Agile Management in Health Professions Education with Respect to Waterfall Life Cycle

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ABSTRACT

Objective: To determine the practice of waterfall life cycle functions in the health profession department of medical institutes by keeping in view the demographic factors of health professions managers.

Study Design: Cross-sectional survey.

Place and Duration of Study: Medical Institutes of Rawalpindi and Islamabad Pakistan, from Feb to Jul 2021.

Methodology: 46 managers were taken as a sample through a systematic random sampling technique. A self-developed questionnaire was used, and it contained 21 items. Mean and standard deviation were used to measure the practices of waterfall agile management, and t-test and ANOVA were used to test the effect of gender and experiences.

Results: Managers were not fully confident about the practices of water fall life cycle functions in their respective organization (Mean=3.08 ± 1.19). Gender has no significant effect on required analysis (p=0.861); design stage (p=0.625); test (p=0.222); deployment (p=0.718) and development (p=0.432) while monitoring and evaluation had significant effect (p=0.042). Similarly, managers' experience has significant effect on required analysis (p=0.013); test (p=0.001); deployment (p≤0.001) and development (p=0.002) while it has no significant effect on design stage (p=0.062) and monitoring and evaluation (p=0.060) in medical institutes.

Conclusion: Health profession managers were neutral about the practices of the waterfall life cycle of agile management in their respective medical institutes.

Keywords: Agile management, Cross-sectional study, Gender and job experiences, Waterfall life cycle.

INTRODUCTION

Health management is an extensive industry, and it requires extra care, attention and alertness in health professions education. Agility defines sectors sensitivity and type of work related to market competitive and health professions education is required for the professional contestants. They need to develop professionally according to the existing conditions and settings.[1] This study was based on the waterfall life cycle model developed by Royce in 1970.[2] The water-fall life cycle is a continuous process of management that consists of six dimensions: required analysis, development, test, monitoring and evaluation, and deployment.[3] All these dimensions were collectively used to determine the practices of the waterfall cycle of agile management in health profession education.

The waterfall approach considers a project as an undeviating procedure based on a series of basic sequential stages where each stage should be appropriate. It endorses earlier jumping to the next stage, which leads to more minor complications in the project implementation process.[4] Different institutes used the waterfall model and went through the phases of requirements analysis, design, execution, testing, release, and maintenance. The documents have to pass through a quality check between all the phases, and this approach is denoted as a stagegate.[5] Agility values working over the comprehensive documentation and emphasizes simplicity and maximizing the quantity of work.[6] The agile management in the health professions department needs careful planning, coordination, estimation, tracking and control. These aspects are formally covered in the waterfall model.[7]

Therefore, researchers investigated the waterfall agile practices in the health profession education department. Agile management is needed for health professions of education because health professions education is multifaceted and uncertain due to unceasingly research tools and theories, so it requires agile management to condense the difficulty in their exclusive health professions education.[8] It is blended and activates where medical and non-medical field members work together, which will be easier if we apply agile management in health professions education.[9] It is necessary for the health professions education

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department to break down immense activities into small sets of activities, which is a requisite everywhere in any institute or organization to perform their works in a refined and wellmannered way.[10] This study was a try to explore the practices of the waterfall life cycle in health professions and to identify the effect of demographic factors on the practice of waterfall life cycle in health professions department of medical institutes.

METHODOLOGY

This study was carried out through an online survey method. There are 14 medical institutes in Rawalpindi and Islamabad, from February 2021 to July 2021. The systematic sampling technique (n=460, k= 10, n=46) was used after approval from the ethical committee of the National University of Medical Sciences (Case Files No: 06/ORIC/NUMS dated 18 Mar 2021). Through systematic random sampling technique, 46 health professions managers were taken as a sample of this study. This sample size was estimated through Epi Tools Epidemiological Calculator while keeping a level of 5%, the confidence level of 95% estimated proper proportion 79% of previous surveys and 11 % of absolute precision.[11]

Inclusive Criteria: Managers working in the health profession education department were included in the study.

Exclusion Criteria: All other administrative managers from medical institutes were excluded from the study.

A self-developed questionnaire was developed after a thorough literature review by keeping in view the objectives of this study. This questionnaire was based on the waterfall model of agile management developed by Royce in 1970.[12] It contained 21 items. It was divided into six sections. Sections were related to six dimensions of the waterfall life cycle of agile management such as required analysis (06-Items), design stage (03-items); test (03-items); deployment (03-items); development (03-items) and monitor and evaluation (03-items). Respondents were responded on a five-point Likert scale.

The content validity of the questionnaire was checked by the experts of social sciences and professional health experts of the National University of Medical Sciences. Its construct validity was measured by exploratory factor analysis (EFA). Reliability (α= 0.929) was checked by Cronbach Alpha, and all the items related to required analysis (α=0.796); design stage (α=0.863); test (α=0.755); deployment (α=0.908); development (α=0.869) and monitor and evaluation

(α= 0.725) were highly reliable are valid for measuring the opinions of health profession managers regarding the practices of waterfall-life cycle model of agile management in their respective medical institutes. After checking the validity and reliability of the questionnaire, researchers generated an online Google forum and distributed it among the partici-pants through an electronic mode of communication.

Data collection was carried out within two months. After data collection, data were organized into Statistical Package for the Social Sciences (SPSS) version 23 and both descriptive statistic (Mean, Standard deviation) was used to measure the responses of participants regarding the practices of waterfall life cycle functions and inferential statistics (t-test, ANOVA) were used to analyze the effect of demographic factors (gender, job experience) over the participants' responses in this study.

RESULTS

Forty-six health profession managers participated in this study, of which 21 (47.7%) were male, and 25 (56.8%) were female. Of 46 managers, 15 have 1-5 years' service experience (32.6%), 16 have 6-10 years' service experience (34.8%), and 15 have 11-15 years' service experience (32.6%) in medical institutes. Similarly, Average responses of health profession managers show that they were not fully confident (Mean=3.08 ± 1.19) about the waterfall life cycle model of agile management in their respective organizations (Table-I).

Table-I: Mean responses of waterfall life cycle function.

Waterfall Life Cycle Function	Mean ± SD
Required Analysis	3.04 ± 1.14
Design Stage	3.10 ± 1.20
Test	3.06 ± 1.23
Deployment	2.78 ± 1.25
Development	3.14 ± 1.20
Monitor & Evaluation	3.38 ± 1.13
Practices of Waterfall Life Cycle Functions	3.08 ± 1.19

Health professions managers were showing neutral behavior towards waterfall life cycle functions such as required analysis (Mean=3.04 ± 1.14); design stage (Mean=3.10 ± 1.20); test (Mean=3.06 ± 1.23); deployment (Mean=2.78 ± 1.25); development (Mean = 3.14 ± 1.20) and monitor and evaluation (Mean = 3.38 ± 1.13) (Table-II).

Table-II showed that most health profession managers were neutral regarding the functions of the waterfall life cycle, such as required analysis, design

stage, test, deployment, development, monitoring and evaluation.

stage (*p*=0.063) and monitoring and evaluation (*p*=0.060) stage in waterfall life cycle model of agile

Table-II: Summary of health professions managers' responses regarding waterfall life cycle functions.

Constructs	Items	Responses, n (%)					Mean ± SD
		SDA	DA	N	A	Sa	
Required Analysis	RA1	5 (10.9)	10 (21.7)	12 (26.1)	19 (41.3)	-	2.98 ± 1.043
	RA2	5 (10.9)	11 (23.9)	14 (30.4)	6 (13.0)	10 (21.7)	3.11 ± 1.303
	RA3	6 (13.0)	9 (19.6)	19 (41.3)	9 (19.6)	3 (6.5)	2.87 ± 1.087
	RA4	7 (15.2)	6 (13.0)	15 (32.6)	12 (26.1)	6 (13)	3.09 ± 1.244
	RA5	2 (4.3)	8 (17.4)	24 (52.2)	4 (8.7)	8 (17.4)	3.17 ± 1.060
Design Stage	DS1	7 (15.2)	7 (15.2)	15 (32.6)	14 (30.4)	3 (6.5)	2.98 ± 1.164
	DS2	5 (10.9)	7 (15.2)	13 (28.3)	11 (23.9)	10 (21.7)	3.30 ± 1.280
	DS3	6 (13.0)	7 (15.2)	19 (41.3)	8 (17.4)	6 (13.0)	3.02 ± 1.183
Test	T1	5 (10.9)	6 (13.0)	10 (21.7)	11 (23.9)	14 (30.4)	3.50 ± 1.346
	T2	5 (10.9)	9 (19.6)	18 (39.1)	8 (17.4)	6 (13.0)	3.02 ± 1.164
	T3	5 (10.9)	22 (47.8)	9 (19.6)	4 (8.7)	6 (13.0)	2.65 ± 1.197
Deployment	Deploy1	11 (23.9)	8 (17.4)	12 (26.1)	11 (23.9)	4 (8.7)	2.76 ± 1.303
	Deploy2	8 (17.4)	12 (26.1)	13 (28.3)	10 (21.7)	3 (6.5)	2.74 ± 1.182
	Depoly3	10 (21.7)	6 (13.0)	16 (34.8)	9 (19.6)	5 (10.9)	2.85 ± 1.282
Development	Dev1	3 (6.5)	13 (28.3)	10 (21.7)	14 (30.4)	6 (13.0)	3.15 ± 1.173
	Dev2	3 (6.5)	9 (19.6)	20 (43.5)	7 (15.2)	7 (15.2)	3.13 ± 1.108
	Dev3	4 (8.7)	15 (32.6)	8 (17.4)	9 (19.6)	10 (21.7)	3.13 ± 1.327
Monitor and Evaluation	ME1	4 (8.7)	6 (13.0)	15 (32.6)	14 (30.4)	7 (15.2)	3.30 ± 1.152
	ME2	11 (23.9)	9 (19.6)	14 (30.4)	12 (26.1)	-	3.59 ± 1.127
	ME3	4 (8.7)	7 (15.2)	15 (32.6)	14 (30.4)	6 (13.0)	3.24 ± 1.139

SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree, RA=Required Analysis, DS=Design Stage, T=Test, Deploy=Deployment, Dev=Development, ME=Monitor and Evaluation

Table-III showed that gender has no significant effect on required analysis (*p*=0.861); design stage (*p*=0.625), test (*p*=0.222), deployment (*p*=0.718) and development (*p*=0.432), while it has a significant effect on monitoring and evaluation (*p*=0.042) stage in waterfall life cycle model of agile management in health profession departments of medical institutes.

Table-III: Mean differences of gender regarding the practices of waterfall life cycle.

Variables	Gender	N	Mean ± SD	*p*-value
Required Analysis	Male	21	15.10 ± 2.827	0.861
	Female	25	15.32 ± 5.258	
Design Stage	Male	21	9.05 ± 2.133	0.625
	Female	25	9.52 ± 3.938	
Test	Male	21	8.57 ± 1.399	0.222
	Female	25	9.68 ± 3.891	
Deployment	Male	21	8.14 ± 1.526	0.718
	Female	25	8.52 ± 4.529	
Development	Male	21	9.00 ± 2.00	0.432
	Female	25	9.76 ± 3.982	
Monitoring and Evaluation	Male	21	9.24 ± 1.814	0.042
	Female	25	10.88 ± 3.180	

Table-IV showed that managers' experience has a significant effect on required analysis (*p*=0.013), test (*p*=0.001), deployment (*p*=0.001), and development (*p*=0.002), while it has no significant effect on the design

management in health profession departments of medical institutes.

Table-V showed that majority of health profession managers who have 1-5 years and 11-15 years of experience had no significant difference in their opinions regarding required analysis (*p*=0.963), design stage (*p*=0.482), Test (*p*=0.001), deployment (*p*=0.000), development (*p*=0.001), monitor and evaluation (*p*=0.218) while all those professional health managers who have 1-5 years and 6-10 years had a significant difference in their opinions regarding required analy-sis (*p*=0.012), design stage (*p*=0.023), test (*p*=1.00), deployment (*p*=0.210) and development (*p*=0.210). Similarly, all those professional health managers who have 6-10 years and 11-15 years had a significant difference in their opinions regarding required analysis (*p*=0.010), Test (*p*=0.001), deployment

DISCUSSION

Health profession managers were showing neutral behaviour about the practices of waterfall life cycle functions. However, most health profession managers practice testing, deployment and development functions while not properly practising the required analysis, design stage and monitoring and evaluation in their agile management. This finding is

Table-IV: ANOVA for experience regarding the practices of waterfall life cycle.

Parameters	Group-1, (1-5 Years) (n=15)	Group-2, (6-10 Years) (n=16)	Group-3, (11-15 Years) (n=15)	p-value
Required Analysis	13.93 ± 4.08	17.69 ± 4.13	13.87 ± 3.64	0.013
Design Stage	8.13 ± 3.40	1.75 ± 3.17	8.93 ± 2.63	0.063
Test	8 ± 2.07	11.38 ± 3.28	8 ± 2.33	0.001
Deployment	6.60 ± 3.18	11.06 ± 3.17	7.20 ± 2.15	0.000
Development	7.67 ± 2.58	11.44 ± 3.54	9.00 ± 2.27	0.002
Monitor & Evaluation	10.13 ± 2.92	11.25 ± 2.93	8.93 ± 1.87	0.060

(p=0.001), development (p=0.023), monitor and evaluation (p=0.018)

quite similar to researchers who found that in the traditional method, people pay more attention to how things will happen during the right moment without being mindful if things are falling into place.[12] While planning is important, it is also essential that developers and quality checkers understand how things should happen, especially with the client or the end-user.[13,14] It is also crucial that all people involved in the project can immediately say how a certain step in project fulfilment can fall apart without waiting for the testing stage.[15,16]

Table-V: Post hoc analysis for experiences regarding the practices of waterfall life cycle.

Group Comparison	Group-1 vs Group-2	Group-1 vs Group-3	Group-2 vs Group-3
Required Analysis	0.012	0.963	0.010
Design Stage	0.023	0.482	0.109
Test	0.001	1.000	0.001
Deployment	0.000	0.571	0.001
Development	0.001	0.210	0.023
Monitor & Evaluation	0.244	0.218	0.018

Similarly, the percentage responses of health profession managers showed that they were not fully confident in practising the various functions of waterfall life cycle models of agile management, such as required analysis, designing, testing, deployment, development and monitoring and evaluation in their respective organization. This result was quite similar to Dima et al,[4] and Saha et al,[11] who found that managers value agility in the planning procedure itself rather than on the resulting documentation.

Another significant finding of this study showed that gender had no significant effect on waterfall life cycle functions such as required analysis, design stage, testing, deployment and development level. In contrast, it had a significant effect on monitoring and evaluating tasks. Similarly, managers' job experiences significantly affected the required analysis, testing, deployment, and development.

In contrast, it had no significant effect over the design stage and monitoring and evaluation stage of the waterfall life cycle. These results were quite similar

to Tolf et al,[17] and Centobelli et al,[3] who said that individuals might change their opinion regarding any features. In such a case, few, if not all, of the phases may have to be re-evaluated. In the Waterfall model, it is the most apparent progress, but this does not mean that this approach will never attract further costs and spent time on the diverse parts of the project, which may lower the individual's satisfaction.[18]

LIMITATION OF STUDY

Limitations of the study include the definition of the waterfall life cycle, the scope of the instrument and the choice of statistical techniques used for data analysis. Health profession managers were limited in number because this study just targeted Rawalpindi and Islamabad medical institutes. Following an extensive search to locate more appropriate instruments and research methodologies because this study was limited to survey method and survey questionnaire cannot fully capture the emotional responses of the respondents.

RECOMMENDATIONS

The Waterfall methodology is a sequential development process, where the project, fully documented in advance, progresses steadily through set phases toward the conclusion. So higher authorities should arrange training for their health profession managers regarding waterfall life cycle practices in their respective organizations.

Proper planning is a must in the waterfall system. A project's requirements must be clear up front, and everyone involved in a project must be well aware of those requirements. Each team member should also understand what his/her role will be in the project and what that role entails. Thorough documentation is a priority in the waterfall project management methodology. Documentation should occur throughout every phase of the process, ensuring that everyone involved is on the same page despite the sequential progression of the project.

CONCLUSION

This study concluded that health profession managers had shown neutral behaviour towards waterfall life cycle functions such as required analysis, design stage and

monitoring and evaluation in their agile management. Similarly, gender had no significant effect on waterfall life cycle functions such as required analysis, design stage, testing, deployment and development level. In contrast, it significantly affected the monitoring and evaluation of tasks. Managers' job experiences significantly affected the required analysis, testing, deployment, and development. In contrast, it had no significant effect over the design stage and monitoring and evaluation stage of the waterfall life cycle.

Conflict of Interest: None.

Author's Contribution

RJ: Manuscript writing, literature review, FF: Manuscript writing, supervision drafting and plagiarism checking, NS: Data analysis, KQ: Manuscript writing and proof reading, SF:, AG: Proof reading and reference checking.

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