requirements are split and are delivered in different iterations, the end users can get an idea of what is coming out of their defined specifications, in a phased manner and could suggest necessary modifications then and there if the delivered software is deviating from their requirements. The shorter the duration of the iteration, the more the time the developers save on developing a wrongly interpreted requirement. Based on the velocity of the team and size of prioritized User stories the number of User stories planned for single iterations are computed. In practical situation number of User stories that could be selected cannot be more than the five for an iteration duration of 3 weeks [1]. The user stories are defined at the level of functional processes. The average number of functional process required to define a User Story may vary between 4 and 6 functional processes.

"Equal Size Band" [4] approach is more suitable for comparatively bigger size software requirements with more than hundreds of functional processes in it, so that they can be made into of groups with considerable numbers of functional process in each group with almost equal sizes. Hence the Equal Band size is not suitable for estimating software requirements with smaller numbers of functional processes as in the Agile case.

The "Average Functional Process" [4] approach is based on an arrived value of single average size. The User stories picked out for next iteration is based on the priority of the requirements only and this single average cannot be applicable for the picked up User stories which will have different sizes of functional processes.

The fixed size classification approach [4] allows us to make a grouping of the functional processes of similar size from the User stories and assign an average value for each grouping. Hence this approach will allow us to make different groupings on the selected number of functional processes for next iteration. This would make the size estimation more accurately than the average size estimation approach.

More the number of classifications we group, the more will be the accuracy of estimation which is a known logical inference. The model we propose should be designed for more number of classifications, because as already stated, there will be a few number functional processes per iteration for any Agile projects. Hence we propose the classifications as Very Small, Small, Average, Large and Very Large. The Size values we assign for each classification depends upon the type of business domains, since different domains will have different range of sizes for each classification. This can be done by making an actual measurement, for similar functional processes taken from the delivered software, using COSMIC measurement method.

The summary of the model for estimating the size of software to be delivered for each iteration of a Agile Software Development Project, a new model [6]:

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1. The model uses the concept of an Early and Quick Estimation based on Fixed size classification approach using COSMIC functional size measurement.
2. The number of classifications for the functional processes contained in each iteration is taken as five.
3. The scaling factors for each classification is the computed value from the actual measurement using COSMIC measurement method defined at the level of data movement types from a similar functional process within the same domain.

This model has been demonstrated using a real business case study [6] and was compared the results to those of the absolute COSMIC values. The paper has just given an extension that whether right statistical tool could be used to evaluate the results thus arrived.

3. SELECTION OF RIGHT STATISTICAL TO EVALUATE THE RESULTS OF THE STUDY

A company wanted to incorporate (WMS) Weigh Bridge Management system into their existing Materials Management package. The broad scope of the software to be developed is given in the Context diagram [3] as shown in figure 1.

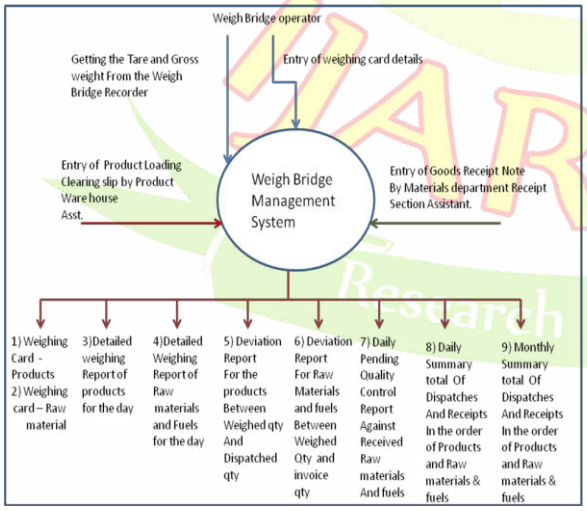

Fig 1. Context diagram for Weigh Bridge Operation

The system Analyst has identified the following functional processes in developing the WMS package. The table 1 show the listing of the functional processes identified. FUR is known as Functional User Requirements when requirements specification for WMS is broken down into a reasonably small activity.

TABLE 1. List of Identified functional process

FUR	Iteration planned	Functional process
01	1	Retrieval of Delivery Note Details
02	1	Capturing Tare weight from the 'C' program running in the PC (Functional Process A)
03	1	Saving the Weighing card detail unto Tare weight
04	1	Retrieval of weighing card details along with Delivery note details
05A	1	Saving the loading advice details – Functional process A
05B	1	Printing the loading advice detail – Functional process B
6	1	Retrieval of Weighing card details unto Tare weight with Loading advice details
7	1	Capturing Gross weight from the 'C' program running in the PC (Functional Process A)
8A	1	Computation of net weight and comparing it to the Delivery quantity
8B	1	Computation of net weight and comparing it to the Delivery quantity
8C	1	Printing of weighing card
9	2	Retrieval of Purchase Order details
10	2	Capturing gross weight from the Recorder
11	2	Saving the weighing card details unto the Gross weight
12	2	Retrieval of the weighing card details and PO details into the Material in ward Note
13	2	Saving the Material Inward Note
14	2	Printing of Material Inward Note
15	2	Retrieval of Weighing card details unto the Gross weight details with Material Inward Note
16	2	Capturing the Tare weight Recorder
17A	2	Computing the Net weight and finding out the deviation between the invoiced quantity and net weight
17B	2	Printing the Weighing card
17C	2	Saving the Weighing card
18	3	Detailed weighing report for the products for the day
19	3	Detailed weighing report for Raw

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Functional process	Absolute Size in CFP	Estimated size in CFP
19	7	7
20	7	7
21	7	7
22	6	7
23 A	5	5
23 B	5	5
24 A	5	5
24 B	5	5
	53	54

		materials and fuels for the day
20	3	Deviation report for products between weighed qty and dispatched quantity
21	3	Deviation report for Raw materials and fuels between weighed quantity and Invoiced quantity
22	3	Daily pending quality control report against the received raw materials and fuels
23A	3	Daily summary totals of Dispatches and receipts in the order of A) products
23B	3	B) Raw materials and fuels
24A	3	Monthly summary totals of Dispatches and receipts in the order of A) products
24B	3	B) Raw materials and fuels

A benchmarking was done for iteration I functional User Requirements, based on the absolute COSMIC FSM level measurement. Then estimations were done for chosen Iteration 2 and Iteration 3 using the bench marked classifications from Iteration 1. The absolute values for Functional User Requirements for iterations 2 and 3 are measured using the COSMIC FSM Methods. The listing of iteration 2 and 3 estimated and absolute values are given the table 2 and 3 respectively.

TABLE 2. Comparison of Estimated size with absolute size for iteration 2

Functional process	Absolute Size in CFP	Estimated size in CFP
9	5	5
10	4	5
11	4	3
12	2	2
13	2	2
14	2	2
15	7	7
16	4	5
17 A	2	3
17 B	3	3
17 C	4	3
	39	40

TABLE 3. Comparison of Estimated size over absolute size for iteration 3

From the table number 2 we see the net difference for iteration 2 is excess of 1 CFP for the estimated size over the absolute size which is about 2.56% over the absolute size.

Similarly from table number 3, we infer that the net difference is about 1.89% in excess for the estimated size over the absolute size for iteration 3.

This is a simple mathematical comparison given in the paper [5].

It is to be evaluated using the right statistical method to find the level of signification of the deviation of the observed readings using the model compared to the absolute COSMIC FSM values. This will give the level of approximation the model has when applied to a population of any business domain and what the level of accuracy it yields. This will lead the Project Manager whether the level of accuracy is enough for their requirement. This figure also gives an idea to the estimators that how much contingency that they have to add up on to the estimated values if they have to make an estimation for a critical situations.

The data we collected is a paired data type [9] that is one with absolute values and other with a new model applied for the same group. The statistic we have to find is that whether the new model has any significant variation over the absolute values. This can be done by designing the experiment with null hypothesis as - there is no significant change when applying the proposed model over the absolute values.

When the sample is less than 30, it is always recommended to use t test than the Normal sampling

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test since Normal sampling will not yield the right result when the sample sizes are less than 30 [8] [9].

4. THE STATISITICAL ANALYSIS USING IBM SPSS

Finding out level of significance of the estimated values over the actual

The next step is to find the level of significance of our new model over the absolute values. If the level of significance is within 5% we can conclude that the new proposed model is in line with the absolute values and it could be taken as a feasible and fairly accurate model for estimation for Agile projects.

The null hypothesis is assumed that there is no significant difference between the proposed model values and the absolute values for iterations 2 and 3 combined together.

The listing of absolute values and the estimated values for the functional processes of iterations 1 and 2 are given in the table number 4.

TABLE 4. Absolute and Estimated size values of iterations 2 and 3

Sl No.	Functional processes	Absolute Values in CFP	Estimated Values in CFP
1	9	5	5
2	10	4	5
3	11	4	3
4	12	2	2
5	13	2	2
6	14	2	2
7	15	7	7
8	16	4	5
9	17A	2	3
10	17B	3	3
11	17C	4	3
12	19	7	7
13	20	7	7
14	21	7	7
15	22	6	7
16	23A	5	5
17	23B	5	5
18	24A	5	5
19	24B	5	5

To find the significance level we use IBM SPSS20 statistical tool [7].

Since the sample size is less than 30, we use 't' distribution for testing the significance of the sample data. The result which is got from the IBM SPSS20 tool is listed in table 5.

TABLE 5. Testing the significance of the estimated values with that of absolute values using paired Sample 't' distribution method

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Estimated	4.63	19	1.832	.420
	Actual	4.53	19	1.775	.407

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Estimated - Actual	.105	.567	.130	-.168	.379	.809	18	.429

The last column Sig.(2-tailed) value is 0.429 which is very much greater than the 0.05 ie 95% confidence level, the hypothesis that there is no significant difference between the absolute values and the sampled estimated values is accepted. Moreover the deviation is 5.67 % from the absolute values [8] [9].

This concludes that our proposed model of estimating the size of the individual iterations for Agile projects are fairly within the accuracy levels.

5. DISCUSSIONS AND CONCLUSIONS

The results we obtained using t test on the observed deviations over the absolute values for the proposed model is not significant to confidence level of 5%. Hence this model – Applying Early and Quick Estimation methods using COSMIC FSM for Agile Projects would give a comparatively accurate estimated values within a considerably lower time compared to making an estimation using COSMIC FSM method. Since Agile projects operates on a

dynamic environment where the priorities are changing frequently before every iterations, Project Managers and System Analysts can always opt for this proposed model which less subjective than the conventional Agile projects. Moreover, the proposed model avoids inconsistency when estimated by different Analysts of same comparable experience which is a major improvement over the conventional Agile Estimation.

One of the improvements that could be done on the above study is that the selected project have functional process less than 30 samples which leads us to use t test sampling analysis method which may lead to a Type I error. Further experiments may be conducted taking a case study whose project size is greater than that is selected here which should have more than 30 sample sizes which could yield a better level of significance.

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