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A Review on Requirements Prioritization Techniques

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***Abstract*— For Software improvement Requirements prioritization is most essential movement. Organizing prerequisites causes the task group to comprehend which necessities are generally significant and generally pressing. Requirement(RP) Prioritization, Basically Process of doling out priority that requests or positions one prerequisite over another. This paper we examine state of art technique and dissect their appropriateness on the domain of software requirement. This paper contain significant Requirements Prioritization Techniques, Research gap of tools & techniques for prioritization of software requirement, Lucid Technique.**

***Keywords*— Requirements Prioritization, Requirement prioritization Technique**

I. INTRODUCTION

For software improvement Requirements prioritization is pivotal activity. Generally, for customers the no. of requirements number become to build organization of lineaments which is executed inside the fixated plan and resources which really accessible. For a notable perception, a large number of requested of necessity or the lineaments are simply not satisfied or they will consider for ensuing deliveries, In this manner development team members, the client need to choose what is pivotal service is whichever should executed hastily you can. In elective conference, the collaborator might have the prioritize requirement [1].

Types of Requirement's :

a) Functional Requirements (FRs)

b) Non-Functional Requirement(NFRs)

FR clarifying those of prerequisites that "depict or tells about what the framework ought to do perform" While Non-Functional Requirements depicts how in reality well a framework should work [54][12]. In The

NFR, contain the assortment of value quality where software system would show, for example, Accessibility, Accuracy, Efficiency, and so on.[2]

There are innumerable factors for Prioritizing like cost of delay/value, Price, likelihood , Learning, managerial, significance. for the business viewpoint there are number of feasible considerations expressly price, value, likelohood, struggling in implementation, victory etc.[54]

Prioritizing requirement plays essential role for negotiation of requirement, release planning of software and another similar area of requirement engineering (RE). Advancement in software relies upon the detail software requirement. Classification where requirement would have implement as define in prioritization of requirement procedure although it could be complex dynamic cycle [13].

II. LITRATURE REVIEW

Innumerable of techniques been previously suggest by numerous authors as yet for requirements prioritization contain allocate rank separately demand as stated by specialized criteria, namely development cost of requirement, requirement value for the customer and several other perspective. We have granted the slight survey to organizing the prerequisite and audit of a couple of these technique gave as:-

II (a) Techniques:-

A. Analytical Hierarchy Process

Saaty uncover Analytical hierarchy process (AHP) . Portrays a whole framework for settling on right choices in fields, for example, business, social insurance, government [3]. Basically, partners decay their objective into littler sub-issues, which can without much of a stretch be grasped and dissected. Leaders make sense of components by look at sets of component each other once hierarchy manufactured. The whole assortment of examinations recommended AHP is x(x-1)/2, x devote different necessities at each and for all positioning level.

B. Cost Value Approach

An activity for organizing software requirements should, on one capacity be simple and fast and on the other, surrender unequivocal and conceivable outcomes. On the off chance that twain condition were not met, the activity isn't proceed for benefit makes systems software advancement being system software to be fruitful, highly caliber should have boosted,

price limited, & time-to-conveyance be stunted could be expected under the circumstances. Cost-value system organizes prerequisites with regards to their relative benefit and cost.

Software administrators could settle on choices relating to whichever necessities arranged rejected with the underlying release to hold an opportunity to-advertise at least. [4]

C. Numerical Assignment (Grouping)

The indicated strategy contains necessities for disparate gatherings relies on ordinal scale in whatever place shareholder could compare whereas certain grouping [5]. Demand could bunch toward basic priorities, modest priorities and discretionary priorities. Shareholder may likewise format necessities as obligatory, significant, rather significant, not significant, and doesn't make a difference so as to portray their significance.

D. Fuzzy Analytic Hierarchy Process

Considering that fuzzy goal exiguous convoluted to convey relatively fresh choice, infer the indicated methodology would be discover and endowment applications in upcoming time F-AHP utilizes within various standard administrative want deductive approaches regarding securing heaps out-of fuzzy pairwise connection frameworks[11]. Credible methodologies carrying twice coordination initial constuct bundle of fuzzy loads determining out for connection grid of duet, despite the fact that rearmost include develop the pack of firm Since fuzzy goal is easier to move relative fresh result.

E. Ranking

At the point when requirements get rank for ordinal scale & introducing rate or numerical incentive for that work significance. Being instance, first number showing much necessitiest centrality and number n can be doled out to the least hugeness prerequisite, n be the entire number of prerequisites.

F. MoSCoW Technique

Through this strategy, shareholder could organizing necessities in a common manner. Or maybe of numbers, MoSCoW technique utilized fourfold inclination gathering: The abbreviation indicated the accompanying [14] :

[1] Must have which establish essential

[2] Should have which establish of sharp priority

[3] Could have which denote can be preferable but not essential

[4] Would have which denote can be delayed and resumed for future implementation.

G. Binary Search Tree

Data Structure(DS) idea utilized here by BST approach collect the information or data and bring when need. BST tear checked example from the parallel tree where each node having most extreme's twice children. Where node of left child contain the low worth or degree in contrast with root on the other node of right child containing the higher worth or degree in contrast with root node.

H. *Top-Ten Requirements*

In this methodology Reason behind not organize is that there is formation of very uncomfortable clash when shareholder support to their higher need in as indicated by their inclination and alternative their third priority just and we are not taking normal past of all member partners in light of the fact that by doing this their will missing some shareholder top necessity and which isn't desirable.

I. Agile Prioritization Technique

In Agile procedure, it can without much of a stretch adjust to their project portfolios because of changing business priority. Agile Project convey working software on a normal timetable typically on more than one occasion in week. these practices enormously help to diminish the danger of dependency on assets who might be move away from the venture anytime. Different necessity prioritization techniques are accessible and it tends to be picked according to the undertaking's need which are recorded beneath:-

a) MoSCoW- Must have, Should have, Could have, Wont have.

b) Business Value- In view of the Business esteem that will be produced to the organization

c) Kano model- Necessity Prioritization dependent on the client Preferences.

d) Validated Learning- Building up any element that isn't try yet and it is delivered to get the client feedback and it is effective applying it to the following delivery.

e) Walking skeleton:- Requirement which can be finished in a limited ability to focus time and negligible start to finish highlights are chosen..

II (b) Prioritization Taxonomies:-

A) Nominal Scale: This scale esteem comprise of undermost appraisal level an incentive according to numerical perspective. With nominal scale easily making

B) sense of pertinence of every necessity requirement as dwell in equal straight out scale.

B) Ordinal Scale: The a short time later is ordinal scale.With ordinal scale, you'll have the option to finding each requirements importance using the inclinations or positions.

C) Interval: It's far incredible you'll have the option to discover each requirement pertinence having a free territory of qualities impressively cautious qualities as inside the nominal and ordinal case.

D) Ratio: The previously mentioned one is most elevated estimation scale in connect to elective scale, as name ratio speak to characterizing the criticalness of necessity as far as considerable extents to each other.

III. DISCUSSION AND FINDINGS

In 2004 After origin of Systematic Literature Survey (SLR), it's getting exceptionally famous in area of software engineering so as to investigate much in individual domain [34]. A SLR is a procedure being apprise and cipher all attainable exploration admissible to reserved examination inquest, point boundary or wondrous intrigue [15].

Primarily, review protocol is structured for the sake of to handling this SLR as figure 1 delineate Review Protocol. The review protocol accommodate stages as : (i) Research question framework (ii) essence of hunt string (iii) culling of search terms and resources for research work (iv) search process (v) study selection (v) conclusive quality assessment criteria (vi) data synthesis/Result.

The exploration inspiration depends on the diverse research issues which are accounted for in the writing and are related to the various prerequisites prioritization methods & viewpoints. The Research query has planned dependent on research inspiration The question for research help to characterize the restrictions of research while investigating the distributed research in a predefined space.

Hunt procedure for inquiry strings are structured which assist for investigating every single allied examen for a specified area. Inquiry strings were defined dependent on technical terms whichever are gotten from extant investigations. Throughout search process, bunches of studies contemplates are gathered however there is a need to sift through the allied research studies exclusive so as to survey the propriety of the examination work, the quality assessment criteria (QAC) is thought of. Quality Assessment Criteria(QAC) aid in assessment of an study of research dependent once relegated focuses.

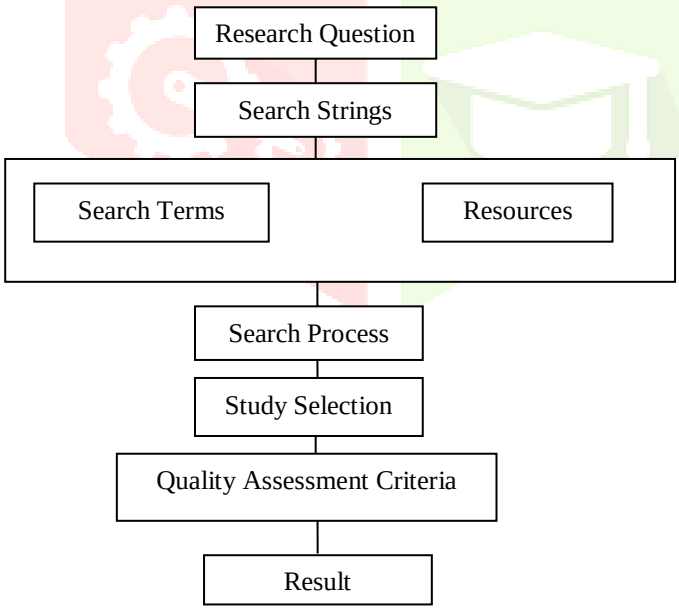

Figure 1 Review Protocol

A) Research Questions

Principle target for research work is to investigate the current research to basically analyze the current software requirement prioritizating methods. Intended research additionally focuses on discover the current methods which bolster prioritizing dependent on the specialized, business and customer perspectives. Following are the rundown of primary question which are tended to in this examination.

Research Question 1: Major Requirement Prioritization Techniques which have been accounted till 2019?

Research Question 2: Explores holes with respect to devices and strategies for software prerequisites prioritization which have been accounted for from 2009 and 2017?

Research Question3: Comparison between Prioritization Techniques.

Research Question 4:- Lucid Technique acc. to previous researches with advantages and disadvantages of techniques.

B) Search Process

The hunt procedure is completed cautiously so as to remove concern research contemplates. Many electronic databases (IEEE Computer Society Digital Library, Science Direct, ACM, Google Scholar and many more) are utilized to gather exploration papers.

C) Study Selection

The leading core is on requirements prioritizing approaches and related sense. Sifting of examination contemplates depends on help for exact proof in separate space. The following is recorded measures considered to achieve research work. Several studies were selected and deemed capable of providing answer to formulated research query.

D) Quality Assessment Criteria

The quality assessment criteria (QAC) are characterized so as to evaluate the nature for essential exploration study. The QAC depends on various questions of research which are utilized for assess quality of an research study. Each investigation is doled out certain focuses dependent upon questions of research [15].

Dyba et al., had propose standards for quality evaluation as an agenda [16] [17]. The essential target of these evaluation models is to discover the utmost pertinent research studies and to think about particular examinations asap piece of SLR.

1V. RESULT

Answers for proposed research questions are depicted underneath with assistance of tables and figure. Answer are for the sake of past investigates.

Requirements prioritization Techniques (RQ1):

Table II shows the different strategies and research identification of these methods. Subtleties of these prerequisites are as per the following:

Analytical Hierarchy Process(AHP): Saaty uncover Analytical hierarchy process (AHP) . Portrays a whole framework for settling on right choices in fields, for example, business, social insurance, government [3]. Basically, partners decay their objective into littler sub-issues, which can without much of a stretch be grasped and dissected. Leaders make sense of components by look at sets of component each other once hierarchy manufactured. The whole assortment of examinations recommended AHP is m(m-1)/2, m devote different necessities at each and every positioning level

Numeral Assignment Technique (NAT): This procedure work at premise of collection prerequisites into different classes for example priority group. Prerequisites Could be characterized into various priority group yet the much widely recognized are:

'Low', 'Medium' and 'High. NAT is much of the time utilized in 14 chose contemplates investigates recognizable proof is given above in Table II

100$ (Cumulative voting): This method is utilized for organize a pre-built rundown of prerequisites. As in present every shareholder is gave option to burn through 100 nonexistent focuses or dollars on recorded prerequisites. When dollars/focuses had been circulated, all out used dollars/focuses for each prerequisite is dispersed by the complete number of clients and the most significant necessity is which has the much elevated worth [27] [24] [23] [22].

Planning game:- It's prerequisite prioritizing method wherein customers sort necessities requirement into groups of three (Optional, Essential and Conditional) relies upon their business objectives.

Binary search tree:- This procedure positions inspired prerequisites in a various hierarchical request. It depends over algorithmic strategy, which store the necessities requirement & afterward can be recovered or looked after. It takmethod takes a shot at the rule that various Stakeholders communicates their points or goals as win conditions and on the off chance that all the shareholders consents to it, at that point those success conditions changes into understandings though on the opposite cycles happen. This procedure takes a shot at the idea that two necessities are taken and contrasted and one another.

The significant artifact about cost-value approach is that it clutch shareholder fulfillment twain; the radiant objective, just as the controlling subject. The Top-10 methodology empowers a shareholder to pick '10' most significant requirement & don't organize them inside.

This methodology is appropriate for numerous shareholder of same priority. Explores distinguishing proof of these portrayed methods are given above in Table II.

Research gap of the requirements prioritization technique and tool (RQ2):

The gap in existing prioritization strategies are listed in Table I. Table I likewise advise about impediments will assist specialists with making further upgrades. The depictions of these procedures show the usefulness of every prerequisite prioritization strategy.

As Binary Search Tree(BST) Technique contain medium no. of requirements it rate the requirement without allocation of any priority values Medium intricacy with medium speed. Not adapt adequately for medium to huge size of prerequisites. In The Win-Win approach, At the point when one-sided partners are concerned, trouble in achieving agreement uniquely; organized prerequisites are conflicting.

In Bubble sort approach it create scalability issue when large number of requirement arrives. In AHP method, it take more time in the case of large requirements, scalability is also issue for this approach. In The Planning game it Do not quantify well with high estimation of prerequisites.

In Value Oriented Prioritization(VOP) Necessity conditions are disregarded in the strategy of calculation. Cost Value approach it take much time & un-scalable too. In Fuzzy AHP it have requirement interdependencies issue. Case Based Ranking is also unscalable. Techniques & their limitation are shown in Table I.

Comparison between Prioritization Techniques (RQ3):

The table III shows the correlation between various procedures based on versatility, usability, textures & the taxonomies of the

techniques. Top-Ten Techniques which are highly discussed and used according to the previous studies are compare in various aspects as number of requirements, their Taxonomies and Technical Aspects as it contain the consistency, Scalability, Ease of Use.

Lucid Technique and advantages and disadvantages.(RQ4):

The aftereffect of that question is relying upon the scale from 1 to 8 that utilized for the estimation, where 1 shows the most noticeably awful and 8 demonstrates the best. The outcome is introduced in Figure 2.

As per the conversation about prerequisites prioritization methods, every procedure has preferences and disservices for multifaceted nature speed, dependability of results, necessities size and simple to utilize. Table IV showing the closed favorable circumstances and weaknesses for every method that we examined in this exploration.

Approach	***Limitation***
Binary Search Tree (BST)	*Rating of necessities, without assigning any need esteems*
Win-Win	*At the point when one-sided partners are concerned, trouble in achieving agreement exceptionally; organized necessities are conflicting.*
Bubble sort	*For huge number of prerequisites, it causes versatility issue*
Analytical Hierarchy Process	*It burns-through more opportunity for high number of necessities and adaptability is additionally an issue*
Planning game	*Try not to gauge well with high estimation of necessities*
Value Oriented Prioritization (VOP)	*Prerequisite conditions are disregarded in the technique of calculation*
Wieger's Matrix Approach	*It very well may be handily utilized by partners who are hoping to accomplish their own objectives*
Case-Based Ranking	*Not adaptable and absence of capacity to keep up coordination among different partners through exchange*

Cost Value approach	*Devour additional time and not versatile*
Top ten requirements	*It can make clashes, or it very well may be equivocal when loads are not utilized during the time spent positioning*
100$ (Cumulative voting)	*Not proper for tremendous number of necessities*
Fuzzy AHP	*necessities interdependencies is an issue*
Interactive requirement prioritization	*There is a requirement for leading extra trials on other contextual investigations to check their results*
Ranking	*Adaptability is the fundamental issue when there are numerous prerequisites. Arrangement of various partners' perspectives is difficult to sort out by this strategy.*
Binary Tree	*Prerequisites are straightforward positioned without allotting any need esteems.*
Pair wise analysis	*It gives untrustworthy, monotonous and complex outcomes.*

TABLE I: MAJOR RESEARCH GAP OF REQUIREMENT PRIORITIZING TECHNIQUES

Sr #	Technique	Researchers Identified	Total
1	Priogov	[28]	1
2	Requirement Triage	[28][31]	2
3	Risk Based Requirement Prioritization	[29]	1
4	Binary Search Tree (BST)	[41][42][43][44][22][28][29][31][31][30]	10
5	Minimal Spanning Tree Matrix	[40] [29]	2
6	Win-Win	[39][38][20][22][28][31]	6
7	Bubble sort	[4][11][12][29][30][31]	6
8	Analytical Hierarchy Process (AHP)	[41][37][36][35][45][46][47][48][49][50][51][52][18][19][21][22] [24][25][26][27][28][29] [30] [31][32][33]	26
9	Planning game	[41][46][47][48][50][51][52][21][23][28][29][31]	12
10	Value Oriented Prioritization (VOP)	[41] [28]	2
11	Wieger's Matrix Approach	[52][22][28][31] [32]	4
12	Numeral Assignment Technique (NAT)	[41][37][36][35][47][48][49][50][51][19][22][24][25][31]	14
13	Cost Value approach	[46][47][48][22][24][31] [32]	6
14	Planguage	[31]	1
15	Top ten requirements	[35][47][48][49][21][27]	6
16	100$ (Cumulative voting)	[41] [36][35][48][38] [30][49][50][51][52] [22][23][24]	14
17	Binary priority listing	[30]	1
18	Value Based Req. Prioritization(VBRP)	[21]	1
19	MoSCoW	[50][52] [21]	3
20	Hierarchical Cumulative voting (HCV)	[46][47] [23]	3
21	Fuzzy AHP	[36][46][47] [23]	4
22	Macbeth	[23]	1
23	Interactive requirement prioritization	[24]	1
24	SERUM	[41]	1
25	EVOLVE	[41][24]	2
26	Ranking	[35][48][49][52]	4
27	Binary Tree	[35][47][48][51][19]	5
28	Value based intelligent req. prioritization	[49]	1
29	Quality function deployment (QFD)	[52][53]	2
30	Round the group prioritization	[52]	1
31	Ping pong balls	[52]	1
32	Pair wise analysis	[52]	1
33	Dot voting	[52]	1
34	Eclipse process framework	[52]	1
35	Relative rating	[52]	1
36	Theme screening	[52]	1

TABLE II : RESEARCH GAP OF REQUIREMENT PRIORITIZING TECHNIQUES

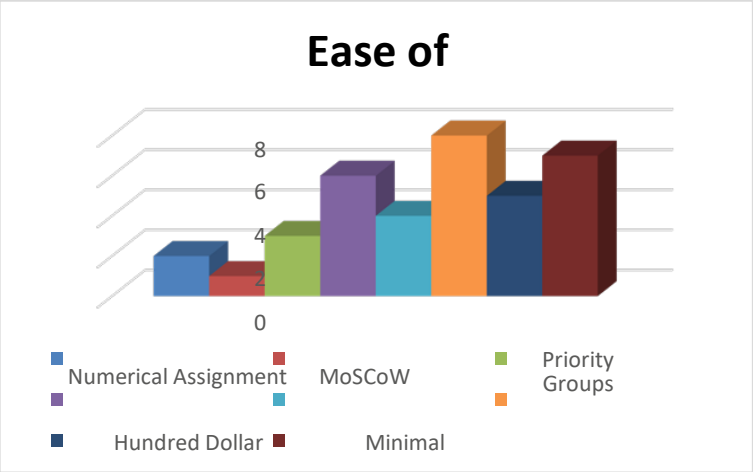

Figure 2. Ease of use comparison among the methods

Sr. No	Approaches	Number of Requirement	Taxonomies	Technical Aspect		
				Consistency	Scalability	Effort Of Use
1	Analytical Hierarchy Process (AHP)	Low	Ratio Scale	Yes	No	Utmost Difficult
2	Numeral Assignment Technique (NAT)	High	Ordinal Scale	No	No	Simple
3	100$ (Cumulative voting)	High	Ordinal Scale	No	No	Simple
4	Planning game	Medium	Ordinal Scale	Yes	No	Very-simple
5	Binary Search Tree	Medium	Ordinal Scale	Yes	Yes	Simple
6	Win-Win		N/a	No	No	Arduous
7	Bubble sort	Low	Ordinal Scale	No	No	Arduous
8	Cost Value approach	High	N/a	No	No	Simple
9	Top Ten Requirements	Medium	Nominal Scale	No	Yes	Simple
10	Ranking	Medium	Ordinal Scale	N/a	N/a	Simple

TABLE III: COLLATION OF TOP TEN REQUIREMENT PRIORITIZING TECHNIQUE

Approaches	Advantages	Disadvantages
Numerical Assignment	Low multifaceted nature with High speed Cope with large Dimensions necessities Simple to utilize	Low pace of unwavering quality Low degree of adaptation to internal failure
MoSCoW	Simple to use for little dimensions necessities Moderate degree of Reliability Elevated level of issue open minded	Medium unpredictability with adequate speed as per necessities size Not versatile for medium to enormous size of prerequisites
Priority Groups	Simple to utilize Reliable outcomes Elevated level of deficiency lenient	Medium unpredictability with satisfactory speed sometimes Not adaptable for moderate to huge dimensions prerequisites
Bubble Sort	Great in little dimensions necessities	Difficult to utilize High intricacy with low speed Not solid outcomes Low degree of flaw lenient Not adapt and turn out to be extremely mind boggling with medium to enormous dimensions necessities
Binary Search Tree	Simple to utilize Reliable outcomes Elevated level of shortcoming lenient	Medium unpredictability with medium speed Not adapt very well for medium to enormous dimensions necessities.
AHP	Excellent in small dimensions prerequisites	Difficult to utilize High unpredictability with low speed Not dependable outcomes Low degree of deficiency lenient Not adapt and get wasteful with medium to enormous size of prerequisites
Hundred Dollar	Low multifaceted nature with rapid Easy to utilize Excellent in small dimensions necessities and useful for medium size of necessities	Medium degree of unwavering quality medium degree of deficiency open minded Not cope with large dimensions prerequisites
Minimal Spanning Tree	Low intricacy with satisfactory speed Simple to utilize Reliable outcomes Elevated level of shortcoming open minded Excellent in little to medium size of necessities	Not proficient with huge dimensions Prerequisites

Table IV. Advantages and Disadvantages of Techniques

V.CONCLUSION

This investigation dispense the most well known strategies for requirement prioritization and their relating literature. Various RP procedures are accessible yet amongst them 10 driving RP methods has talked about in this paper and it's found that every strategy has their own advantages & disadvantages. Similar examination of these procedures were perform utilizing key components i.e RP scale, convenience, adaptability consistency. It help us for recognize most ideal RP strategies for given circumstance asap there are no silver projectile for it. Examination of this driving RP methods, in this paper, can be useful during software advancement process since they give essential comprehension of which requirement are significant than other and which one should be delivered firstly. By utilizing prioritizing strategies, the outcomes can be comprehended and could be all around educated through appropriate dynamic rather than legitimately tolerating as a last decision.

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