ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A STUDY ON MODELING OF E-COMMERCE BASED WEBAPPLICATIONS

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ABSTRACT

The e-commerce industry is increasing at a about 70% each year. According to an October report by Gartner, an American information technology research and advisory firm, ecommerce in India is likely to cross $6 billion in revenues in 2015, recording a 70 percent increase from a year ago. This makes India one of the fastest-growing ecommerce markets in the Asia-Pacific region. In order to help the developers to design a website in such a manner to improve the quality of e-commerce site an empirical study was carried out to know if the development methodology adopted influences the website quality.Te development factors are compared to the quality factors to come to conclusion aboth what influences the website quality.

KEYWORDS: Software development, e-commerce, website quality, e-commerce quality.

INTRODUCTION

The e-commerce industry is growing at a faster rate all over the world. The popularization of the e-commerce laid foundation for the e-commerce. As the e-commerce doesn't have a location boundary it may play an important role in every country's economic growth. The new way of doing business, i.e. e-commerce has a great impact for the business developments in every organization around the world.

The Internet is a powerful new communication medium for conducting free-market style business transactions involving the instant exchange of billions of dollars on a worldwide scale. Primarily due the Internet industry's low market entry requirements, the 21st century shifted the balance of power away from industrial age firms. This enabled Internet firms to monopolize market share and achieve unprecedented levels of profitability (Vise, 2005). Likewise, it presents large challenges for managing the development of Internet software. Some firms manage the development of Internet software using principles of flexibility and agility, while other firms use traditional methods rooted in the scientific management era.

Given to the importance of E-commerce, We have concentrated on the technological aspect of the e-commerce. The use web application methods require very dynamic and stringent operational guidelines in comparison to the traditional non web based computer application. The Internet software require some new approach compared to the traditional software development methods, which were too cumbersome, expensive and rigid.

PURPOSE AND SCOPE OF STUDY

After extensive literature study we found that most modern e-commerce developers use and incorporate the four methods namely iterative development, customer feedback, well structured teams and Flexibility as part of their software development strategy. The purpose of this study is to determine whether the little studied areas such the use of these methods: iterative development, customer feedback, well structured teams and Flexibility results in better e-commerce website quality study. Higher quality websites may be a stepping stone to improve organizational and market performance. The scope of this is limited to an empirical analysis of the links between these factors and e-commerce website quality. There are many website quality models. However we preferred to choose the eTailQ (Wolfinbarger & Gilly, 2003). e-commerce website quality model as our reference model for quality. So survey instrument for website quality was derived from the factors, subfactors, and questions from eTailQ (Wolfinbarger & Gilly, 2003). The eTailQ instrument itself was designed from an analysis of literature, use of focus groups, and extensive field testing and validation of data collected from over 1,000 respondents. Four major factors are associated with eTailQ:

(a) Website design,

(b) Privacy and security,

(c) Fulfillment and reliability, and
(d) Customer service.

Significance

The development methods may be significant and interesting to a number of stakeholders. These may include managers and developers of Internet software. Managers may want to use software development approaches well suited for Internet technologies. Developers may want to focus on creating the best possible Internet software without the overhead of using traditional methods. This study may help to understand the dynamics of creating e-commerce applications.

RESEARCH FRAMEWORK

Each of the development method consists of different factors ad each factor is considered as a variable in our empirical study. The different sub-factors in each development methods are given in Table1.

Table 1. Variables of software development

Factor	Variable	Item
Iterative development	Time boxed releases	We develop software using time-based iterations, increments, or demonstrations
	Operational releases	We develop software using operational iterations, increments, or demonstrations (working code)
	Small releases	We develop software using small iterations, increments, or demonstrations
	Frequent releases	We develop software using daily, weekly, bi-weekly, or monthly iterations, increments, or demonstrations
feedback	Feedback solicited	We seek customer feedback on our software iterations, increments, or demonstrations
	Feedback received	We receive customer feedback on our software iterations, increments, or demonstrations
	Feedback frequency	We receive timely customer feedback on our software iterations, increments, or demonstrations
	Feedback quality	We receive a lot of (detailed) customer feedback on our software iterations, increments, or demonstrations
	Feedback incorporated	We incorporate customer feedback into our software iterations, increments, or demonstrations
Well-structured	Team leader	Our software teams have clear administrative or technical leaders
	Vision and strategy	Our software teams have clear visions, missions, or strategies
	Goals and objectives	Our software teams have clear goals or objectives
	Schedules and timelines	Our software teams have clear schedules or timelines
	Small team size	Our software teams have a small size with no more than 10 people
Flexibility	Small size	Our software is designed to be as small as possible
	Simple design	Our software is designed to be as simple as possible
	Modular design	Our software is designed to be modular or object-oriented
	Portable design	Our software is designed to work on multiple operating systems
	Extensible design	Our software is designed to be changed, modified, or maintained

Similarly the quality factors are given in table 2

Table 2. Variables of websiote quality

Factor	Variable	Item
Website design	In-depth information	The website provides in-depth information
	Processing efficiency	The site doesn't waste my time
	Processing speed	It is quick and easy to complete a transaction at this website
	Personalization	The level of personalization at site is about right, not too much or too little
	Product selection	This website has good selection
	Protection of privacy	I feel like my privacy is protected at this site

Privacy and security	Feelings of safety	I feel safe in my transactions with this website
	Adequate security	The website has adequate security features
Fulfillment and reliabilit	Order received	You get what you ordered from this site
	On time delivery	The product is delivered by the time promised by the company
	Order accurate	The product that came was represented accurately by the website
Customer service	Willingness to respond	The company is willing and ready to respond to customer needs
	Desire to fix issues	When you have a problem, the website shows a sincere interest in solving it
	Promptness of service	Inquiries are answered promptly

Two different questionnaires prepared one for the development methods and another for e-commerce website quality in graduated Likert-type 5 point scale 1 being strongly disagree to 5 being strongly agree. The first questionnaire ascertained to what extent the developers incorporate the desired parameters in the development process and the second one is aimed to ascertain the quality of e-commerce sites restricting the variables to the discussed variables. Statistical methods like Pearson's correlation analysis, regression analysis and factor analysis was conducted. Finally, statistical models was designed and built to correlate all of the factors of our method to the factors of website quality, including a composite model of all of the factors of website quality.

Hypothesis

There are four hypothesis and for each hypothesis there are many sub hypothesis

- **Hypothesis 1- (H1): Iterative development is linked to higher website quality**

As we consider four sub-factors of website quality, there will be four sub–hypothesis. These sub-hypotheses which emerge from the hypothesis one are:

Hypothesis 1a -(H1a): Iterative development is linked to better website design

Hypothesis 1b -(H1b): Iterative development is linked to higher website privacy and security

Hypothesis 1c- (H1c): Iterative development is linked to higher reliability and customer need fulfillment.

Hypothesis 1d- (H1d): Iterative development is linked to better customer service.

- **Hypothesis 2- (H2): Customer feedback is linked to higher website quality**

As we consider four sub-factors of website quality, there will be four sub–hypotheses. These sub-hypotheses which emerge from the hypothesis one are:

Hypothesis 2a- (H2a): Customer feedback is linked to better website design

Hypothesis 2b- (H2b): Customer feedback is linked to higher website privacy

Hypothesis 2c- (H2c): Customer feedback is linked to higher reliability and customer need fulfillment.

Hypothesis 2d- (H2d): Customer feedback is linked to better customer service.

- **Hypothesis 3 (H3): Well-structured teams are linked to higher website quality**

As we consider four sub-factors of website quality, there will be four sub–hypotheses. These sub-hypotheses which emerge from the hypothesis one are:

Hypothesis 3a -(H3a): Well-structured teams are linked to better website design.

Hypothesis 3b -(H3b): Well-structured teams are linked to higher website privacy.

Hypothesis 3c -(H3c): Well-structured teams are linked to higher reliability and customer need fulfillment.

Hypothesis 3d -(H3d): Well-structured teams are linked to better customer service.

- **Hypothesis 4- (H4): Flexibility is linked to higher website quality**

As we consider four sub-factors of website quality, there will be four sub–hypotheses. These sub-hypotheses which emerge from the hypothesis one are:

Hypothesis 4a- (H4a): Flexibility is linked to higher better website design

Hypothesis 4b- (H4b): Flexibility is linked to higher website privacy

Hypothesis 4c- (H4c): Flexibility is linked to higher reliability and customer need fulfillment.

Hypothesis 4d- (H4d): Flexibility is linked to better customer service.

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DATA ANALYSIS

Survey was used to capture information on three major groups of data:

(a) The use iterative development, customer feedback, well structured teams and flexibility in the process of e-commerce web application development,

(b) The quality of the resulting websites.

The data analysis process consists of analyzing descriptive, demographic, benefit, and website quality data, in addition to the relationships between the three major groups of data. Statistical software SPSS version 13 was used to analyze the descriptive, demographic, benefit, and website quality data, along with the relationships between these last three major groups of data. Approximately 750 respondents provided data on design methods, and 54 respondents provided addresses of e-commerce websites. Data analysis revealed correlations within groups of data, correlations between e-commerce web application design methods and website quality data. There were an adequate number of data points on design methods and project outcomes to analyze the relationships within and between these groups of variables. The means were quite high, which may mean that respondents agreed with statements about these variables. The means for website quality were higher, but the low number of Internet addresses would prove problematic for examining the relationships between design methods and website quality.

The summary of the demographic data from the main survey revealed some interesting findings . Out of the753 respondents:

(a) 741 reported their job function,

(b) 745 reported their years of experience,

(c) 743 reported their organization's number of employees,

(d) 747 reported the industry sector for which software is developed.

A correlational analysis of the 20 variables was performed (as shown in Table 3). There were five variables associated with each of the four major factors of design methods. As expected the five variables associated with each of the four major factors were closely correlated (using Pearson correlations).

Within the first group, iterative development, the highest correlation was between small releases and operational releases, small releases and frequent releases, and small releases and numerous releases. Within the second group, customer feedback, the highest correlations were between feedback solicited and feedback received, feedback solicited and feedback incorporated, and feedback frequency and feedback quality. Within the last two groups, well-structured teams and flexibility, the highest correlations were between vision and strategy and goals and objectives, and small size and simple design. With some exceptions, this analysis indicates the variables were well-chosen.

A linear regression of the 20 variables was also performed. Within the first group, iterative development, the highest adjusted R^2 values were between operational releases and small releases, small releases and frequent releases, and small releases and numerous releases. Within the second group, customer feedback, the highest adjusted R^2 values were between feedback solicited and feedback received, feedback received and feedback frequency, and feedback frequency and feedback quality. Within the third group, well-structured teams, the highest adjusted R^2 values were between vision and strategy and goals and objectives. Within the fourth group, flexibility, the highest adjusted R^2 values were between small size and simple design and modular design and extensible design. Overall, the highest adjusted R^2 values seem to be within the second group, customer feedback, but each major group of variables is closely related. This analysis further indicates the variables were well-chosen and reliably describe and represent the individual factors. Figures in italics are not significant.

Table 3. Data variable analysis

Variable	Time-boxed	Operational releases	Small releases	Frequent releases	Feedback solicited	Feedback received	Feedback incorporated	Feedback frequency	Feedback quality	Team Vision	and Goals and Objectives	Schedules	Small size	Small releases	Simple design	Modular design	Portable design	Extensible design
Time-boxed releases	1.000	0.149	0.258	0.269	0.104	0.095	0.070	0.093	0.094	0.090	0.069	0.107	*-0.004*	0.052	0.121	0.036	0.071	
Operational releases	0.149	1.000	0.309	0.136	0.052	0.038	0.115	0.110	0.055	0.067	0.062	0.012	0.021	0.078	0.073	*0.000*	0.053	

Small releases	0.258	0.309	1.000	0.356	0.122	0.085	0.168	0.166	0.049	0.111	0.141	0.069	0.017	0.169	0.184	0.050	0.170
Frequent releases	0.269	0.136	0.356	1.000	0.061	0.100	0.125	0.041	0.045	0.133	0.134	0.092	*0.001*	0.105	0.181	0.083	0.167
Numerous releases	0.187	0.196	0.322	0.206	0.121	0.049	0.078	0.142	0.036	0.078	0.128	0.021	0.017	0.058	0.125	0.016	0.105
Feedback solicited	0.104	0.052	0.122	0.061	1.000	0.319	0.284	0.535	0.040	0.061	0.057	0.019	0.026	0.102	0.109	0.034	0.109
Feedback received	0.066	0.084	0.109	0.067	0.549	0.471	0.442	0.463	0.056	0.145	0.130	0.060	0.016	0.105	0.125	0.015	0.138
Feedback frequency	0.095	0.038	0.085	0.100	0.319	1.000	0.573	0.256	0.106	0.212	0.153	0.117	*-0.004*	0.089	0.077	0.052	0.100
Feedback quality	0.070	0.115	0.168	0.125	0.284	0.573	1.000	0.241	0.066	0.174	0.155	0.060	*0.002*	0.143	0.097	0.062	0.133
Feedback incorporated	0.093	0.110	0.166	0.041	0.535	0.256	0.241	1.000	0.059	0.078	0.085	0.022	0.046	0.160	0.188	0.030	0.149
Team leader	0.094	0.055	0.049	0.045	0.040	0.106	0.066	0.059	1.000	0.357	0.289	0.271	*-0.004*	0.047	0.092	0.052	0.062
Vision and strategy	0.090	0.067	0.111	0.133	0.061	0.212	0.174	0.078	0.357	1.000	0.636	0.300	*0.002*	0.173	0.119	0.069	0.192
Goals and objectives	0.069	0.062	0.141	0.134	0.057	0.153	0.155	0.085	0.289	0.636	1.000	0.299	*0.033*	0.149	0.128	0.063	0.188
Schedules and timelines	0.107	0.012	0.069	0.092	0.019	0.117	0.060	0.022	0.271	0.300	0.299	1.000	*-0.004*	0.030	0.082	0.015	0.056
Small team size	*-0.004*	0.021	0.017	*0.001*	0.026	*-0.004*	*0.002*	0.046	*-0.004*	*0.002*	*0.033*	*-0.004*	1.000	0.038	*-0.004*	*0.009*	*0.008*
Small size	0.053	0.073	0.148	0.098	0.112	0.098	0.108	0.095	0.048	0.152	0.134	0.040	0.027	0.505	0.202	0.068	0.225
Simple design	0.052	0.078	0.169	0.105	0.102	0.089	0.143	0.160	0.047	0.173	0.149	0.03	0.038	1.000	0.234	0.115	0.343
Modular design	0.121	0.073	0.184	0.181	0.109	0.077	0.097	0.188	0.092	0.119	0.128	0.082	*-0.004*	0.234	1.000	0.138	0.350
Portable design	0.036	*0.000*	0.050	0.083	0.034	0.052	0.062	0.030	0.052	0.069	0.063	0.015	*0.009*	0.115	0.138	1.000	0.121
Extensible design	0.071	0.053	0.170	0.167	0.109	0.100	0.133	0.149	0.062	0.192	0.188	0.056	*0.008*	0.343	0.350	0.121	1.000

An analysis of the four major factors of design methods and the four major factors of website quality was performed (as shown in Table 4). Linear regression was used to build statistical models between each of the four factors and the four factors of website quality. There was one rare exception, which exhibited a high adjusted R^2 value between iterative development and privacy and security. There were some more high adjusted R^2 values between well-structured teams and privacy and security, flexibility and website design, and flexibility and privacy and security. These were significant at the 0.10 level, though the 0.05 level has been used as a strict cutoff to judge all correlations and statistical relationships.

Table4. Website Quality Factor Analysis

Factor	Variable	Website design	Privacy and security	Fulfillment and reliability	Customer Service	Composite
Iterative development	*Adjusted R^2 value*	0.546	0.860	-0.120	-0.187	0.326
	F-value	3.163	12.053	0.807	0.716	1.872
	Significance	*0.144*	0.016	*0.599*	*0.644*	*0.282*
Customer feedback	*Adjusted R^2 value*	-0.869	-0.725	0.425	-0.495	-0.531
	F-value	0.256	0.328	2.184	0.470	0.445
	Significance	*0.912*	*0.869*	*0.276*	*0.784*	*0.799*
Well-structured teams	*Adjusted R^2 value*	0.540	0.729	-0.049	0.420	0.558
	F-value	3.115	5.840	0.915	2.301	3.272
	Significance	*0.147*	*0.056*	*0.549*	*0.220*	*0.137*

Flexibility	*Adjusted R^2 value*	0.740	0.656	0.038	0.287	0.538
	F-value	6.126	4.438	1.072	1.726	3.099
	Significance	*0.052*	*0.087*	*0.487*	*0.309*	*0.148*

Model analysis

Five statistical models were constructed between the four major factors of website quality (including a composite model called eTailQ) and the four major factors. Two of the models, privacy and security and fulfillment and reliability as a function of iterative development, customer feedback, well-structured teams, and flexibility had high adjusted R^2 values (and were statistically significant). The composite model, eTailQ was significant at the 0.10 level, which was far above the minimum threshold for significance used in this analysis. About half of the Beta values associated with the factors of iterative development, customer feedback, well-structured teams, and flexibility were statistically significant. Only one of the models, fulfillment and reliability, had a high adjusted R^2 value, good F-value, high significance, and statistically significant Beta values. The weakest model was the customer service model, though few of the models were very strong. This analysis indicates the aggregated factors are strongly correlated to two of the factors of website quality (67% and 84%) and aggregated factors of website quality (e.g., 54%).

Using the data from Table 5, an analysis of the hypotheses and sub-hypotheses was performed. There was some evidence that iterative development was correlated to website quality, website design, privacy and security, and fulfillment and reliability at the 0.05 level. Customer feedback was correlated to website quality and fulfillment and reliability at the 0.10 level. Well structured teams were negatively correlated to website quality and fulfillment and reliability at the 0.10 level. Flexibility was negatively correlated to website quality, privacy and security, fulfillment and reliability, and customer service at the 0.10 level. However, our hypotheses were stated as positive correlations, so negative ones are viewed as failed hypotheses. We cannot put too much confidence in these results due to the small amount of data. The final analysis indicates iterative development and customer feedback are correlated to factors of website quality (e.g., there is some evidence that half of our hypotheses are true).

Table5 . Model Analysiss

Model	Statistic	Website Design	Privacy and Security	Fulfillment Reliability	Customer Service	Overall
(Model)	*Adjusted R^2*	0.448	0.674	0.843	0.131	0.541
	F-value	2.829	5.648	13.097	1.339	3.650
	Significance	*0.142*	0.043	0.007	*0.372*	*0.094*
(Constant)	*Beta*	6.583	6.520	6.568	6.154	6.474
	t-value	5.516	5.760	5.812	2.364	4.834
	Significance	0.003	0.002	0.002	*0.064*	0.005
Iterative development	*Beta*	0.745	1.029	0.634	0.632	0.758
	t-value	3.071	4.470	2.761	1.193	2.783
	Significance	0.028	0.007	0.040	*0.286*	0.039
Customer feedback	*Beta*	0.249	0.398	3.389	2.306	1.395
	t-value	0.411	0.693	5.908	1.745	2.052
	Significance	*0.698*	*0.519*	0.002	*0.141*	*0.095*
Well-structured teams	*Beta*	-0.613	-0.809	-2.600	-1.791	-1.333
	t-value	-1.317	-1.832	-5.894	-1.763	-2.551
	Significance	*0.245*	*0.126*	0.002	*0.138*	*0.051*
Flexibility	*Beta*	-0.528	-0.708	-1.876	-1.348	-1.031
	t-value	-1.721	-2.435	-6.462	-2.015	-2.997
	Significance	*0.146*	*0.059*	0.001	*0.100*	0.030

FINDING

Based on the above results the following conclusion may be drawn

Hypothesis 1_a -($H1_a$): Iterative development is linked to better website design is accepted

Hypothesis 1_b -($H1_b$): Iterative development is linked to higher website privacy and security is accepted

Hypothesis 1_c- ($H1_C$): Iterative development is linked to higher reliability and customer need fulfillment is accepted

However the Hypothesis 1_d is not substantiated.

Hence we can conclude

Hypothesis 1- (H_1): Iterative development is linked to higher website quality is accepted and valid.

Similarly the Hypothesis 2_c- (H_{2c}): Customer feedback is linked to higher reliability and customer need fulfillment is substantiated hence accepted.

Other hypothesis could not be substantiated. Hence the conclusion is

Hypothesis 2- (H2): Customer feedback is linked to higher website quality is partially accepted.

The sub Hypothesis 2_c- (H_{2c}): Customer feedback is linked to higher reliability and customer need fulfillment is accepted.

The major component of the customer feedback which influences website quality is fulfillment and reliability.

The hypothesis H3 and H4 couldn't be substantiated. Hence the hypothesis H3 and H4 are rejected.

LIMITATIONS

There were several limitations associated with this study:

(a) Use of a new conceptual model of design,
(b) Use of a new survey instrument,
(c) Use of self- selected respondents, and
(d) Use of a small number of websites.

CONCLUSION

There were several lessons we learned from our study, which could help other scholars with similar studies. First, choose a larger and slower industry to study and use a general-purpose model of software quality to maximize the amount of data one can possibly obtain. Second, use cognitive interviews to pre-test surveys, interview novices and experts alike, and conduct trial- runs and pilot surveys to evaluate your survey instruments early. Fourth, use online survey websites to collect data, especially ones that are inexpensive, flexible, and easy-to-use, rather than conducting phone, snail-mail, email, or traditional paper surveys. Fifth, use popular web blogs to promote surveys instead of email surveys, of which good ones are hard to find.

REFERENCES

1. Vise, D. A. (2005). The google story: Inside the hottest business, media, and technology success of our time. New York, NY: Delcorte Press.
2. Waldstein, N. S. (1974). *The walk thru: A method of specification design and review* (TR00.2536). Poughkeepsie, NY: IBM Corporation.
3. US Census Bureau Statistics, US Department of Commerce, Economic and Statistics Administration, May 2012
4. U.S. Department of Commerce. (2003). *Digital economy*. Washington, DC: Author.
5. U.S. Department of Commerce. (2006). *Information and communication technology: 2004*.Washington, DC:
6. Sukert, A. N. (1979). Empirical validation of three software error prediction models. *IEEE Transactions on Reliability, 28*(3), 199-205.
7. Rayaguru A. K. Das, (2010), Computer applications, Newage publications, Odisha
8. *Systems Journal, 28*(3), 386-406.
9. Sunazuka, T., Azuma, M., & Yamagishi, N. (1985). Software quality assessment technology.*Proceedings of the* [10]*Eighth International Conference on Software Engineering, London, England*, 142-148.
10. Shooman, M. L. (1983). *Software engineering*. New York, NY: McGraw Hill.
11. Shooman, M. L., & Bolsky, M. I. (1975). Types, distribution, and test and correction times for programming errors. *Proceedings of the International Conference on Reliable Software, Los Angeles, California, USA*, 347-357.

12. Rayaguru A. K. Das, (2010), Information Technology, Newage publications, Odisha
13. Royce, W. W. (1970). Managing the development of large software systems. *Proceedings of the Western Electronic Show and Convention (WESCON 1970), Los Angeles, California, USA*, 1-9.
14. Rayaguru A. K. Das, B. K. Pattanayak, A. B. Khan, S.K. Misra, Rapid Web Development Life Cycle: A Structured Methodology for Web Application Development, *International Journal of Applied Engineering Research Volume 10, Number 15 (2015) pp* 35431-35435
15. Radice, R. A., Harding, J. T., Munnis, P. E., & Phillips, R. W. (1985). A programming process study. *IBM Systems Journal, 24*(2), 91-101.
16. Reid, R. H. (1997). *Architects of the web: 1,000 days that build the future of business.* New York, NY: John Wiley & Sons.
17. Palmer, S. R., & Felsing, J. M. (2002). *A practical guide to feature driven development*. Upper Saddle River, NJ: Prentice Hall.
18. Panzl, D. J. (1976). Test procedures: A new approach to software verification. *Proceedings of the Second International Conference on Reliable Software, San Francisco, California, USA*, 477-485.
19. Schulze, A., & Hoegl, M. (2006). Knowledge creation in new product development projects. *Journal of Management, 32*(2), 210-236.
20. Rubey, R. J., & Hartwick, R. D. (1968). Quantitative measurement of program quality.*Proceedings of the 23rd ACM National Conference, Washington, DC, USA*, 671-677
21. ulack, R. A., Lindner, R. J., & Dietz, D. N. (1989). A new development rhythm for AS/400 software. *IBM*
22. Schick, G. J., & Wolverton, R. W. (1978). An analysis of competing software reliability analysis models. IEEE Transactions on Software Engineering, 4(2), 104-120.