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EFFECT OF HUMAN BEHAVIOR IN SDLC

Effect of Human behavior in SDLC

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Abstract - Successful operation of any computer system depends largely on the hardware component, software component and human interface. As human factor plays a major role in the development and usage of software, system reliability can never be considered in isolation from human factors. Analysis of the software reliability is also dependent on the human errors. Errors occurring during the development of the software have impact of human personality factors. It will highlight on the errors being caused by the developer and user which may result in comprising the quality of the software being developed. Thus, human reliability focuses on the human factors that may affect the quality of the ultimate product under development and the ways of improving these errors. It outlines key requirements for the human behavior study during SDLC. Such research is helpful for the Human Resource departments of software industry in the selection of competent candidates, reducing the software cost & development time and improving quality of product as well as process. It will also help managers of IT industry to select more appropriate team for a particular project.

Keywords: Human Reliability, Human Behavior, Personality Factors, SDLC, System Reliability

1. INTRODUCTION

Successful operation of any computer system depends largely on its hardware component, software component and human interface. Quality software performs its intended functions correctly and reliably and can be quantitatively expressed in terms of software reliability. A lot of work is being done regarding software reengineering and quality process management. Software Reliability Models (SRM) are used to evaluate the software quantitatively which involve error recognition and detection. Quantitative analysis begins with the identification of various errors at various software development stages of Software Development Life Cycle (SDLC). Since human factor plays a major role in the development and usage of software, thus system reliability can never be considered in isolation from human factors keeping this in mind the system reliability has to be redefined as

System Reliability = Hardware

Reliability + Software reliability +

Human Reliability

Various errors occurring during the development and use of software are considered in conjunction with the human factors affecting the quality and usage of the

software. Analysis of the software reliability should consider the human errors greatly since errors occurring during the development of the software have human personality factors as major contribution.

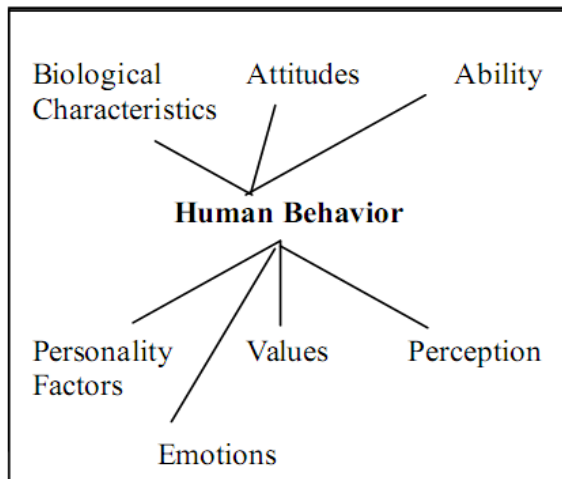
Various Software Reliability studies had considered the failure occurrence due to lack of knowledge, lack of specifications as the only reasons for the error occurrences during SDLC, but nobody has considered the human behavior affecting the software development and usage.

The human factor can be taken into account at two levels: Normal operations and Emergency operations. In both cases, human reliability is concerned with the understanding of 'human error' mechanisms in order to model it.

Basically, the human behavior comprises of individual's biological characteristics [1],[2],[3], ability, perception, beliefs, attitudes[6], values[4], and various personality factors. Most human behavior is "unintentional", carried out automatically. All these aspects have a profound impact on the working, behavior, thinking of an individual. Unaware behavior can be costly unless it is shaped according to requirements. Performance Shaping Factors (PSF)[17],[18] results in deadly damage if not taken care of properly. The PSFs are: Stress, Culture, The Meaning of Behavior, Self Confidence and The Past

control today's performance. These factors subconsciously control the behavior of an individual. Through learning, the behavior can be molded accordingly but the basic traits cannot be altered. All the factors force an individual to perform in some predefined pattern. So, the person undergoing the software development process will have the effect of his personality on the final product he will be delivering; which will be ultimately affecting the quality of the product (software).

There are various psychological factors affecting human behavior. These are:



Biological characteristics (Age, Gender, Marital Status, tenure)

Ability (Intellectual – Number aptitude, verbal comprehension, perpetual speed, inductive reasoning, deductive reasoning, memory)

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- with different types (Satisfaction, Involvement, Commitment)
- with different components (Cognition, Affect, Behavior)

Emotions (Happiness, Surprise, Fear, Sadness, Anger, Disgust). Emotions can be positive or negative. It can be measured in terms of Emotional Intelligence (EI).

Personality factors (Locus of Control, Machiavellians [11], Self-esteem, Self monitoring, Risk taking, extrovert, Agreeable, Conscientiousness, Emotionally stable, Openness to experience)

PERCEPTION

- In situation (Time, Work setting, Social setting)
- In perceiver (Attitudes, Motives, Interest, Experience, Expectations)

- In target (Novelty, Motion, Sound, Size, Background, Proximity, Similarity)

VALUES

- Terminal[5] values(Comfort ability, Peace, Equality, Security, Freedom, Happiness, Self-respect, Wisdom, Social recognition, Spirituality)
- Instrumental[5]values (Ambitious, Broad-minded, Capable, Courageous, Forgiving, Helpful, Honest, Imaginative, Independent, Intellectual, Logical, Loving, Obedient, Polite, Responsible, Self-control)

Thus, human reliability is an integral part of the computer system reliability besides hardware and software reliability. It will highlight on the errors being caused by the developer on the errors and user which may result in comprising the quality of the software being developed. Thus, human reliability focuses on the human factors that may affect the quality of the ultimate product under development and the ways of improving these errors.

In this paper, we have concentrated on the various personality factors and values, biological characteristics. The questionnaire used in the experiment contains questions covering 16 personality factors and values.

This paper is organized into 8 sections. Section 2 describes the background work or research in related work. Section 3 highlights the factors affecting human behavior during SDLC. Section 4 presents a case study. Section 5 gives the analysis of the study undertaken. Section 6 gives the conclusion. Section 7 is related to the future work to be undertaken. Section 8 gives the references.

2. BACKGROUND AND RELATED WORK

A need to improve the quality of the software being developed from the viewpoint of improving the human errors resulting due to varied human behaviors has motivated me to undertake the study of human reliability in software development and use. These efforts will result in the enhancement of the first generation and second-generation HRA methods but still it is immature to say things with finality.

Research is being done in the field of HRA like nuclear power plant [7],[8],[9], railroad, positive train control system (PTC)systems, OECD-NEA[10].

No study had been undertaken towards considering the human behavior in the development of software. This paper outlines key requirements for the human behavior study during SDLC.

3. HUMAN BEHAVIOR FACTORS AFFECTING ERROR OCCURRENCE DURING SDLC

Human factors that result in various types of errors during SDLC comprises of problem definition, design, coding, implementation, testing and maintenance. Each of the mentioned stages results in various errors caused by human behavior, if ignored, quality has to be compromised, and so, various errors and causing factors are being tabulated in TABLE 1.

Table 1: Errors occurring during SDLC and the respective human behavior factors responsible (under normal conditions)

Error characteristics	Human Behavior factors affecting error characteristics
Requirement not properly followed	Careless, ambitious, competitive, logical, agreeable, obedient, responsibility, interest
Specifications not met	Controlled, accomplishment, responsibility, imaginative, intellectual, logical, trustworthy, agreeable
Open-ended(expandability)	Imaginative, open-minded, experience, competency, wisdom, practical, reserved
Inappropriate language selected	Domain knowledge, careless, sincerity, intellectual, competency, experience, practical
Inappropriate data structure selected	Domain knowledge, experienced, practical, efficiency
Inappropriate report design	Experience, wisdom, capability, intellectual, responsibility, timidity, adjustable
Inappropriate algorithm selected	Experience, Domain knowledge, efficiency
No reusability	Imaginative, open-minded, experience, competency, wisdom, practical, reserved, ambitious
Not modular	Domain knowledge, experience, wisdom, imagination, practical, capability
Not user friendly	Experience, maturity, practical, helpful, obstinate
Improper integration of modules	Maturity, experience, practical, intellectual
Improper logic	Logical, rational, experience
Lack of programming language knowledge	Intellectual, capability, responsible
Improper selection of platform	Capability, domain knowledge, experience
Documentation errors	
Inefficient	Efficiency, experience, responsibility
Insufficient	Careless, capability, responsibility

4. CASE STUDY

In an experiment on a sample of undergraduate students who are new to computer programming, instructor gave five programs to develop and observed the occurrence of errors. The conditions for the case study are:

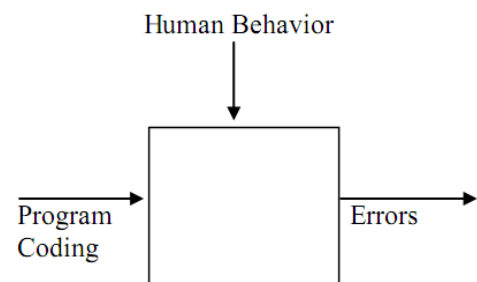
1. Case study was done under normal conditions.
2. Sample data consists of the following characteristics:

- i) Unmarried
- ii) Mixed gender
- iii) Having age less than 25 years

3. Sample data is homogeneous at mental level.

The case study is being done in the following steps:

1. Psychological Test: To study the individual behavior of the students, a psychological questionnaire consisting of 187 questions is given. The questions are based on 16 personality factors (standard 16PF questionnaire). The questionnaire contains multiple-choice questions having 3 alternatives- two at the extreme end and one at middle level. The students were instructed not to spend time pondering, not to fall back on the middle, "uncertain" answers except when the answer at either end is really impossible, not to skip any question, somehow, and answer as honestly as possible. They were assured that answer sheets will not be scored without a special stencil key.
2. A list of 5 simple programs (Looping, modular programming, mathematical and logical operations) is given to the students and the general behavior is studied in the first attempt. Errors that occur are analyzed and categorized. Multiple errors have come corresponding to each category, thus the single ranking is done corresponding to that category.
3. Data is being taken up for performance evaluation of student's practical. The type of errors that occurred during SDLC is being recorded for each student and is being correlated with the student's behavior.



5. ANALYSIS

- a) According to case study's Psychological test, the results are being presented graphically as

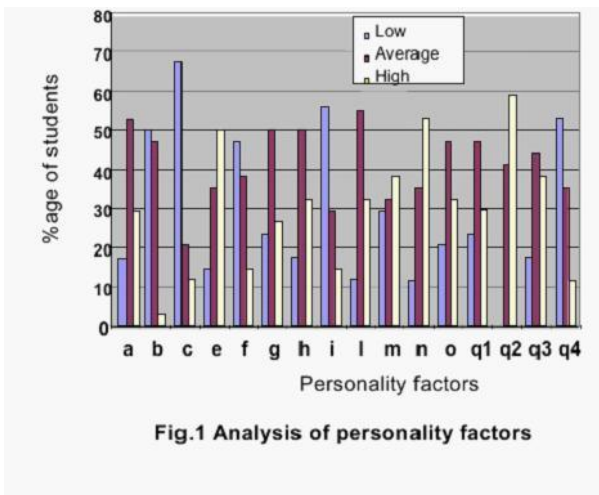
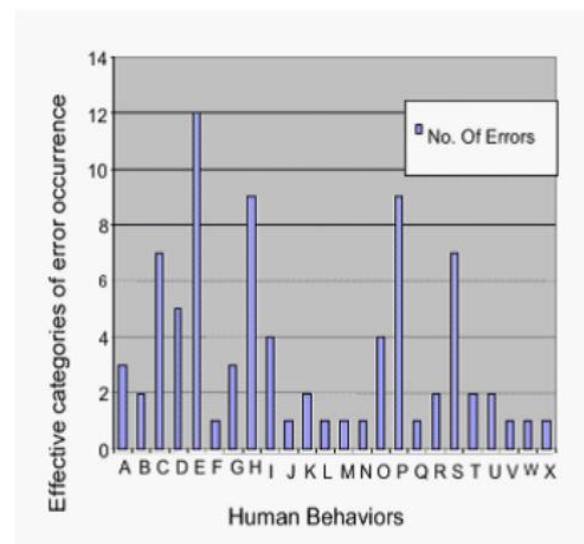


Fig.1 Analysis of personality factors

Personality factors are plotted along x-axis and the percentage of students exhibiting these behaviors are plotted on y-axis. The various personality factors are a (Sizothymia [13], [14], [15], [16] Vs Cyclothymia) , b (Scholastic Mental Capacity) , c (Ego strength) , e (Submissiveness Vs Dominance) , f (Desurgency Vs Surgency) , g (Superego strength) , h (Threctio [13], [14], [15], [16] Vs Pannia [13], [14], [15], [16]), i (Horria [13], [14], [15], [16] Vs Premsia[13], [14], [15], [16]) , l (Alaxia[13], [14], [15], [16] Vs Protension) , m(Proxemia Vs Autia[13], [14]), n(Artiessness[13], [14], [15], [16] Vs Shrewdness), o(Untroubled adequacy Vs Guilt proneness), q1(Conservatism Vs Radicalism), q2(Group adherence Vs self-sufficiency), q3(Self-concept control) , q4(Ergic tension). In the graph, blue bar represents low %age, red bar average %age and yellow bar high %age of students showing the given behaviors. E.g. 17.6% age of students have sizothymiotic behavior, 53% are having average sizothymiotic/cyclothymiotic behavior and 29.4%age of students have cyclothymiotic behavior.

Thus, various types of factors are correlated to the student's behavior.

b) The results of the error detection of programming test (5 simple programs) have been correlated with the student's behavior as shown graphically in Fig 2. Human behaviors are plotted along x-axis and the effective categories of error occurrence have been plotted along y- axis. The various human behavior are A (careless) , B (ambitious), C(responsibility which also includes obedience), D(domain Knowledge), E (experience), F (timid ness), G(efficiency), H(capable which is a combination of capability and competitive), I(logical which includes logical and rational), J(adjustable), K(agreeable), L(having interest), M (controlled) , N(accomplishment), O(imaginative), P (intellectual as well as wisdom), Q (trust-worthy), R (open-minded), S (practical) , T (reserved), U (mature), V (helpful), W(tough-minded).



According to the graph, students which are less imaginative will commit 4 different types of errors (as specifications not met, open-ended (expandability), no reusability and not modular) as given in table 1. Similarly, students which are careless commit 3 different types of errors (Requirement not properly followed, inappropriate language selected and insufficient documentation, that can be verified from the table also.)

c) It has been found that students with characteristics emotional stability, tough - mindedness, self-control, responsibility, obedience, logical, capable, open-mindedness have high score and make less number of errors while developing a software.

6. CONCLUSION

The present paper has undertaken the study of human behavior and it has been concluded that the students having emotional stability, tough-mindedness, self-control, responsibility, obedience, logical, capable, broad-mindedness have high performance and commit fewer errors.

Such research is helpful for the Human Resource departments of software industry in the selection of competent candidates for software development. The advantage of such type of research is that it will help in reducing the software cost, development time and improving quality of product as well as process and will help in making good team.

7. FUTURE WORK

During the study, student data has been taken for the study of human behavior in software development. For developing a human reliability metric, diverse data from different environments like software development industry and automated industry should be taken.

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