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AN INVESTIGATION OF SOFTWARE COMPONENT FOR WEB APPLICATION INTEGRATION BASED ON HYBRID FILTERING

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Abstract

Software component analysis has been done in the software market for the past two decades. Web interfaces and applications need the expertise services for their day to day transactions. So the software components are the inevitable ingredients in playing the integration role. Quality of service (QoS) is the essential measuring scale for the software component selection for the web applications. Research articles from the past 20 years have been taken into consideration for retrospective study and in total 573 papers were considered in this regard with 3 jargons 'Software', 'Component' and 'Selection' through content based filtering. With collaborative and hybrid filtering the final total ended up with 58 papers. An inclusive analysis was performed to identify the domain gaps and was exhibited in this research article.

Keywords: Software component, Interfaces, Quality of service, content based filtering, Collaborative filtering and Hybrid filtering.

1. Introduction

Software component have provided an extensive service in 'N' directions to the web applications. Components have been identified with different fragrance and recipes. Commercial components, Customized components, Giant components, Irreducible components, Lumped components, Web service components, Snap-ins, Plug-ins etc have different varieties in the market. Selection process among software components, a herculean task and need behind the models; framework and architecture have the literal backbone in the proposed work. Fourteen different segments like Software development engineering, Mathematical, Statistical, Operation research, Soft computing techniques, Crisp, Service oriented architecture, Distributed system, Modularity, Evolutionary computing, Knowledge based system, Recommender system,

Web services and QoS ontology have been perceived for the analysis and work. Though 'N' dimensions in the present component market ruling the web applications would still have more starvations which is never ending. Research articles have not been selected in a random manner but using different filtering techniques. Identifying the gap in analysis provides a great strength for the article and provides more mileage and milestone for the future in software components arena. In the first phase of research paper collection based on 3 jargons stated in the abstract using content based filtering fetched 573 papers. In the second phase models, Frame works and architecture have considered for further refinement in the existing papers and summing up to 367 papers. In the last and third phase collaborative filtering and hybrid filtering has been applied in the above said papers and finally made 58 well refined research articles ready for the analysis.

2. Proposed methodology

In software component development analysis has been made from 2001 to 2014. Models and techniques methodologies are affluently available. The papers obtained include both Conference Proceedings and Journal articles too. Software development model proposed for developing reusable software component has been available between years 2008 to 2013. It sums upto 10 papers. Right from the year 2013 up to 2014 soft computing techniques methodologies were proposed to identify the best reusable component whose availability could be traced to 13 papers. Crisp methodology was introduced right from the year 2010 onwards to 2014 and 6 papers has been published in the arena of software component selection. Modularity, a good segment has been prevailing between 2004 and 2007. Evolutionary computing, Operation research, Ensemble model and Statistical methodology has been implied in the research article and the total comes to around 13 papers. Knowledge based system, Architectural based ideology, recommended system, and Distributed system,

3. Filtration of research articles for reusable software component selection

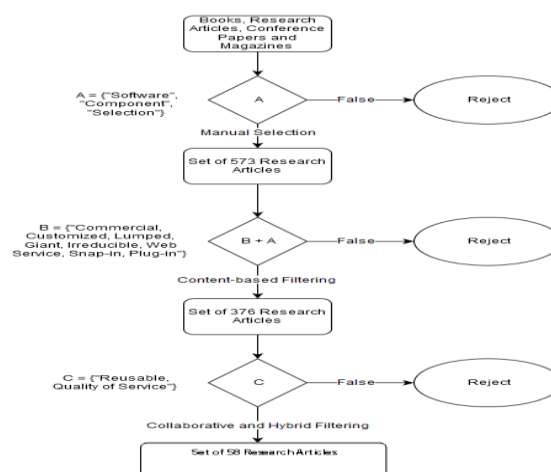


Fig 1 Activity Diagram.

Table 1. Analysis of software components using different models.

S.NO	YEAR	JOURNALS	AUTHORS	TYPES	MODELS
1	2008	ACM SIGSOFT	Gill, et al [1]	Research	software development software
2	2008	Int. J. Softw. Eng. Know., Software Engineering and	Sharma, et al.[2]	Research Conferen	development software
3	2008	Advanced Applications International Journal of	Land, et al.[3]	ce	development software
4	2010	Computer Applications	Kaur , et al.[4]	Research	development software
5	2010	Computer. Ind. Eng. International Journal of	Kwong, et al.[5]	Research	development software
6	2010	Computer Science and Security European Journal of Operations	Seth,et al. [6]	Research	development software
7	2011	Research The Journal of Systems and	Tang.J.F et.al. [7] Marko Palviainen	Research	development software
8	2011	Software Science of Computer	et.al.[8] Herman Hartmann	Research	development software
9	2013	Programming Engineering Applications of	et.al.[9] Santosh Mungle et.al.	Research	development Soft Computing
10	2013	Artificial Intelligence	[10]	Research Conferen	Technique Soft Computing
11	2013	Procedia Technology	Akhil jabbar et.al.[11] Krzysztof Trawiński	ce	Technique Soft Computing
12	2013	Knowledge-Based Systems	et.al.[12] Francisco Rodrigues	Research	Technique Soft Computing
13	2013	Applied Soft Computing	Lima Junior et.al.[13] Michela Fazzolari	Research	Technique Soft Computing
14	2013	Knowledge-Based Systems Neural Computing and	et.al.[14] Ravichandran KS	Research	Technique Soft Computing
15	2014	Applications	et.al.[15]	Research	Technique Soft Computing
16	2014	Neuro Computing	Lam.H.K et.al.[16]	Research	Technique

			Wen-Chung Chiang		Soft Computing
17	2014	Pattern Recognition	et.al.[17]	Research	Technique
			Subhashish Chatterjee		Soft Computing
18	2014	Applied Soft Computing	and Arunava Roy[18]	Research	Technique
			Hisao Ishibuchi and		Soft Computing
19	2014	Knowledge Based Systems	Yusuke Nojima[19]	Research	Technique
		Journal of Computational			Soft Computing
20	2014	Science	Cjha.P et.al. [20]	Research	Technique
					Soft Computing
21	2014	Fuzzy Sets and Systems	Dawei Zhang et.al. [21]	Research	Technique
		Journal of Computational			Soft Computing
22	2014	Science	Jhaa.P.C et.al. [22]	Research	Technique
			Stefanos K. Goumas		Crisp
23	2010	Information Fusion	et.al. [23]	Research	methodology
		International Journal of Web			Crisp
24	2011	and Grid Services	Sun .Q et.al.[24]	Research	methodology
		Asian Journal of Current	Gaurav Sharma and		Crisp
25	2012	Engineering and Maths	S.H. Abbas[25]	Research	methodology
		Expert Systems with			Crisp
26	2013	Applications	Wei Wang et.al. [26]	Research	methodology
			Chintakindi Srinivas	Conferen	Crisp
27	2013	AASRI Procedia	et.al. [27]	ce	methodology
			Gabriela Czibula et.al.		Crisp
28	2014	Information Sciences	[28]	Research	methodology
					Crisp
29	2014	Decision Support Systems	Houtao Deng et.al.[29]	Research	methodology
30	2004	IEEE T. Evolut. Comput	Khoshgoftaar et.al. [30]	Research	Modularity
31	2007	IEEE T. Software Eng	Sarkar et.al. [31]	Research	Modularity
		Journal of Applied			Evolutionary
32	2006	Mathematics and Mechanics	Von Mises et.al.[32]	Research	computing
		European Journal of	Dimitrios Tsesmetzis		Evolutionary
33	2008	Operational Research	et.al.[33]	Research	computing
		Future Generation Computer			Evolutionary
34	2012	Systems	Min Liu et.al.[34]	Research	computing
35	2011	Applied Mathematics	Edward Samuel.A and	Research	Operation

			M. Venkatachalapathy		Research
			[35]		
		Mathematical and	Serdar Korukoglu and		Operation
36	2011	Computational Applications	Serkan Balli[36]	Research	Research
		Annals of Pure and Applied			Operation
37	2012	Mathematics	Hakim.et.al.[37]	Research	Research
					Operation
38	2012	IOSR Journal of Engineering	Shweta Singh et.al.[38]	Research	Research
			G´omez-Verdejo		
39	2006	Neuro computing	et.al.[39]	Research	Ensemble Model
		The Journal of Systems and	Raj Kiran .R and V.		
40	2007	Software	Ravi[40]	Research	Ensemble Model
					Statistical
41	2008	Wiley Online Library	Saltelli A. et.al. [41]	Research	methodology
		Journal of Theoretical and			
		Applied			Statistical
42	2012	InformationTechnology	Sekar et.al. [42]	Research	methodology
					Knowledge Based
43	2001	Decision Support Systems	Sang C Park et.al.[43]	Research	System
		Original Research Article,			
		Simulation Modeling Practice	Vuong Xuan Tran		Knowledge Based
44	2009	and Theory	et.al.[44]	Research	System
					Service Oriented
45	2007	Performance Evaluation	Daniel et.al.[45]	Research	Architecture
			Michael Schäfer		Service Oriented
46	2008	ACM Transactions on the Web	et.al.[46]	Research	Architecture
			Bilal A. Choudry and	Conferen	Service Oriented
47	2010	WAS , USA	Jinli Cao[47]	ce	Architecture
			Shweta Tyagi and		
			Kamal K.	Conferen	Recommender
48	2012	Procedia Computer Science	Bharadwaj[48]	ce	system
			GirishJ. Brahnmath	Conferen	
49	2002	The Proceedings of the Southea	et.al.[49]	ce	Distributed system
50	2004	WOSP'04	Daniel A. Menasce	Research	Distributed system

51	2009	ACM, ISBN Expert Systems with	Mohammad Alrifai et.al.[51]	Conferen ce	Distributed system
52	2009	Applications	Kun Yue et.al.[52] Thomi Pilioura and Aphrodite	Research	Web services
53	2009	ACM Transactions on the Web Proceedings of the 11th	Tsalgatidou[53] Weiqiang Liang and	Research	Web services
54	2009	international conference ACM International Journal of	Xiaoling Dai[54] Thirumaran .M	Research	Web services
55	2010	Computer Applications International Journal of	et.al.[55]	Research	Web services
56	2011	Software Engineering (IJSE)	Sathya .M et.al.[56]	Research Conferen	Web services
57	2010	In Proceedings of ICWIT'10 International Journal on Soft	Yessad L et.al.[57] Lamia Yessad and	ce	QoS ontology
58	2011	Computing (IJSC)	ZizetteBoufaida[58]	Research	QoS ontology

Web services and QoS ontology were proposed to find an effective reusable software component and has been shortlisted to 17 papers for the analysis work. Out of 58 papers, 50 research papers and 8 conference papers were taken into account for the final analysis.

In the above 58 papers were taken for analysis used different techniques from different segmentations and introduced affluent techniques for measuring and identifying the good component selection. Methodologies like Fuzzy c-means, Fuzzy bi criteria, Optimization models, Classifiers, ANN, Association rule mining, Hybrid association rule mining, Machine learning, Induction tree, Multi-objective method, Modularity, Branch and bound, Vogel's approximation, Modified Vogel, Ad boost, Ensemble model, Sensitive analysis, AHP, Ranking methodologies, Decision support system and Linear programming. Mathematical, Statistical, Operation research, Data mining, soft computing techniques has been the segmented area mostly applied in the well refined analyzed 58 papers. Now the gap has been identified for future work and analyzing good component selection for the upcoming web interfaces. Rough sets rankings, Rough sets classification, Rough sets clusters and Deep learning algorithms have been produced. A vital selection of reusable

components provides a good mileage and milestone for web application services through different fragrances cited in

introduction of the research review articles.

Table 2: Software component analysis through models, methods and approaches.

S.no	Year	Authors	Models, Methods and Approaches
1	2008	Gill, et al [1]	Coupling
2	2008	Sharma, et al.[2]	Weyukar's properties
3	2008	Land, et al.[3]	Selection and classification
4	2010	Kaur , et al.[4]	Hierarchical decomposition
5	2010	Kwong, et al.[5]	Genetic algorithm
6	2010	Seth,et al. [6]	Reliability model and reliability analysis
7	2011	Tang.J.F et.al. [7]	Optimization
8	2011	Marko Palviainen et.al.[8]	Predictive
9	2013	Herman Hartmann et.al.[9]	Model driven approach
10	2013	Santosh Mungle et.al. [10]	Fuzzy clustering
11	2013	Akhil jabbar et.al.[11]	KNN with genetic algorithm
12	2013	Krzysztof Trawiński et.al.[12]	Ensemble classifiers
13	2013	Francisco Rodrigues Lima Junior et.al.[13]	Fuzzy rule
14	2013	Michela Fazzolari et.al.[14]	Fuzzy genetic
15	2014	Ravichandran KS et.al.[15]	Fuzzy relational coefficient
16	2014	Lam.H.K et.al.[16]	Neural based classifiers and KNN and Bayes
17	2014	Wen-Chung Chiang et.al.[17]	Fuzzy neural network
18	2014	Subhashish Chatterjee and Arunava Roy[18]	Multivariate fuzzy forecasting algorithm
19	2014	Hisao Ishibuchi and Yusuke Nojima[19]	Multi-objective genetic fuzzy systems
20	2014	Cjha.P et.al. [20]	Fuzzy bi-criteria optimization model
21	2014	Dawei Zhang et.al. [21]	Fuzzy, c-means
22	2014	Jhaa.P.C et.al. [22]	Fuzzy bi –criteria and optimization model
23	2010	Stefanos K. Goumas et.al. [23]	Different classifiers
24	2011	Sun .Q et.al.[24]	SVM classifiers
25	2012	Gaurav Sharma and S.H. Abbas [25]	ANN
26	2013	Wei Wang et.al. [26]	Hybrid association rule mining
27	2013	Chintakindi Srinivas et.al. [27]	Clustering and hybrid XOR function

Table 2: Software component analysis through models, methods and approaches (Cont...)

S.no	Year	Authors	Methods
28	2014	Gabriela Czibula et.al. [28]	Machine learning
29	2014	Houtao Deng et.al.[29]	Conditional based tree
30	2004	Khoshgoftaar et.al. [30]	Multi objective MOM
31	2007	Sarkar et.al. [31]	Human-modularized
32	2006	Von Mises et.al.[32]	Multiple orthogonal channels
33	2008	Dimitrios Tsesmetzis et.al.[33]	Selective Multiple Choice Knapsack Problem
34	2012	Min Liu et.al.[34]	Branch and Bound methodology
35	2011	Edward Samuel.A and M. Venkatachalapathy[35]	Modified Vogel's methodology
36	2011	Serdar Korukoglu and Serkan Balli[36]	Improved VAM
37	2012	Hakim.et.al.[37]	Vogel's approximation method
38	2012	Shweta Singh et.al.[38]	Vogel's approximation method
39	2006	G´omez-Verdejo et.al.[39]	Adaboost
40	2007	Raj Kiran .R and V. Ravi[40]	Ensemble models
41	2008	Saltelli A. et.al. [41]	Global sensitivity analysis
42	2012	Sekar et.al. [42]	Direct mapping
43	2001	Sang C Park et.al.[43]	Knowledge refinement system
44	2009	Vuong Xuan Tran et.al.[44]	Analytic Hierarchy Process
45	2007	Daniel et.al.[45]	QoS Ranking
46	2008	Michael Schäfer et.al.[46]	Forward recovery system compensation
47	2010	Bilal A. Choudry and Jinli Cao[47]	Resource tracking and negotiations
48	2012	Shweta Tyagi and Kamal K. Bharadwaj[48]	Association rules
49	2002	GirishJ. Brahmamath et.al.[49]	Programming techniques
50	2004	Daniel A. Menasce et.al.[50]	QoS based model
51	2009	Mohammad Alrifai et.al.[51]	Integer programming and optimal global QoS decomposition
52	2009	Kun Yue et.al.[52]	Intelligent decision support system
53	2009	Thomi Pilioura and Aphrodite Tsalgatidou[53]	PYRAMID-S framework
54	2009	Weiqliang Liang and Xiaoling Dai[54]	Proceedings of the 11th international conference ACM

55	2010	Thirumaran .M et.al.[55]	Architecture Trade-off Analysis
56	2011	Sathya .M et.al.[56]	QoS Service Selection techniques
57	2010	Yessad L et.al.[57]	QoS matching process and ranking process
58	2011	Lamia Yessad and ZizetteBoufaida[58]	Ranked based on QoS

According to fourteen segments like software development, Soft computing techniques, Crisp methodology and so on which are all referred below have got some significant work rather some research papers. Out of 58 research works in different segments has got a 4.14 average of research papers expected in different arenas. The work in the selection process of reusable software components which is below the average (4.14%) were available in Modularity, Ensemble Model, Statistical Methodology, Knowledge Based Systems, Recommender System and QoS Ontology. 42.85 % segments were being reported below the average. So concentration is more needed for good research in terms with reusable software components. Above average Software Development, Soft Computing Techniques, Crisp Methodology, Evolutionary Computing, Operation Research, Service Oriented Architecture, Distributed System and Web Services were all above the average with the percentage of 57.15%. Analyses are being done through the Table 3.

Table 3. Models, Reference and No of papers.

S.no	Models	References	No of papers
1.	Software development	[1] to [9]	9
2.	Soft Computing Technique	[10] to [22]	13
3.	Crisp methodology	[23] to [9]	7
4.	Modularity	[30] and [31]	2
5.	Evolutionary computing	[32] to [34]	3
6.	Operation Research	[35] to [38]	4
7.	Ensemble Model	[39] and [40]	2
8.	Statistical methodology	[41] and [42]	2
9.	Knowledge Based System	[43] and [44]	2
10.	Service Oriented Architecture	[45] to [47]	3
11.	Recommender system	[48]	1
12.	Distributed system	[49] to [51]	3
13.	Web services	[52] to [56]	5
14.	QoS ontology	[57] and [58]	2

In table 4 methods like Fuzzy, Optimization, Classification, ANN, Association rule mining, Machine learning, Multi objective model, Operation research, Sensitive analysis, AHP, QoS based ranking, Decision support system, Model

driven approach, Genetic algorithm, Clustering, Coupling, Cohesion, Decomposition and Other heterogeneous models are the 17 different fragrances that have got roles in the research work of 58 papers in terms with optimal reusable components.

Table 4. Models, Methods and Approaches with their reference.

Models, Methods and		
S.no	Approaches	Reference
		[10] [13] [14] [15] [17] [18] [19]
1	Fuzzy	[20] [21] [22]
2	Optimization	[7] [33]
3	Classification	[3] [12] [16] [23] [24] [40]
4	ANN	[25]
	Association rule	
5	mining	[26] [48]
6	Machine learning	[28] [29] [39]
7	Multi-objective model	[30]
8	Operation research	[34] [35] [36] [37] [38] [51]
9	Sensitive analysis	[41]
10	AHP	[44]
11	QoS based ranking	[45] [50] [56] [57] [58]
	Decision support	
12	system	[52]
	Model driven	
13	approach	[9]
14	Genetic algorithm	[5] [11]
15	Clustering	[27]
	Coupling, Cohesion	
16	and Decomposition	[1] [4]
	Other heterogeneous	
17	models	[2] [6] [8] [31] [32] [42] [43] [46] [47] [49] [53] [54] [55]

Fuzzy method has got 17.2 %, optimization-3.44%, Classification-10.3%, ANN-1.72%, Association rule mining-3.44%, Machine learning-5.17%, Multi objective model-1.72%, Operation research-10.3%, Sensitive analysis-1.72%, AHP-

1.72, QoS based ranking-8.62%, Decision support system-1.72%, Model driven approach-1.72%, Genetic algorithm-3.44%, Clustering-1.72%, Coupling, Cohesion, Decomposition-3.44% and Other heterogeneous models-22.4%.

Table 5. Years, Papers with respective percentage.

Years	Methods	No of papers	Percentage
2001 to 2007	Multi objective MOM Human-modularized	9	15.52
	Multiple orthogonal channels Adaboost Ensemble models Knowledge refinement system QoS based ranking Programming techniques QoS based model		
2008	Coupling Weyukar's properties Seletion and classification Selective Multiple Choice Knapsack Problem Global sensitivity analysis Forward recovery system compensation	6	10.34
2009	Analytic Hierarchy Process Integer programming and optimal global QoS decomposition Intelligent decision support system PYRAMID-S framework Proceedings of the 11th international conference ACM	5	8.62
2010	Hierarchical decomposition Genetic algorithm Reliability model and reliability analysis Different classifiers Resource tracking and negotiations Architecture Trade-off Analysis QoS matching process and ranking process	7	12.07
2011	Optimization Predictive SVM classifiers Modified Vogel's methodology Improved VAM Quality of Service based Service Selection techniques	7	12.07
	Ranked based on QoS		

Table 5 Years, Papers with respective percentage (Cont...)

2012	ANN Branch and Bound methodology Vogel's approximation method Vogel's approximation method Association rules Direct mapping	6	10.34
2013	Model driven approach Fuzzy clustering KNN with genetic algorithm Ensemble classifiers Fuzzy rule Fuzzy genetic Hybrid association rule mining Clustering and hybrid XOR function	8	13.79
2014	Fuzzy relational coefficient Neural based classifiers and KNN and Bayes Fuzzy neural network Multivariate fuzzy forecasting algorithm Multi-objective genetic fuzzy systems Fuzzy bi-criteria optimization model Fuzzy, c-means Fuzzy bi –criteria and optimization model Machine learning Conditional based tree	10	17.24

In Table 5 it is being cleared that the research articles published from 2001 to 2007 model based QoS and modularity has got a greater impact 15.52% in the selection of reusable software components. In 2013 and 2014 there has been a greater rain for the research articles in terms with software components and has got a percentage of 13.79 and 17.24 respectively in concern with soft computing techniques. Total impact from 2013 to 2014, the percentage were became 31.03.

Nearly one third has been incurred from the domain soft computing techniques were comprised of genetic algorithm, fuzzy logic and neural network.

For the past one and half decades Model based, Data mining, Operation research, Soft computing techniques and Machine learning algorithms were the premier domains involved in the selection of reusable software components.

Through the information some other good domains still were waiting for the researchers to do their research work in the field of Random process theory, Rough sets with meralogy and Support Tensor Machine. Inference and the gap were identified in the above said domains to progress further in the software component field.

In Random process theory many classification approaches available like Discrete time and discrete state space, Continuous time and continuous state space, Discrete time and continuous state space and continuous time and discrete state space.

In Rough sets others models like Dominance based rough set approach, Decision theoretic rough set, Semantic of rough set theory and Rough set hybridization. Soft computing techniques like Evolutionary computing, Machine learning, Probabilistic reasoning and Chaos theory.

In Artificial intelligence other new areas like Adductive reasoning, Case based reasoning, Commonsense reasoning and Ambient intelligence are the emerging trends available in the research of software component selection.

Pictorial Representation of Table 5

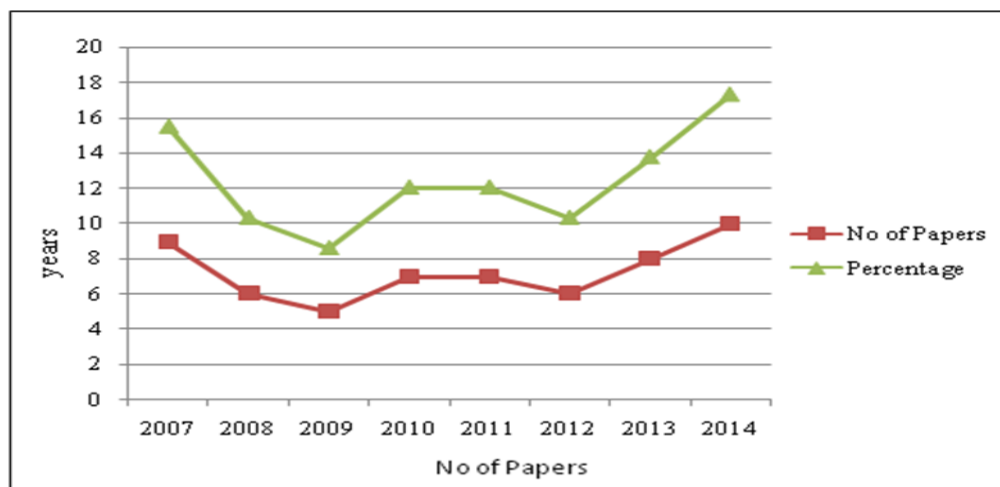


Fig 1 Year, No of Papers and their respective Percentage.

4. Results and Discussions

Table 1 a discussion on types and models for 58 research articles that gave the leading edge to analyze the literal inference behind the reusable software components has been carried out. In Table 2 methods and approaches has been exhibited in length and breadth to the core. In Table 3 models, references with number of papers have been shown with corresponding percentages are discussed below the table. In Table 4 methods and approaches with their corresponding reference papers have been produced which gives a clear picture for the researchers to understand the intricacies and to taken a new path in

the coming days and months. In Table 5 methods, number of papers and percentage has been revealed using years threshold. Through Table 5 was given a new knowledge and inference through percentage intensity and has shown a new path and a gap prevailed for the researchers to proceed their journey in the field of reusable software components.

5. Conclusion

In future, a plan to propose the selection of reusable components from Tensor based data representation is to be done and the performance has to be measured when implemented with **Support Tensor Machine**.

Moreover, Rough sets and Random process theory are the techniques which can also be applied for the purpose of selecting software components optimally. Thus a belief that insight into future dimensions which may marginally improve the selection process could be done.

Another factor called '**services of component**' which essentially triggers component selection is available. The avenue then also paves way for future research work.

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