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Comparative Study on Multidimensional Developers Performance with Cognitive Load

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Abstract- Human resource is the challenging resource in the software development industry to meet the customer requirement and deliver the project on time to the client. The resource management techniques are used to optimize the resources with a homogeneous property. The multi-disciplinary and multi-demanded resource allocation is one among the challenging task to perform software development and deliveries cycle. The software industry requires multi-skill and dynamic performers. The skills domain knowledge and the developer's performance are considered as the potential key factors for the success of the delivery of projects. The developer's performance is influenced with cognitive factors and its measures. This study aimed to observe and compare a developer's performance in the software industry with his/her cognitive workload. The real-time observations of around 250 employees, 15 projects work status and its corresponding cognitive load such as physical ability, mental ability, temporal ability, effort, frustration and performance in Web application, Database application and Multimedia application domains are taken into consideration. According to the observed data the relationship between the performance and the cognitive load is evaluated.

I. INTRODUCTION

The industries are starving for the knowledge to sustain their business operations. Quality, customer relationship are determining the quality of service to satisfy their customer. Performance measures are not directly predictable but they are measurable based on the influencing factors [1]. The skills of knowledge domain and the developer's performance are considered as the potential key factors for the success of business. The developer's performance is influenced with cognitive factors and its attributes. The organization assets evaluated in terms of human power and their intellectual performance. The modern working environment is very much interested to validate the employee performance to increase the knowledge asset of the firm. The software development concern success are mostly depends on the performance of human intellectual capital instead of physical establishments [2, 3]. Intellectual processes evaluated with the performance measure via proving complexity simplicity. This research paper initiated with an idea to observe and compare the software developers performance to obtain quality product with minimum cognitive workload.

II. SCOPE AND OBJECTIVES

The software development industry and its performance are based on developers skills and their intelligent contribution towards the assigned tasks. The performance could be measured with developers individual contributions on the organizational activity and its equivalence emotional reflections. This is focused on two different paradigms. The real-time observations of around 250 employees, 15 projects work status and its corresponding cognitive load such as physical ability, mental ability, temporal ability, effort, frustration and performance in Web application, Database application and Multimedia application domains. According to the observed data the relationship between the performance and the cognitive load is evaluated and represented below.

a) Data observation using NASA WORKLOAD INDEX approach
b) The observed real-time data analyzed and presented with its possible measures.
c) Comparing developers' industrial activity performance with the Cognitive load.

III. NASA GRADING SCALE FOR COGNITIVE FACTORS

NASA task load index is a multidimensional rating procedure that provides over all work load based on a weighted average of rating on six subscales such as mental demand , physical demand , temporal demand , Own performance ,Effort and Frustration[4, 5]. This technique (referred to as the "NASA Bipolar Rating Scale") was quite successful in reducing between-rater variability and provided diagnostic information about the magnitudes of different sources of load from subscale ratings [6, 7]. However, its sensitivity to the experimental manipulation is better than other popular techniques and as a global one-dimensional workload rating. The cognitive load calculation described below.

3.1 Cognitive Workload Calculation

The NASA Task Load Index workload evaluation procedure is a two-part procedure requiring the collection of both weights and ratings from the selected software development and the manipulation of the collected data to provide weighted subscale ratings and an Overall Workload score. There are fifteen possible pair-wise comparisons of the six scale elements. When Weight is selected, the load presents each pair to the subject one pair at a time. The order in which the pairs are presented and the position of the two elements (left or right) are completely randomized and are different. Factor select which element they felt contributed the most to the workload on the specific task. When all fifteen possible pairs have been presented the second part will continue.

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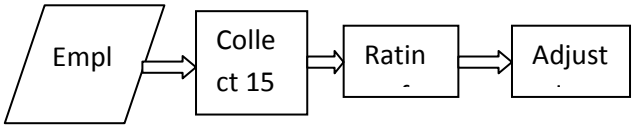
The second requirement is to obtain numerical ratings for each scale element that reflect the magnitude of that factor. The responds lies between 0 to 20. The Weighted workload rating for each element in a task is simply the Weight (tally) for that element a number between zero and five, multiplied by the Magnitude of load, a number between zero and one hundred. OVERALL workload for a particular task is determined by summing all of the weighted workload ratings for an individual, subject to performance for the particular task and dividing by 15.Using the above calculation the different combination cognitive load are observed and calculated.



3.2 Experimental Procedural Steps used in NASA WORKLOAD INDEX

3.2.1. Rating Scale Instruction

Examining the Workload of a developer is a difficult concept but simple one to understand. The factors that influence the experience of Workload come from the task. That is feelings about the developer's own performance, how much effort the developer is putting in or the stress and frustration he/she felt. The Workload contributed by different task may change as the developer gets more familiar with a task. Since Workload is something experienced by the developer, there are no effective "rulers" that can be used to estimate the Workload of different activities [8]. The set of six rating scales which were used to evaluate the experiences of the developer during the different tasks. After performing each task, the developer is given a sheet of rating scales, by evaluating his/her task by putting "X" on each of the six scales that matches with his/her experience. Each line has two endpoints called "good" on the left and "bad" on the right.

3.2.2. Sources of Workload Evaluation

It is a technique that assesses the relative importance of six factors in determining how much Workload the developer experienced during the different phases of the development process. There will be a series of pairs of rating scale titles and the developer asked to choose which is more important in the task he/she just performed [8]. Using the developer's choice create a weighted combination of the ratings from that task into a summary Workload score.

IV. DATA OBSERVATION

Cognitive load such as physical ability, mental ability, temporal ability, effort, frustration and performance are calculated using their weights and raw rating. The basic performance factors for this calculations involves with regularity, task completion, accountability, team involvement and reporting. All these performance factors are evaluated for the individual employees based on their login sheets, task completed out of assigned tasks, completed dependent task based on dependent tasks, no of meetings attended and the daily, weekly, monthly reports submitted. The performance is calculated on the basis of the above said input factors.

V. INTERPRETATION

The developers performance is observed in the three domains of web, database and multimedia domain and different fifteen projects of seven phases of development. This observed data is approached to determine the relationship of developer's activities and their emotional cognitive relations. The observation factors are divided into internal and external factors such a way that factors, which are measurable according to the execution of activities, are presented as external and the activities, which are presented involved the emotion and internal by the developers are presented as internal activities. The NASA scale load observation and the external factors presented below.

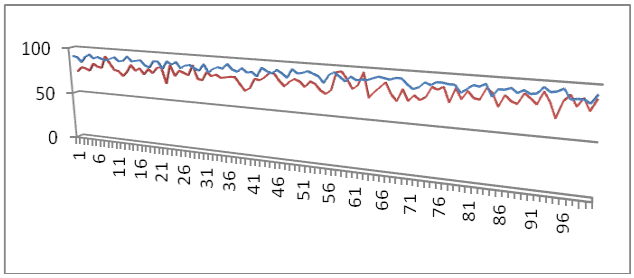


Figure: Perforamcne with Cognetive load

The cognitive load and the average performance of the external factors are inline close one with another . the level of values and its association may various one with another but the values of the perforamcne and the cognitve load is various with the external factors. The performance and the cognitive load mean and median lies in the same level of values which shows that there is a close relationship occurs between the performance and the cognitive load as per the observation of 8238 data records.

The performance and the cognitive load minimum level is differ but the maximum level for same as per the table. The project phases are observed for the employee to enhance the efficiency of the project delivery.The external performance are depends on the above mentioned factors. The performance of the employee is low when the task completion and reporting also low. The regularity and the accuracy are high then performance also appreciated. The internal factors for the same are observed and represented below. The cognitive load of the employee is less to do the maximum performance. The performance level is differing according to the developers internal working load memory.

The above table show that cognitive memory of internal factors and the performance are associated one with another. The difference of the working and its relational inflation occurs with their internal observed factors with the external activities. The same observation made in three different domains and around fifteen project. All the measures are ensured the associative relationship of multi skill level of the developers. The developers are exhibited differ skill according to the phases of the software development activities.

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	Regularity	Task completion	accuracy	Team Involvement	Reporting	Performance	Cog. Load
min	80	80	80	80	80	84	68
max	100	100	100	100	100	96	96
Mean	91	90	90	89	90	90	81
median	92	90	90	89	88	91	91	81

Phases	Regularity	Task completion	accuracy	Team Involvement	Reporting	performance
1	100	82	98	84	90	91
2	83	97	84	99	87	90
3	83	90	87	84	89	87
4	86	83	86	85	83	85
5	88	95	89	83	97	90
6	97	96	82	98	92	93
7	99	88	98	91	92	94

phases	ME	PH	TE	PE	EF	FR	CL
1	67	73	45	45	70	66	61
2	60	55	43	85	90	57	65
3	95	32	60	63	85	70	68
4	90	47	70	53	53	70	64
5	75	40	100	67	75	18	63
6	63	27	57	100	57	33	73
7	85	60	30	60	90	87	69

VI. CONCLUSION

The software development project and product developments become successful one as per the contribution of developers. The multi skilled developer's performance and its variations of the cognitive loads are observed in three different domains and fifteen projects. As a summary of analysis and the observed data, the internal activity and the external activities are associated one with another. However, the performance of the internal factor and its corresponding cognitive loads are not same while performing different phases of the software development activities.

REFERENCES

[1] P.N. Robillard, P. d'Astous, F. De´tienne, W. Visser, Measuring cognitive activities in software engineering,in: Proceedings of the 20th International Conference on Software Engineering, Kyoto, Japan, 19–25 April 1998,pp. 292–300.

[2] Curtis, B., "Cognitive issues in reusing software artifacts". In Software Reusability. Concepts and Models, T.J. Biggerstaff and A.J. Perlis, Editors. ACM Addison Wesley Publishing Company:New York, New York. 1989, p. 269-287.

[3] Waters, R.C. and Y.M. Tan, "Toward a design apprentice: Supporting reuse and evolution in software design", ACM Software Engineering Notes 16(2), 1991: p. 33-44.

[4] Beyers, J.C., Bittner, Jr, A. and Hills, S.G. Traditional and raw task load index (TLX) correlations: are paired comparisons necessary. Advances in Industrial Ergonomics and Safety I. London: Taylor and Francis, 1989.

[5] Hart, S. G., & Staveland, L. E. (1988). Development of a multi-dimensional workload rating scale: Results of empirical and theoretical research. NASA

[6] Hitt II, J.M., Kring, J.P., Daskarolis, E., Morris, C., & Mouloua, M. (1999). Assessing mental workload with subjective measures: An analytical review of the NASA-TLX index

[7] Wierwille, W.W. & Eggemeier, F.T. (1993). Recommendation for mental workload measurement in a test and evaluation environment. Human Factors, 35, 263-281.

[8] NASA Task Load Index, (2001) Hart and Staveland's NASA Task Load Index (TLX) method.

[9] Heerlen Juhani E. Tuovinen (2001) Cognitive Load Measurement as a Means to Advance Cognitive Load Theory Fred Paas Educational Technology Expertise Center Open University of The Netherlands.