4PCDT: A Quantifiable Parameter-based Framework for Academic Software Project Management

Vikas S. Chomal[1], Jatinderkumar R. Saini[2]*, Hema Gaikwad[3], Ketan Kotecha[4]
School of Engineering,P P Savani University,Kosamba, India[1]
Symbiosis Institute of Computer Studies and Research, Symbiosis International (Deemed University), Pune, India[2, 3]
Symbiosis Centre for Applied Artificial Intelligence, Symbiosis International (Deemed University), Pune, India[4]

***Abstract*—Many authorities like Project Management Body of Knowledge (PMBOK) and Capability Maturity Model Integration for Development (CMMI-Dev) lend a hand to software development organizations in management of their crucial projects. Though this area needs focused research, such models are not dedicatedly available for the academic projects developed by students of computer science and engineering where software project development is considered as one of the criteria for the award of degree to the future professionals of the IT industry. With this motivation, we explored 4PTRB, 3PR and software project management practices, approaches as well processes framed and provided by PMBOK and CMMI-Dev. The main aim of this research is to introduce and propose a software project management framework for the academic domain. The proposed framework contains identification and description of 7 and 26 quantifiable parameters and sub-parameters respectively .The framework is called 4PCDT for People, Process, Product, Project, Complexity, Duration and Technology for the academic software projects. To validate the proposed framework, an online survey of 113 faculties was conducted to rank and weigh the quantifiable parameters. The results show that People, Process and Technology management parameters are top 3 ranked parameters. The robustness of the approach is further evident from the results of experimentation on 18 actual academic software projects of final year post graduate students of the IT domain.Not only the proposed work is first of its kind, but also it is bound to generate an excellent ripple effect in the research community.**

***Keywords*—Academic; CMMI-Dev;PMBOK; project management; software project; student**

I. Introduction

Software project management plays a critical role in software project development. To manage project efficiently is considered as an art as well as a major demanding task in the Information Technology (IT) domain. The art and challenging role make both project development as well as management an extremely imperative research object in society. Project management has become a key process area as well as given a due importance irrespective of industry domain. To effectively deal with and manage project is considered as one of the decisive success causes for any software project [11].Today software project management is deemed to have equivalent significance as those of applying software engineering concepts in software development environment and these both are considered as driving aspects to deliver a successful as well a qualitative software project outcome [15].

Software project development also has a significant importance in academic courses of computer science and engineering as well as information technology. Through this project development, practical knowledge of software development is imparted to students. During academic software project development students are provided with strict guidelines as well as instructed to mandatorily execute all the phases of system development life cycle [5][6]. One of the universal observations found in academic software project development is failure of students to accomplish software project development within a predetermined timeframe. There may be numerous causes behind this failure, but the most vital cause is inappropriate management of software project by students. It is extremely imperative to make students acquainted with guiding principles regarding proper software project management from the very preliminary period of software project development in order to endow them with intellectual IT proficiency.

The intention of study is: (a) to explore and evaluate software project management in software project development; (b) to indicate the significance of software project management in academic framework; (c) to propose an comprehensive methodology and framework that assists in managing software project considering academic context on the basis of rich literature review on software project management to encourage student's software project success probability; (d) to introduce a software project management framework by examining and incorporating earlier project management methodology/ frameworks that will guide, assist project mentors and students to deliver successful software project.The layout of the paper is as follows: a concise literature evaluation is discussed in Section 2. The planned framework is introduced in Section 3. Experiment and Result of the anticipated framework is presented in Section 4. Lastly conclusion and future enhancement drawn from this research is highlighted in Section 5.

II. Literature Review

According to Chang et al. [1] software project management is a problem-solving activity and task like other activities that are involved in software development process. Further, Chang et al. [1] also proposed a software project management model termed as SPMNet for resource allocation, scheduling and to track and handle project status.Marinho et al. [11] in their research work focused on various uncertainties that can be effectively managed using project management

*Corresponding Author.

techniques. The major contribution provided by Marinho et al. [11] are – (a) a systematic review for academic community to clearly understand about various challenges and uncertainties in project management, (b) techniques and strategies to deal with these uncertainties. Cristobal et al. [9] summarized project complexities and also discussed how to address these complexities using effective project management. Sajad et al. [15] define software project management as a process which starts from proper planning and then flow towards organizing, staffing, monitoring, controlling and leading a software project. He has presented a comparative analysis of various project management tools and also predicted about project management tools that will have greater impact on software development and quality. Mac and Pinto [10] stated that software project management has become a focused discipline in software engineering domain. Further, risk management was the major factor on which they proposed their findings in consideration with software project management. According to Mahdi et al. [14] planning and assessment are important activities of software project management and are considered to have immense effect on project performance and its outcome. Author's also presented an in-depth review on use of various machine learning algorithms in software project management. Cunha et al. [8] conducted a methodical literature evaluation on software project management and concluded through empirical study that decision making is one of the most important criteria in software project management and stated that more studies are needed to carry out to understand decision making fact from this naturalistic perception.Barghothet al. [13] affirmed that project management plays a central role for making software project a success story. They proposed a framework named 4PTRB which consist people, process, product technology, risk, and business management areas. The said methodology provides a complete and exhaustive support to software project administrators to get better their project administrating managing skills and efficacy.

In their research work, Alok and Deepti [12] focused that software processes applied as well as software project management are having due weight-age for developing a qualitative software.Also, they presented a comparative study of various project management tools that can be utilized for effective management of software development activities.Varajaoa [7] asserts that project management is discipline that has achieved a notable identification in research domain.Also, author states that irrespective of industries relevance of good project management practices leads to a successful project. Mira and Pinnington [3] in their research work tested the association between project management performance and project success and for their investigation they considered empirical data of project management professionals. Rehman and Hussain [20] reported exhaustive study on different project management methodologies and their importance in project management. Also, authors examined and presented a parameterize comparison between various project management methodologies with PMBOK.

Dey et al. [17] explored and described contemporary drift in software project management. Authors in their work analyzed and highlighted all categories of risks that are related with technology, financial, scheduling, legitimate, principle, operational, security, communication, project and personnel as well as all these risks require timely involvement as well as proper follow-up and controlling needed in project management. The research work of Nakigudde [16] focused on foremost decisive factors that lead to the success as well as failure of the project. Author also explained the significant role played by project management model in making software project a successful journey. Demir et al. [2] examined and presented diverse approaches to examine the efficiency of project management in software development life cycle. Singh and Lano [19] worked out on techniques and framework of project management and their finding states that different techniques are suited and can be applied in different types of software project development. Kwak [21] scrutinized and presented in-depth history of project management as well enhancements that have taken place in domain of project management. Raj and Sinha [18] provided proposal on handling as well as enrichment in project management considering agile framework. Packer et al. [4] proposed a model that provides support in project management decisions in agile development considering the issues and difficulties faced in using GitHub repositories.

III. Proposed Framework

For the present research work, a study and examination of previous project management models such as Project Management Body of Knowledge (PMBOK), Capability Maturity Model Integration - Development (CMMI-Dev) processes and 4PTRB (People, Process, Product, Project, Technology, Risk, and Business) [13] was carried out.

These project management models provide with a set of software project management approaches, procedures as well as directive philosophy for software project management discipline. Software project management framework 4PTRB [13]is considered as fundamental base model for research work. Since the said proposed framework is been implemented in academic context we borrowed People, Process, Product, Project and Technology software management areas from 4PTRB [13] and instead of software management areas we coined and define it as software management parameters. Parameters namely risk and business of 4PTRB [13] were not considered since our proposed framework is for educational project hence no risk factors need to be examined and evaluated similarly educational project are not developed considering business and other profit earnings. Also, these software management parameters are termed as quantifiable parameters since they are considered as a metrics for measuring software project management. Furthermore, two software management parametersare integrated to the existing 4PTRB [13] model framework.

One of the software management parameters concerned with academic domain is duration and the other one is complexity. The reason behind considering duration parameter is that academic software projects need to be completed within the stipulated time duration. Similarly, project mentors and students both have to examine and consider the complexity level of the software to be developed. In Table I, we present listing of identified software management parameters of the

proposed framework along with concise clarification of each parameter.

TABLE I. THE PROPOSED FRAMEWORK 4PCDT PARAMETER(S)

Sr. No.	Parameters	Depiction
1.	People	People are considered as one of the most important components of a project. Some of the assigned role in academic software project is team members and mentors.
2.	Process	Process is the clearly and well-defined roadmap that needs to be followed during software project development. In academic software development, students are strictly bound to follow defined process methodology.
3.	Product	Product refers to the outcome of the project, the main objective of the project. The students (team member) need to explain the product scope to the mentors and concerned authority so that the end results are understood to all the stakeholders.
4.	Project	The next parameter but not the least component is the project. This is where the huge role and accountability of the team members and mentors are under the limelight. The students need to execute as well as handle major development task as well as to ascertain timely completion of the phases and functionality of the software project development. Whereas, mentors have the task of overseeing the project, guiding and assisting team members with issues, and trying to ensure the project stays on track with the well-defined deadlines.
5.	Complexity	Complexity of software to be developed
6.	Duration	Stipulated time duration for completion of software project development
7.	Technology	Technology used for developing software

After preparing software project management areas list, next step is to identify and map sub-parameters for individual and main software project management parameters. 4PTRB software project management model [13] contains 28 sub areas. Further we revised the sub areas for the said proposed framework considering relevance and importance in academic software development and the same which is presented in Table II.

As revealed in Table II there are total seven main parameters and 26 sub-parameters for the proposed framework. The comparative analysis of main parameter(s) and sub-parameter(s) of proposed framework and 4PTRB [13] are summarized in Tables III and IV.

The primary objective of the research is to measure academic software project management efficiency based on the software project management parameters introduced in the anticipated framework. Therefore, a formula for measuring project management effectiveness namely Academic Software Project Management efficacy (ASPME) is been introduced and the formula consists of the summing up of each main quantifiable parameters of software management. The formula for Academic Software Project Management Effectiveness (ASPME) is mentioned below [1]:

ASPME Score = PeoplePW + ProcessPW + ProductPW + ProjectPW + ComplexityPW + DurationPW + TechnologyPW

Here, ASPME Score = Academic Software Project Management Effectiveness Score, PeoplePW = People Parameter Weight, ProcessPW = Process Parameter Weight, ProductPW = Product Parameter Weight, ProjectPW = Project Parameter Weight, ComplexityPW = Complexity Parameter Weight, DurationPW = Duration Parameter Weight and TechnologyPW = Technology Parameter Weight.

Also these seven quantifiable parameters are not having equal weight-age. An online survey has been executed to endow with a rating to these academic software project management parameters. In the next section, the validation of the proposed framework including survey results and experimentation is presented.

TABLE II. IDENTIFICATION AND LISTING OF SUB-PARAMETERS

Sr. No.	Quantifiable Parameters	Proposed Framework (Sub-Parameters)	Sub Parameters Total
1.	People	Communication, Co-ordination, Team, Mentor and Team work	5
2.	Process	Project Identification, Project Feasibility, Project Planning, Project Monitoring & Controlling and Project Development Guidelines	5
3.	Product	Phase/Task verification & validation and Quality assurance	2
4.	Project	Phase/Task Definition, Phase/Task Allocation, Requirement Management, Reporting and Change Management	5
5.	Complexity	Project Domain, Project Scope, Team Size	3
6.	Duration	Task Duration Estimation, Monitoring & Controlling Task Duration and Verification & Validation of Task Completion	3
7.	Technology	Identification of Technology, Team Skills and Expertise and Knowledge Management	3
Total	**7**		**26**

TABLE III. COMPARISON OF MAIN PARAMETER(S) OF 4PCDT WITH 4PTRB [13]

Sr. No.	Software Project Management Model	Main Parameter	Total
1.	4PCDT	People, Process, Product, Project, Complexity, Duration and Technology	7
2.	4PTRB [11]	People, Process, Product, Project, Technology, Risk and Business	7

TABLE IV. COMPARISON OF SUB-PARAMETER(S) OF 4PCDT WITH 4PTRB [13]

Sr. No.	Main Parameter	Sub-Parameters		Total ofSub-Parameters	
		4PCDT	4PTRB [13]	4PCDT	4PTRB [13]
1.	People	Communication, Co-ordination, Team, Mentor and Team work	Communication, Teamwork, Leadership, Organizational Commitment, Project Manager, Stakeholder involvement, Staffing and Hiring	5	7
2.	Process	Project Identification, Project Feasibility, Project Planning, Project Monitoring & Controlling and Project Development Guidelines	Requirement Management, Project Planning, Project Monitoring& Control and Scope Management	5	4
3.	Product	Phase/Task verification & validation and Quality assurance	Configuration Management and Quality Engineering	2	2
4.	Project	Phase/Task Definition, Phase/Task Allocation, Requirement Management, Reporting and Change Management	Activity Definition, Activity Sequencing, Activity Resource Estimates, Activity Duration Estimates, Schedule Variance, Estimate Costs, Determine Budget and Cost Variance	5	8
5.	Technology	Identification of Technology, Team Skills & Expertise and Knowledge Management	Technology Maturation & Risk Reduction and Knowledge Management	3	2
6.	Complexity	Project Domain, Project Scope, Team Size	--	3	--
	Risk	--	Risk Management and Risk Control	--	2
7.	Duration	Task Duration Estimation, Monitoring & Controlling Task Duration and Verification & Validation of Task Completion	--	3	--
	Business	--	Contracting Management, Procurement Management and Benefit Management	--	3
Total				26	28

IV. EXPERIMENTALRESULTS

For simplicity and enhanced inclusive research, the phased process was followed. These phases are presented below:

- Execution and analysis of online survey for assigning weights to parameters.
- Weight calculation for each parameter.
- To conduct experiment on data set.
- Analysis of the experiment result.

A. Execution and Analysis of Online Survey

Further, after identifying and listing these quantifiable parameters and sub-parameters attributes next procedure is to assign weights to these seven quantifiable parameters. For assignment of weights, we randomly selected one quantifiable parameter to begin with and going on to other parameters while keep on comparing the already assigned weights and the parameters to which weights are to be assigned.

This procedure was acknowledged by conducting an online survey for assigning weights to 7 quantifiable parameters by 113 faculties engaged in post graduate streams of information technology as well as computer science and engineering. These faculty members are having more than 10 years of academic experience as well as providing mentorship to students in their software project development. The averaged based on the values provided by 113 faculties are mentioned in tabular format in Table V.

It is significant to declare that each of the 7 quantifiable parameters were assigned weight out of 100 and it was not necessary to have the total of weights of 7 parameters as break-up of 100. This course of action in principle is based on human perception and general aptitude.

B. Weight Calculation for each Parameter

In the next phase of research weights need to be calculated for each quantifiable parameter. The procedure implemented for the same is to divide average weight of each quantifiable parameter by total weight average as shown in Table VI.

TABLE V. AVERAGED VALUE OF QUANTIFIABLE PARAMETERS

Sr. No.	Quantifiable Parameters	Average (%)
1.	People	82.10
2.	Process	80.13
3.	Product	63.90
4.	Project	69.12
5.	Complexity	65.98
6.	Duration	70.04
7.	Technology	73.09

TABLE VI. WEIGHT AVERAGE TO QUANTIFIABLE PARAMETERS

Sr.No.	Quantifiable Parameters	Average (%)	Weight
1.	People	82.10	0.1621
2.	Process	80.13	0.1582
3.	Product	63.90	0.1261
4.	Project	69.12	0.1365
5.	Complexity	65.98	0.1308
6.	Duration	70.04	0.1383
7.	Technology	73.09	0.1443
Total	7	506.36	1.0000

TABLE VII. SIGNIFICANCE OF 4PCDT

Results	Choices						Total
	Very Significant	Significant	Somewhat Significant	Neutral	Not Significant	No Opinion	
Number of Respondent(s)	61	31	13	5	3	0	113
Percentage (%)	53.98	27.43	11.50	4.42	2.65	0	100

In the online survey form given to the respondents, the respondents were also asked about the significance of the proposed framework called 4PCDT.The respondents were informed that this framework could be employed as a guiding principle for the software project management for the academic domain. The results were analyzed, summarized and presented in Table VII.

C. Experiment on Dataset

The perform experiment on dataset is an imperative element of the research. Similarly, the practical execution of the proposed framework was executed in our organization. For experiment, software project developed by Master Degree students were considered. Final year students need to develop this academic software project within six months. We inspected and assessed18 large academic software projects developed during the three consecutive years 2016-2017, 2017 – 2018 and 2018-2019 and led by 5 faculties and there mentored the same software projects. Further free online Software Project Management Effectiveness Evaluator (SPMEE) tool named Wrike was used to perform the experiment of the proposed framework. This tool provides with a facility were by we can design self-administered project management effectiveness questionnaire. A structured and organized set of closed-form questionnaire was prepared considering academic software project development life cycle based on the implementation of the proposed framework taking into consideration quantifiable parameters introduced.

D. Analysis of Experimental Result

The academic software projects considered for experiments are presented in Table VIII. Further, all faculty participants were provided with project management effectiveness questionnaire. In the next step, academic project success scores need to be provided by each faculty members using this online software project management efficacy evaluator and project management effectiveness scores calculated were in-between range 0 to 10. Where 0 means a software project is not successful stating that least effective project management parameters have been functionally applied by students and mentors. While a score 10 denotes an extremely successful academic software project were at most care is taken as well as foremost efficient software project administration and execution has been functionally implemented.

Finally, we compared the results obtained by us through the 4PCT model, which is the modified 4PTRB model with 4PTRB [13] project management model itself. The implementation was done on the said 18 academic software projects and the software project management effectiveness was measured. Each academic software projects were solely varied from other projects in the dataset. The development time duration for each academic software projects was 6 months whereas each project varies in domain, functionality, team size, technology, complexity. In Table IX in-depth experiment result analysis and comparison of proposed framework and 4PTRB [13] is presented. Software project management score is automatically measured by the online Software Project Management Effectiveness Evaluator (SPMEE) considering the Academic Software Project Management Effectiveness (ASPME). These analysis and findings strengthen the legitimacy of the proposed framework.

It has been found that project success score and software project management effectiveness (PME) are closely associated with each other and have a strong correlation. The same is graphically presented in Fig. 1. Also the association between proposed framework PME score and success score is stronger than 4PTRB [13] PME score and success score. Further, the Pearson correlation co-efficient is 0.9754, while it is 0.9288 when the 4PTRB [13] framework is applied. Thus, it can be wrapped up that employing the proposed framework highlights the higher probability of delivering as well as managing software project more effectively and successfully .Also, it can be observed that score generated by proposed framework 4PCDT and Success rate score is closer in comparison to 4PTRB [13].

TABLE VIII. ACADEMIC SOFTWARE PROJECT DEVELOPMENT YEAR

Sr. No.	Academic Year	Project Considered for Experiment
1.	2016-2017	6
2.	2017-2018	6
3.	2018-2019	6
	Total	18

TABLE IX. ANALYSIS OF DATASET

Sr. No.	Project Title	Development Year	Team Size	Project Completion(%)	Project Type	Success Rate	4PCDT (Proposed)	4PTRB [13]
1	APMC Mgt System	2016-2017	2	91	Desktop	6	6.12	5.11
2	E-Shop	2016-2017	2	100	Web-Based	8	8.09	7.52
3	Online Multistore Portal	2016-2017	2	80	Web-Based	6	6.23	6.12
4	E – Library	2016-2017	1	90	Web-Based	7	7.02	6.08
5	On line Exam	2016-2017	2	100	Mobile App	8	8.01	7.71
6	Online Shopping Portal	2016-2017	3	100	Mobile App	7	7.67	6.62
7	Corporate Recruitment Mgt System	2017-2018	3	90	Web-Based	7	7.31	6.19
8	Online Review System	2017-2018	2	100	Mobile App	8	8.05	7.81
9	Restaurant Mgt System	2017-2018	2	100	Web-Based	7	7.81	6.02
10	College Mgt System	2017-2018	2	95	Mobile App	6	6.46	5.07
11	Work Flow Mgt System	2017-2018	1	90	Desktop	6	6.21	5.82
12	Rental Application	2017-2018	1	80	Web-Based	5	5.09	5.03
13	Car Pooling System	2018-2019	2	100	Mobile App	7	7.11	6.21
14	Inventory & Supply Chain Mgt System	2018-2019	3	100	Web-Based	7	7.19	6.52
15	Digital Campus	2018-2019	2	100	Web-Based	8	8.41	7.12
16	Milk Distribution	2018-2019	1	80	Desktop	6	6.36	5.09
17	Billing System	2018-2019	2	100	Desktop	8	8.11	6.86
18	Production Monitoring System	2018-2019	3	80	Web-Based	5	5.09	4.19

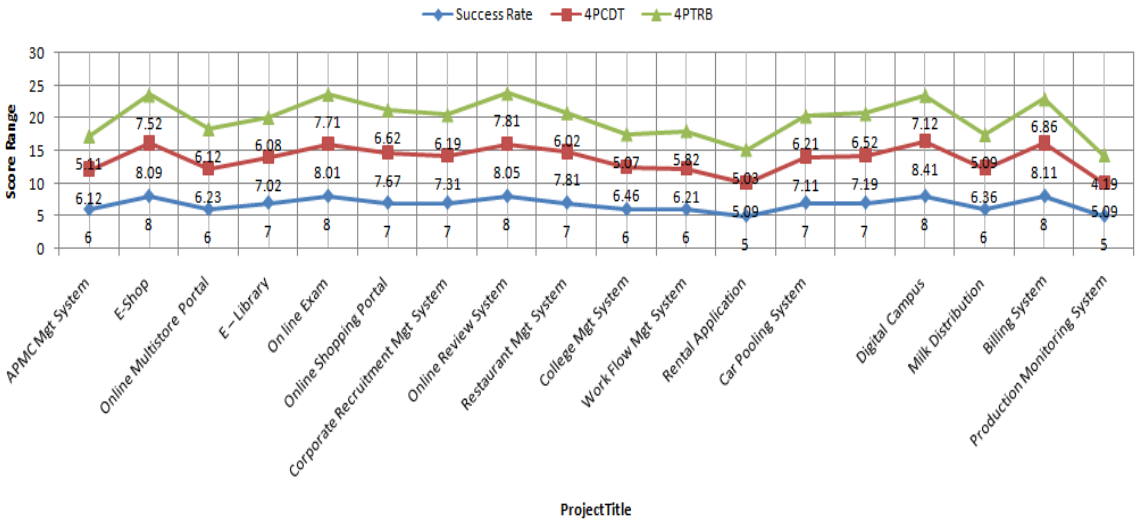

Fig. 1. Relationship between the Project Success Rate and 4PCDTas well as 4PTRB [13] PME score.

V. CONCLUSION AND FUTURE ENHANCEMENT

In the present research we proposed an academic software project management framework named as 4PCDT which is developed with consideration of multiple parameters. Seven main quantifiable parameters and 26 sub-parameters were recognized and listed based on their relevance. The primary aim of categorizing these parameters was to provide with the academic software project management framework which is best suited in consideration with academic context. Existing software project management frameworks like 4PTRB [13], 3PR and various guidelines were explored for proposing the academic software project management framework. However, the proposed framework is having unique characteristics because we revised the parameters and sub-parameters which were included in earlier versions of project software management framework and introduced list of new parameters and sub-parameters to cover more facets and propose a more holistic and comprehensive framework for managing academic software projects. Validation of the identified quantifiable parameters and sub-parameters was done through more than 100 faculties of post graduate courses of computer

science, computer engineering and information technology. All chosen faculties were active mentors for academic software project development. The results showed that 'People' management has been considered with maximum significance followed by 'Process' and 'Technology' in the academic software project management domain.

In the present work 18 academic software projects were used to experiment and validate the proposed framework. The academic project development work was carried out during the academic years 2016-2017 to 2018-2019. In the next step of research we prepared project management questionnaire and was provided to five faculty participants. Faculty members usedthis questionnaire on these 18 academic software projects and provided project success scores, project management effectiveness score using online Software Project Management Effectiveness Evaluator (SPMEE) tool. Further, scores were calculated considering the range 0 to 10, where 0 signifies that a software project is not successful and the causebehind this is least effective project management parameters has been practiced by students and mentors. While a score 10 means an extremely successful academic software project were at most care is taken as well as foremost effective software project management has been functionally implemented. Same technique was considered in the previous framework and their studies stated a positive association and relationship between software project success score and project management effectiveness.

Similarly, the finding and analysis of present research shows a strong and optimistic interrelationship between software project success score and project management efficiency with 0.9754 value of Pearson correlation co-efficient whereas it is 0.9288 when 4PTRB [13] framework is applied. Thus, it can be concluded by findings of the analysis that the proposed framework is hypothetical, optimum, applicable and appropriate to be used in academic software project management. Considering the same we deem that academic courses that are having major as well minor software project development as a part of their core curriculum should emphasis, consider and endow with course of action as well asmodels and methodologies regarding software project management in software project development.

The extensive framework presented through this research work will definitely assist the faculty mentors as well as the students in the domains like Information Technology, Computer Science, Computer Engineering, and Computer Application to manage the academic software development projects more effectively. Proceeding with the research, we would execute the work in direction to introduce software project management effectiveness model for academic domain in consideration with proposed framework. In the current research work only 18 academic software projects were included in the experiment; hence if the size of dataset for validating the framework is increased it may disclose novel dimensions. Also, the proposed framework considered the academic context whereas 4PTRB [13] framework was designed considering software projects developed in IT industries. Hence at last, we express that the proposed framework for academic software project management is unconditional independent, reliable, prescribed as well as shows a better participation of students and faculty mentors and can be effortlessly employed in academic outline irrespective of project categories.

REFERENCES

[1] Carl K. Chang, Chikuang Chao, Thinh T. Nguyen Mark Christensen, "Software Project Management Net: A New Methodology on Software Management", Proceedings. The Twenty-Second Annual International Computer Software and Applications Conference , 2002, IEEE.doi**:** 10.1109/CMPSAC.1998.716715.

[2] Demir, K.A., Michael, J.B. and Osmundson, J.S, "Approaches for Measuring Software Project Management Effectiveness", International Conference on Software Engineering Research and Practice, Las Vegas, Vol. 2, 613-619, 2009. doi: 10.21236/ADA484712.

[3] Farzana Asad Mira, Ashly H. Pinningtonb, "Exploring the Value of Project Management: Linking Project Management Performance and Project Success", International Journal of Project Management, 32, 202-217, 2017. doi: 10.1016/j.ijproman.2013.05.012.

[4] Heather S. Packer, Adriane P. Chapman, L. Carr, "GitHub2PROV: Provenance for Supporting Software Project Management", Published in TaPP 2019 Computer Science, Engineering, 2019.

[5] J.R. Saini, V.S. Chomal, "SaiCho: A Parameters Based Model for Team Building for Academic Software Projects", proc. of IEEE Inter. Conf. on Electrical, Computer and Communication Technologies (ICECCT-2015), Coimbatore, India; Feb. 2017, pp. 1129-1138 3.

[6] J.R. Saini, V.S. Chomal, "Domain–based Ranking of Software Test–effort Estimation Techniques for Academic Projects", proc. of Inter. Conf. on ICT for Sustainable Development (ICT4SD-2019), Panaji, India; in press with AISC, Springer, Mar. 2020.

[7] Joao Varajao, "Success Management as a PM knowledge area – work-in-progress", Procedia Computer Science 100 (2016) 1095 – 1102, Available online at www.sciencedirect.com, 2016.

[8] Jose Adson O. G Cunha, Hermano P. Moura, Franciso J.S.Vasconcellos, "Decision-Making in Software Project Management: A Systematic Literature Review", Procedia Computer Science 100 (2016) 947-954, 2016.

[9] Jose R. San Cristobal ,Luis Carral , Emma Diaz, Jose A. Fraguela and Gregorio Iglesias, "Complexity and Project Management: A General Overview", Review Article, Hindawi Complexity, Volume 2018, Article ID 4891286, 10 pages, 2018. doi: 10.1155/2018/4891286.

[10] Kevin MacG, C. Ariel Pinto,"Software Development Project Risk Management: ALiterature Review", 26th ASEM National Conference Proceedings, October 2005.

[11] Marcelo Marinho,Suzana Sampaio,Telma Lima and Hermano de Moura, "A Systematic Review of Uncertainties in Software Project Management", International Journal of Software Engineering & Applications (IJSEA), Vol.5, No.6, 2014. doi: 10.5121/ijsea.2014.5601.

[12] Mishra Alok,Mishra Deepti," Software project management tools: a brief comparative view" , ACM SIGSOFT Software Engineering Notes,May 2013 Volume 38 Number 3, 2013. doi: 10.1145/2464526.2464537.

[13] Mohamed Ellithey Barghot, Akram Salah, Manal A. Ismail, "A Comprehensive Software Project Management Framework", Journal of Computer and Communications, 2020, 8, 86-102 https://www.scirp.org/journal/jcc, ISSN Online: 2327-5227, ISSN Print: 2327-5219, DOI: 10.4236/, 2020.

[14] Mohammed Najah Mahdi , Mohd Hazli Mohamed Zabil , Abdul Rahim Ahmad , Roslan Ismail , Yunus Yusoff , Lim Kok Cheng , Muhammad Sufyian Bin Mohd Azmi , Hayder Natiqand Hushalini Happala Naidu , "Software Project Management Using Machine Learning Technique—A Review", 8th International Conference on Information Technology and Multimedia (ICIMU), Publisher: IEEE, DOI: 10.1109/ICIMU49871.2020.9243543, 2020.

[15] Muhammad Sajad, Muhammad Sadiq , "Software Project Management: Tools assessment, Comparison and suggestions for future development",IJCSNS International Journal of Computer Science and Network Security, VOL.16 No.1, January 2016.

[16] Nakigudde, S, "Project Management Models and Software Development Project Success", https://doi.org/10.13140/RG.2.2.36203.08482, 2019.

[17] Pradip Peter Dey, Mohammad Amin, Bhaskar Raj Sinha, Shatha Jawad, Laith Al Any, Hassan Badkoobehi, " Current Trends in Software Project Management", Advances in Social Science, Education and Humanities Research, volume 120, DOI:10.2991/mshsd-17.2018.5, World Conference on Management Science and Human Social Development, 2017.

[18] Prixit Raj,Parul Sinha, "Project Management In Era Of Agile And Devops Methodologies", International Journal Of Scientific & Technology Research Volume 9, Issue 01, January 2020.

[19] Ravinder Singh, Kevin Lano, " Literature Survey of Previous Research Work in Models and Methodologies in Project Management", International Journal of Advanced Computer Science and Applications, Vol. 5, No. 9, 2014.

[20] Ur Rehman, A. and Hussain, R, "Software Project Management Methodologies/ Frameworks Dynamics "A Comparative Approach". International Conference on Information and Emerging Technologies , DOI: 10.1109/ICIET.2007.4381330, Publisher: IEEE, 2007.

[21] Young Hoon Kwak, "Brief History of Project Management", Chapter 2 in The Story of Managing Projects by Carayannis, Kwak, and Anbari (editors), Quorum Books, 2003.