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Design of FAHP based Security Framework under Agile Software Development

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Abstract: Software security is becoming complex under projects development phase. It has challenges for assessment of security type and level with cost-effective solutions. Agile Software Development (ASD) is significantly associated with self-management. Thus, product development team and the owners expects to manage security prioritization. This paper is addressing a framework that influences the priority given to security under Agile Software Development through support & interactions of teams rather than fixed priorities and activities. To perform this task effectively it is desired to understand the factors that supports or hinders in decision of prioritizing the security. Based on the deep study of vast number of literature an insight of strategy applied for influencing the priority of security by security professional is framed under environment of agile software development process. The result are helpful in influencing the process of finding factors under priority during security framework design using approach of Fuzzy Analytic Hierarchy Process (FAHP) that helps to understand the key features for security system design.

Keywords*: *Software security, Agile software development, Analytic Hierarchy Process (AHP), Fuzzy AHP.

1. Introduction

Agile methodologies are not only applied for traditional projects, but also in development of modern systems where regulations and standards are very important driving prerequisites [1], [2]. Organizations forcing to deal the competition in market to satisfy customer demands that goes through rapid evolution and rapid changes. Agile environment created due to customer-centric focus based process development [3]. Hence, to shorten the life-cycles of development and to keep a simple design, organizations selects the process associated with adaptation cycles with use of early feedback.

Challenges that are frequently focused the achieving the compliance with standards security norms for approaches under

agile software development (ASD) process. Previous studies on conventional and modern schemes that are existing on the common approach of following compliance in ASD with security norms, contributions are in isolation: either factors are analyzed independently [4] or security aspects are considered from specific

standards of security [5]. This violates the clear understanding of modes for achieve security under agile development process.

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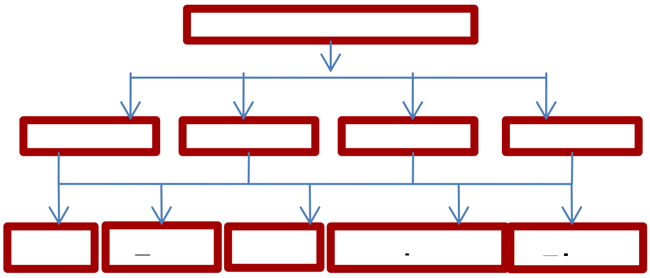
2. Related Work

Presently, software development is important as well as integrated part all organizations related to infrastructures of critical application of daily life. It is getting very essential that software must inherent security at adequate level. The word "adequate security" varies depending on the type of software project, and even during development, time and needs are negotiated [6].Furthermore, the selection of relevant methods for reaching the given security level is often determined by the organization and the design approach used in the development process. Clarity regarding security decisions and priorities is required during the development process of software projects in an agile setting. The problem of prioritizing security aspects is critical and frequently necessary in both traditional development techniques and ASD [7, 8]. ASD is more prevalent in current software development processes; hence there is a need to address the issues related with ASD. From a security aspect, many frameworks expressed doubt towards ASD [9], and discussed about various challenges in context of quality and security aspects under ASD [10, 11, 12, 13, 14, 15]. Challenges to prioritize the factors on which security depends are including implicit and missing requirements of agile process [12, 14], incentives lack for considering for security under early proposed systems of project development in agile conditions [11, 14] and security issues neglected as a part of agile environment [11] – all of these aspects lead to negligence of maintenance of secure system process [10, 11, 14, 15]. ASD helps in bringing positive aspects in setting security priority by supporting security requirements iterations [9] , and the security incompatibility [16]. Several approaches used in agile environment like Scrum [17] do not have activities or roles related to security. Due to this deficiency, enhancements to Scrum and other agile frameworks have been proposed for incorporating security into agile system development [18, 19, 16, 20, 21]. However, Scrum has not been shown to be sufficiently capable of specifying how to execute work development (including software security). Rather, it is a management framework used to create an environment that assists in structuring development teams and assigning job responsibility to the appropriate amount during the project development process [9]. ASD assists individuals in dealing with procedures and tools, as well as trained and motivated software teams in completing their tasks effectively [7]. Thus, in ASD, the difficulty of gaining insight into security variables should be addressed through team interactions rather by prescribing techniques for software security and prioritizing [9, 22].There is demand for understanding the factors that supports and hinders the process of achieving security standards.

The software applications cannot be made fully secure [2]. There are always certain security issues that are not addressed throughout the development process due to time restrictions or other reasons [4]. Flaws are addressed, prioritized, and repaired. Maintenance is ongoing and will continue until a software program is totally taken over in real time. Maintaining security is expensive and time-consuming, hence it is a critical component that should be optimized [5].Development of safe software applications is critical for assuring lifespan [4]. Integrating security durability into early stages of software development is both profitable and cost-effective for enterprises [4], [5]. The selection of a wide range of durability-security properties is based on expert decisions from many research and academic sectors. As a result, the concerns under consideration become apparent. The Analytic Hierarchy Process (AHP) is well-known decision-making tools that may assist solve amorphous situations [6]. AHP is employed in a variety of information technology applications, including network security, information security, and computer security [6, 7]. The outcomes of the evaluation assist decision-makers in making meaningful and relevant decisions. Decision-makers must identify the variables that contribute to long-term security, as well as the most useful and justified considerations for making proper decisions. Recent research has focused on the Fuzzy analytic hierarchy process (FAHP) technique, which incorporates the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), to examine the longevity of security methods. The study investigation was conducted to test the recommended methodologies on a software application in order to determine the framework's efficiency. The examination of security-related variables using effective approaches is extremely desirable for increasing the quality of the agile software development process [8].Furthermore, the assessment and selection of security variables in agile software development applications raises decision-making concerns [4]. This paper utilizes a Fuzzy AHP-based method [9]. This strategy is useful for attaining the best outcomes. Several experts can incorporate fuzzy logic in AHP [7] but specific recommendations are not provided for quantitative assignment of qualitative weights of qualities. The approach FAHP systematically assists decision-makers in weighing qualities, hence eliminating ambiguities and uncertainties in the evaluation. Pair-wise comparisons and fuzzy numbers are used to derive factor consistent weights. The Fuzzy-AHP is efficient since it includes repetitious computations with a small number of possibilities to compare. As a result, the authors advocate that the Fuzzy AHP technique be used to examine the effect of options in a quick and straightforward manner [22 -25].

3. Results



Some Common Mistakes

(a) AHP based conventional approach

Table 1. Criteria (level 1) based paired comparison matrix w.r.t overall adjective

CRITERIA	Confidentiali	Integrity	Availability	Authenticity	**Priority**	**λ (Eigen**	Results
Confidentiality	1	0.33	0.33	0.33	0.1	4.03	λ_{max} = 4.15 CI= 0.05 RI= 0.9 CR=0.05
Integrity	3	1	3	1	0.37	4.21	
Availability	3	0.33	1	0.33	0.17	4.13	
Authenticity	3	1	3	1	0.37	4.21	

Table 2.1: Pairwise comparison matrix of factors (level 2) for Confidentiality using AHP

	Iterat	Fa	Visibi	Adapt	Flexibi	Prior	λ	Results
Iterative	1	0.3	0.33	0.14	5	0.09	5.3	λ_{max}= 5.36
Fast	3	1	3	0.33	5	0.24	5.3	
Visibilit	3	0.3	1	0.33	3	0.14	5.4	
Adaptiv	7	3	3	1	9	0.48	5.4	CI =
Flexibili	0.2	0.2	0.33	0.11	1	0.04	5.1	0.09

Table 2.2: Pairwise comparison matrix of factors (level 2) for Integrity using AHP

	Iterat	Fa	Visibi	Adapt	Flexibi	Prior	λ	Results
Iterative	1	0.5	3	0.14	5	0.16	5.48	λ_{max}= 5.41
Fast	2	1	3	0.33	3	0.20	5.73	CI = 0.1
Visibilit	0.33	0.3	1	0.33	5	0.12	4.9	RI = 1.12
Adaptive	7	3	3	1	9	0.49	5.77	CR =
Flexibility	0.2	0.2	0.2	0.11	1	0.04	5.14	0.09

Table 2.3: Pairwise comparison matrix of factors (level 2) for Availability using AHP.

CRITERIA	Iterative	Fast	Visibility	Adaptive	Flexibility	Priority	λ	Results
Iterative	1	0.2	3	0.33	3	0.13	5.44	λ_{max}= 5.36
Fast	5	1	7	3	5	0.49	5.57	CI = 0.09
Visibility	0.33	0.14	1	0.33	3	0.08	5.14	
Adaptive	3	0.33	3	1	5	0.24	5.51	RI = 1.12
Flexibility	0.33	0.2	0.33	0.2	1	0.05	5.13	CR = 0.08

Table 2.4: Pairwise comparison matrix of factors (level 2) for Authenticity using AHP

CRITERIA	Iterative	Fast	Visibility	Adaptive	Flexibility	Priority	λ	Results
Iterative	1	0.2	3	0.33	3	0.13	5.48	λ_{max}= 5.4
Fast	5	1	5	3	5	0.46	5.66	CI = 0.1
Visibility	0.33	0.2	1	0.2	3	0.09	5.07	RI = 1.12
Adaptive	3	0.33	5	1	5	0.27	5.63	CR = 0.09
Flexibility	0.33	0.2	0.33	0.2	1	0.05	5.16	(Acceptable)

Table 3: Overall composite weights for the factors

Criteria		**Confidentiality**	**Integrity**	**Availability**	Authenticity	Composite Weight=(sum of all row values)/4	Rank
Factor	Criteria Weight	0.1	0.37	0.17	0.37		
Iterative		0.09	0.16	0.13	0.13	0.13	3
Fast		0.24	0.2	0.49	0.46	0.35	2
Visibility		0.14	0.12	0.08	0.09	0.11	4
Adaptive		0.48	0.49	0.24	0.27	0.37	1
Flexibility		0.04	0.04	0.05	0.05	0.05	5

Combined CR= $\sum W_i CI_i / \sum W_i RI_i$ **=**(**1** * 0.05 + **0.10** * 0.09 + **0.37** *0.10 + **0.17** * 0.09 + **0.37** * 0.10) / (**1*** 0.9 + **0.10** * 1.12 + **0.37***1.12 + **0.17** * 1.12 + **0.37** * 1.12) = 0.07

Combined CR = 0.07 < 0.10, shows that results were **consistent** with evaluations.

(b) Proposed FAHP based approach:

Table 4: Criteria (level 1) based paired comparison matrix with respect to overall objective

CRITERIA	Confidentiality			Integrity			Availability			Authenticity			GEOMETRIC MEAN =(V1*V2*V3)^(1/4)			Relative fuzzy wt. of each criteria			MI	NW
Confidentiality	1	1	1	4	5	6	3	4	5	6	7	8	2.91	3.44	3.94	0.42	0.60	0.85	0.63	0.60
Integrity	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	1	1	1	$\frac{1}{3}$	$\frac{1}{2}$	1	2	3	4	0.58	0.74	1	0.08	0.13	0.21	0.14	0.13
Availability	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{3}$	1	2	3	1	1	1	2	3	4	0.80	1.11	1.41	0.11	0.19	0.30	0.207	0.197
Authenticity	$\frac{1}{8}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	2	3	4	1	1	1	0.30	0.35	0.45	0.04	0.06	0.09	0.068	0.065
										SUM			**4.59**	**5.64**	**6.80**				**1.052**	**1.000**
										REVERSE			**0.21**	**0.17**	**0.14**					
										ASCENDING			**0.14**	**0.17**	**0.21**					

Table 5.1: Pairwise comparison matrix of factors (level 2) for Confidentiality using FAHP

Alternatives	Iterative			Fast			Visibility			Adaptive			Flexibility			GEOMETRIC MEAN =(V1*V2*V3)^(1/5)			RELATIVE FUZZY WT. OF EACH CRITERIA			MI	NW
Iterative	1	1	1	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	0.259	0.301	0.370	0.035	0.047	0.068	0.050	0.048
Fast	4	5	6	1	1	1	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	2	3	4	9	9	9	1.783	2.141	2.551	0.239	0.334	0.472	0.348	0.336
Visibility	9	9	9	2	3	4	1	1	1	4	5	6	$\frac{1}{8}$	$\frac{1}{7}$	$\frac{1}{6}$	1.552	1.807	2.048	0.208	0.282	0.379	0.290	0.280
Adaptive	2	3	4	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	1	1	1	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	0.425	0.525	0.660	0.057	0.082	0.122	0.087	0.084
Flexibility	2	3	4	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	6	7	8	4	5	6	1	1	1	1.398	1.635	1.844	0.187	0.255	0.341	0.261	0.252
													SUM			**5.417**	**6.409**	**7.473**				**1.036**	**1.000**
													REVERSE			0.185	0.156	0.134					
													ASCENDING			0.134	0.156	0.185					

Table 5.2: Pairwise comparison matrix of factors (level 2) for Integrity using FAHP

Alternatives	Iterative			Fast			Visibility			Adaptive			Flexibiliity			GEOMETRIC MEAN =(V1*V2*V3)^(1/5)			RELATIVE FUZZY WT. OF EACH CRITERIA			MI	NW
Iterative	1	1	1	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	4	5	6	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	0.45	0.51	0.60	0.060	0.083	0.116	0.086	0.083
Fast	4	5	6	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	2	3	4	9	9	9	1.78	2.14	2.55	0.239	0.343	0.487	0.356	0.342
Visibility	9	9	9	2	3	4	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	7	8	9	1.99	2.35	2.76	0.267	0.376	0.528	0.391	0.375
Adaptive	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	2	3	4	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	0.46	0.58	0.75	0.062	0.093	0.145	0.100	0.096
Flexibiliity	2	3	4	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{8}$	$\frac{1}{7}$	2	3	4	1	1	1	0.54	0.66	0.76	0.073	0.106	0.145	0.108	0.104
															SUM	**5.23**	**6.25**	**7.44**				**1.041**	**1.000**
															REVERSE	0.19	0.16	0.13					
															ASCENDING	0.13	0.16	0.19					

Table 5.3: Pairwise comparison matrix of factors (level 2) for Availability using AHP

Alternatives	Iterative			Fast			Visibility			Adaptive			Flexibiliity			GEOMETRIC MEAN =(V1*V2*V3)^(1/5)			RELATIVE FUZZY WT. OF EACH CRITERIA			MI	NW
Iterative	1	1	1	2	3	4	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	2	3	4	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{4}$	0.699	0.903	1.149	0.101	0.163	0.257	0.174	0.164
Fast	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	2	3	4	9	9	9	1.024	1.246	1.552	0.148	0.224	0.348	0.240	0.226
Visibility	4	5	6	2	3	4	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	7	8	9	1.695	2.091	2.551	0.246	0.376	0.571	0.398	0.374
Adaptive	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	2	3	4	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	0.500	0.644	0.871	0.073	0.116	0.195	0.128	0.120
Flexibiliity	2	3	4	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{8}$	$\frac{1}{7}$	2	3	4	1	1	1	0.548	0.660	0.760	0.079	0.119	0.170	0.123	0.116
															SUM	**4.466**	**5.544**	**6.883**				**1.062**	**1.000**

REVERSE	0.224	0.180	0.145
ASCENDING	0.145	0.180	0.224

Table 5.4: Pairwise comparison matrix of factors (level 2) for Authenticity using AHP

Alternatives	Iterative			Fast			Visibility			Adaptive			Flexibiliity			GEOMETRIC MEAN =(V1*V2*V3)^(1/5)			RELATIVE FUZZY WT. OF EACH CRITERIA			MI	NW
Iterative	1	1	1	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	4	5	6	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	0.450	0.517	0.608	0.049	0.065	0.089	0.068	0.066
Fast	4	5	6	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	2	3	4	9	9	9	1.783	2.141	2.551	0.194	0.270	0.375	0.280	0.272
Visibility	9	9	9	2	3	4	1	1	1	6	7	8	7	8	9	3.764	4.324	4.816	0.410	0.545	0.708	0.554	0.539
Adaptive	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{1}{7}$	$\frac{1}{6}$	1	1	1	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	0.265	0.316	0.401	0.029	0.040	0.059	0.043	0.041
Flexibiliity	2	3	4	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{8}$	$\frac{1}{7}$	2	3	4	1	1	1	0.548	0.660	0.760	0.060	0.083	0.112	0.085	0.082
															SUM	**6.810**	**7.958**	**9.136**				**1.029**	**1.000**
															REVERSE	0.147	0.126	0.109					
															ASCENDING	0.109	0.126	0.147					

Table 6: Comparing Agile Characteristic [SECURITY CONSTRAINTS: Confidentiality, Integrity, Availability, and Authenticity]

Criteria		AHP		FUZZY AHP	
Factor	Criteria Weight	Composite Weight	Rank	Composite Weight	Rank
Iterative		0.13	3	0.077	5
Fast		**0.35**	**2**	**0.311**	**2**
Visibility		0.11	4	**0.328**	**1**
Adaptive		**0.37**	**1**	**0.090**	**4**
Flexibility		0.05	5	0.194	3

Regression Model Analysis: Project under group A considers web application for online shopping system it has 7 sub-modules R1 to R7 as shown in table 7.1.

Table 7.1: Project group A

Sr No	Project	Iterative	Fast	Visibility	Adaptability	Flexibility	Calculated
1.	**P1**	0.2660	0.45200	0.4020	0.263	0.256	0.73444
2.	**P2**	0.2369	0.22300	0.5630	0.214	0.124	0.48098
3.	**P3**	0.5890	0.56900	0.2580	0.260	0.369	0.91538
4.	**P4**	0.8960	0.25400	0.1560	0.412	0.478	0.94525
5.	**P5**	0.2570	0.45600	0.4120	0.456	0.149	0.77996
6.	**P6**	0.6320	0.23140	0.2580	0.178	0.256	0.70247
7.	**P7**	0.2580	0.11100	0.4360	0.650	0.458	0.78443
8.	**P8**	0.6970	0.78900	0.1480	0.145	0.369	1.03260
9.	**P9**	0.2540	0.42300	0.4720	0.502	0.456	0.83793
10.	**P10**	0.1260	0.23600	0.2314	0.625	0.745	1.02355
11.	**P11**	0.2570	0.43600	0.4220	0.456	0.149	0.76539

Regression Equation Development:

Table 7.2: Project group B

Standard Confidentiality = 0.465 - 0.0118 *Iterative + 0.542 *Fast + 0.609 *Visibility + 0.073 *Adaptability - 0.185 *Flexibility

S. No.	Project	Standard	Iterative	Fast	Visibility	Adaptability	Flexibility
1.	**R1**	0.874	0.320	0.44200	0.236	0.320	0.210
2.	**R2**	0.982	0.560	0.51000	0.562	0.360	0.789
3.	**R3**	0.761	2.600	0.26900	0.290	0.450	0.145
4.	**R4**	0.930	0.890	0.41000	0.459	0.780	0.442
5.	**R5**	0.870	0.260	0.38889	0.480	0.360	0.478
6.	**R6**	0.810	0.360	0.56000	0.202	0.269	0.359
7.	**R7**	0.556	0.236	0.12300	0.102	0.441	0.369

Table 7.3: Correlations Matrix for Group A & B projects

		Confidentiality	Iterative	Fast	Visibility	Adaptability	Flexibility
Pearson Correlation	**Confidentiality**	1.000	-.333	.597	.554	-.319	-.707
			Group A				
	Iterative	-.333	1.000	.266	-.737	-.511	.041
	Fast	.597	.266	1.000	-.315	-.491	-.195
	Visibility	.554	-.737	-.315	1.000	.200	-.497
	Adaptability	-.319	-.511	-.491	.200	1.000	.527
	Flexibility	-.707	.041	-.195	-.497	.527	1.000
			Group B				
	Iterative	.159	1.000	.215	.005	.054	.452
	Fast	.026	.215	1.000	.173	.063	.283
	Visibility	.039	.005	.173	1.000	.277	.060
	Adaptability	.169	.054	.063	.277	1.000	.048
	Flexibility	.007	.452	.283	.060	.048	1.000

Table 8.1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.999[a]	.999	.998	.00634
a. Predictors: (Constant), Flexibility, Iterative, Fast, Adaptability, Visibility				

Integrity Model

Model development

Standard Integrity= 0.756 + 0.0761* Iterative + 0.152 *Fast + 0.077* Visibility - 0.120 *Adaptability + 0.014* Flexibility

Table 8.2 a: Descriptive Statistics for integrity model for Group A projects

	Mean	Std. Deviation
Integrity	.8295	0.04911
Iterative	.406264	0.2500700
Fast	.380036	0.1935590
Visibility	.341673	0.1371321
Adaptability	.378273	0.1766426
Flexibility	.346273	0.1858570

Table 8.2 b: Correlation matrix for integrity model for Group A & B projects

		Integrity	Iterative	Fast	Visibility	Adaptability	Flexibility
Pearson Correlation	**Integrity**	1.000	.593	.852	-.360	-.830	-.372
				Group A			
	Iterative	.593	1.000	.266	-.737	-.511	.041
	Fast	.852	.266	1.000	-.315	-.491	-.195
	Visibility	-.360	-.737	-.315	1.000	.200	-.497
	Adaptability	-.830	-.511	-.491	.200	1.000	.527
	Flexibility	-.372	.041	-.195	-.497	.527	1.000
				Group B			
	Iterative	.027	1.000	.215	.005	.054	.452
	Fast	.000	.215	1.000	.173	.063	.283
	Visibility	.139	.005	.173	1.000	.277	.060
	Adaptability	.001	.054	.063	.277	1.000	.048
	Flexibility	.130	.452	.283	.060	.048	.

Table 8.2 c: Model Summary for integrity model for Group A projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.999[a]	.998	.996	.00295
a. Predictors: (Constant), Flexibility, Iterative, Fast, Adaptability, Visibility				

Availability Model

Standard Availability = 0.573 + 0.0465 Iterative + 0.439 Fast - 0.579 Visibility + 0.418 Adaptability + 0.287 Flexibility

Table 8.3 a: Descriptive Statistics for integrity Availability for Group A projects

	Mean	Std. Deviation
Availability	.8148	.16056
Iterative	.406264	.2500700
Fast	.380036	.1935590
Visibility	.341673	.1371321
Adaptability	.378273	.1766426
Flexibility	.346273	.1858570

Table 8.3 b: Correlation matrix for availability model for Group A & B projects

		Availability	Iterative	Fast	Visibility	Adaptability	Flexibility
Pearson Correlation	Availability	1.000	.371	.449	-.805	.201	.706
	Iterative	.371	1.000	.266	-.737	-.511	.041
	Fast	.449	.266	1.000	-.315	-.491	-.195
	Visibility	-.805	-.737	-.315	1.000	.200	-.497
	Adaptability	.201	-.511	-.491	.200	1.000	.527
	Flexibility	.706	.041	-.195	-.497	.527	1.000
	Iterative	.131	1.000	.215	.005	.054	.452
	Fast	.083	.215	1.000	.173	.063	.283
	Visibility	.001	.005	.173	1.000	.277	.060
	Adaptability	.277	.054	.063	.277	1.000	.048
	Flexibility	.008	.452	.283	.060	.048	1.000

Table 8.3 c: Model Summary for availability model for Group A projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.998[a]	.996	.993	.01353
a. Predictors: (Constant), Flexibility, Iterative, Fast, Adaptability, Visibility				

Authentication Model:

*Standard Authentication = 0.312 - 0.0610 *Iterative + 0.099 *Fast - 0.695* Visibility + 0.938 *Adaptability + 0.355 *Flexibility*

Table 8.4 b: Correlation matrix for authentication model for Group A and Group B projects

		Authentication	Iterative	Fast	Visibility	Adaptability	Flexibility
Pearson Correlation	Authentication	**1.000**	**-.088**	**-.196**	**-.417**	**.783**	**.875**
			Group A				
	Iterative	-.088	1.000	.266	-.737	-.511	.041
	Fast	-.196	.266	1.000	-.315	-.491	-.195
	Visibility	-.417	-.737	-.315	1.000	.200	-.497
	Adaptability	.783	-.511	-.491	.200	1.000	.527
	Flexibility	.875	.041	-.195	-.497	.527	1.000
			Group B				
	Iterative	.399	1.000	.215	.005	.054	.452
	Fast	.282	.215	1.000	.173	.063	.283
	Visibility	.101	.005	.173	1.000	.277	.060
	Adaptability	.002	.054	.063	.277	1.000	.048
	Flexibility	.000	.452	.283	.060	.048	1.000

Table 8.4 c: Model Summary for authentication model

Model Type	R	R Square	Adjusted R Square	Std. Error of the Estimate
Regression	.999[a]	.998	.996	.01353
a. Predictors: (Constant), Flexibility, Iterative, Fast, Adaptability, Visibility				

4. Conclusion

The latest applications are including development that associates attention towards security by designers & researchers. This articles giving the assessment of security under agile software development process. This method focuses on the factors that impact security in agile environment. It is helpful in recommending attributes that act as dependent factor for security that should be considered in initial stages of for software applications development. The proposed methodology presents results drawn from a real time projects related to agile environment that facilitate ideas & activities for software security during development process. It has been observed that Adaptibility, Visibility and Fast Delivery has significant impact among all other agile characteristics on the basis of chosen security criteria both through AHP and Fuzzy AHP technique. In future, security estimation may be performed with other factors concerned to security. Different methodologies may also be considered based on latest statistics based or soft computing based approach that may be further applied for evaluation of security analysis in agile software development.

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Author contributions

Ms. Sangeeta Mishra: Conceptualization, Methodology, Software, Field study **Dr. Mohd. Haroon**: Data creation, Writing-Original draft preparation, Software, Validation, Field study **Mr. Anurag Banoudha**: Visualization, Investigation, Writing-Reviewing and Editing.

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