EPiC Series in Computing

Volume 82, 2022, Pages 21–31

Proceedings of 37th International Conference on Computers and Their Applications

Cost Effective Service Oriented Model for Recruitment

Md Jakir Hossain Molla [1], Sk Md Obaidullah[1], Parveen Ahmed Alam[1], Narayan C. Debnath[2] and Soumya Sen[3]

[1] Aliah University, Kolkata, India

[2] Eastern International University, Vietnam

[3]University of Calcutta

jakirhossain20@gmail.com, sk.obaidullah@gmail.com, ahmedparveen2003@yahoo.co.in, ndebnathc@gmail.com, iamsoumyasen@gmail.com

Abstract

Quality human resources are the most important issue for the success of a company as almost all of the companies are today knowledge driven and use information technology to operate their systems. All these companies have HR managers to recruit the people to match their requirements as per required skills, experience etc. In order to meet the requirement of skilled workforce companies recruit fresher candidates across the country from different educational Institutions and obviously it is a very complex process. The complexity is manifold for different rounds of recruitment process, involvement of human resources, travel etc. and incur huge cost too. The traditional methods of recruitment are On-Campus (where the Organization visits the educational Institutes) and Off-campus (Candidates visit the office of the recruiter). Both of these models are costly and have many complexities. This research work proposes a new service based model that will reduce the complexity of the existing recruitment process, dynamic in nature (helps in quick recruitment) and saves the cost drastically. The proposed model analyzes the skill level of the applicants from all possible perspectives that helps the companies to find out suitable resources for them. A real life case study is also shown to depict the cost effectiveness of the proposed model.

1 Introduction

Selection and Recruitment of human resources for various positions of responsibilities is one of the most pivotal functions for any Business Organizations as they seek highly skilled professionals to fill up their challenging positions. For this purpose, corporate have been relying upon maximum on campus placements to fill up their operational level positions. This method by far is one of the best

ways for them to get the right resources in a shorter span than relying on other sources like job portals, consultancies, advertisement based recruitments and walk-ins. Recently, providing campus placement to successful students is considered as institutional obligation and institutions are ranked based on number of successful job.

While the companies get the best manpower from different universities, engineering colleges, technical institutes and B-Schools in large quantities, students too as well get a chance to start their career with some of the best companies in the business world. Every university should have a career services division to help the students find their right career where they can hone their skills and prepare for a bright future ahead. Campus Recruitments are advantageous for the fresh graduates in many ways. The students get exposed to the industry atmosphere at the very right time and learn how to prepare them for fighting stiff competitions. Employment Services cell in a university/college implies that the institution administration is very focused about the career of their graduate students. Moreover, stakeholder perception today regarding higher education has seen a paradigm shift towards universal employability. This is why it is always a smart choice for youngsters to choose a University/College/Institute that offers campus placements to its students.

In Campus Recruitment Process, Recruiters expect that they should get Quality, Skilled and Domain Knowledge experts from the Institute/University/B-Schools. They lay extra emphasis on Soft Skills, Communication, Aptitude, Attitude, Conceptual and Problem Solving Skills.

In the case of fresher recruitment a group of people from the organization travel across the country that include HR managers, technical resources for conducting technical rounds, Subject Matter experts for different rounds as well as other members for conducting written test and other formalities. This is a massive task and organization need to plan the recruitment process also in a cost-effective way to reduce the cost. A company organizes one or multiple on-campus and pool-campus recruitments as per their needs. It is the decision of the HR managers how to plan the recruitment process based on the number of opening. This planning also involves the decision like recruitment of the students for which job description. Obviously for these different types of job requirements different set of skills are required. If the resources are not recruited as per the requirement the company will struggle to allocate suitable manpower for a specific job and this will lead to serious problem. If the requirements are analyzed for the fresher candidates the parameters such as Analytical Thinking, Interpersonal Skills, Communication skills, Knowledge of contemporary issues, Organizational ability, Technical Capabilities are important for recruitment. Different companies plan their placements based on these different parameters (may consider some additional parameters also). Companies have specific skill set requirement for different types of job roles. However it has been observed for a specific business domain majority requirements of different companies are same. But every company conducts the same types of tests for the candidates and many of these tests do not require interaction (such as technical and HR rounds) with the resource person of the company. If it is observed from the Industry perspective huge time and money are wasted for same types of evaluations. An alternative business model can be deployed in this context. A third party can be assigned to conduct the different tests that do not require the interaction of human resources. This is to be deployed as a Service Oriented Architecture (SOA) model where the different recruiters will take the service of the third party company who will conduct the tests of the fresher candidates across the country to assess the skill levels of applicants. The recruiter companies will ask for a set of candidates based on certain skill set from this third party company. This third party company will provide the suitable candidates as per the evaluation policy. This model will save the time and money of the recruiters and going to be effective across the industry. In this research work a service model will be proposed to help the recruiters to save the money and time as well as the technical method will show how the analysis will be carried out to identify the suitable resources for recruitment. The service model will consider evaluation of different skill level as different service and these will be composed using a service composition model to serve the requirement of different job roles for different companies.

The rest of the paper is organized as follows. Section 2 presents a survey work on the recruitment process and service modeling techniques. Section 3 gives idea of different skill set for recruitment and how these skill set act as services. Section 4 depicts the objective and contribution of this work. In the next section (Section 5) the lattice service model is proposed and illustrates an example of the proposed model and section 6 demonstrates a comparative study on real life data. Finally, in section 7 the research work concluded.

2 Related Works

Campus Placement of students is important for majority of the institutes across the world that offers technical/engineering and other courses which are related to the corporate world. Different types of research work have been carried out in this particular domain. Different attributes are identified [1] that are part of the academics as well as extra-curricular activities. To make the students industry-ready, industrial or internship programs are considered as one the important factor [2] to crack the campus interview process. This model [2] has proved to be successful in many engineering colleges across the India. A weighted score clustering model [3] was proposed to evaluate problem solving skills and critical thinking skills of the students so that the students those who are weak could be identified and trained as per their requirements. Industry-Academia collaboration [4] is quite useful to enhance the employability skills of the students. Moreover, due to COVID-19 [5] the online execution of campus placement is getting important. In [6] a case study is conducted on the outsourcing of the recruitment process for an effective HR management. However, for the last two decades IT (Information Technology) and ITES (Information Technology Enables Services) emerged as the most important job generation verticals. Many of the recruitment policies and strategies are aligned towards these two verticals. In [7] a recommendation model for the HR managers to select the suitable candidates using the social media is discussed. Along with these, different other research works are also being carried out on for the placement and training data for prediction and analysis to help the institutes to evaluate their students more efficiently. A skill analyzer mechanism [8] was proposed to will help to rate the students based on the predefined score in all the potentials they have. It is also important for the students to get recommendation the suitable courses for their skill improvement. In [9] a lattice based recommendation model was proposed for the student's to select their course. Similarly for the recruiters also some ready-made solution model is required for recruitment. Service modeling could be useful in this context. Service modeling have been proposed in different research work for different types of application domains such as QoS aware web service recommendation [10], multi-agent based service model recommendations in IoT [11], machine learning service recommendation system [12] etc. On the other hand lattice based model found to be suitable for different systems such as Materialized view management [13], Optimal query path [14] selection etc.

No research work is found that proposed an alternative service based model to reduce the cost and complexity of existing recruitment system. In this research work authors proposed a service oriented framework of recruitment that simplify the recruitment process, ensures quick access to resources and also reduces the cost of the system.

.

3 Skill Set Analysis and Parameter Identification for Service Modeling

In order to recruit fresher candidates different skill set are required for different job roles. In this section the major parameters are identified. Along with this different sub parameters are also shown for analyzing each of the parameter.

1. Analytical Thinking (A): Different sub parameters for Analytical Thinking (A) are
   - Problem Analysis
   - Problem solving for effective decision-making
   - Data and Information Analysis
2. Communication Skills (C): Different sub parameters for Communication Skills (C) are
   - Verbal Communication
   - Nonverbal Communication
   - Written Communication
3. Knowledge of Contemporary Issues (K): Different sub parameters for Knowledge of Contemporary Issues (K) are
   - Thirst for acquisition of new knowledge continuously
   - Keeping updated on new communication and computer technologies
   - The ability to continue learning Technologies
4. Organizational ability (O): Different sub parameters for Organizational ability (O) are
   - Physical organization
   - Planning
   - Time management
   - Prioritizing
5. Technical Capabilities (T): Different sub parameters for Technical Capabilities (T) are
   - Developing new solutions with existing technology
   - Experience of using a variety of relevant software packages
   - Ability to use existing knowledge to diagnose technical issues
   - The ability to acquire in-depth technical competence in a specific engineering
6. HR Skills (H): Different sub parameters for HR Skills (H) are
   - Demonstrating sensitivity/empathy
   - Maintaining open relationship
   - Showing Cultural Awareness

In this research work service model will work with the parameters only. The sub parameter analysis is not in the scope of this research work. However Technical Capabilities (T) and HR Skills (H) will not be deployed under the proposed service oriented model as these would be evaluated one-to-one basis through human interaction.

4 Objectives and Contributions

Cost optimization is important for any organization to ensure higher profits. With the advancement of technologies, many alternative solutions are emerged over the time to reduce the cost of a company. In the context of recruitment (specially the fresher's recruitment), many steps and involvement of many resources are required. From the business model, perspective a new model could be deployed to conduct those tests that do not require human interaction such that the recruiter can get a ready-made solution (suitable resource person) instantly as required based on the skill set parameters of the resources. The evaluation of the resources should be fully customized based on the different skill set and dynamic in nature. The contribution of this research work is listed below.

Contributions:

1. A specialized model to help the HR managers to recruit the candidates for specific domain knowledge as per their requirements in real time.
2. An innovative business model where a Third party company will be required to conduct the tests but that will reduce the cost and provide resources as and when required.
3. The business model will work under a service-oriented framework and the composition of the services will be based on an algebraic model.

5 Proposed Methodology

The proposed framework is fully customized and dynamic in nature. The requirement of the companies varies for different job roles. Even it may be possible that for two different job roles they require resource person with same skill set but the level of skills may vary. Therefore the model should able to evaluate and store the performance metric of the students in different combinations of the skill set. It is found from the practice that all the combinations of the skill set are required for different type of job roles. Henceforth a deployment model is required that will be able to work with all possible combinations of skill set. In data warehouse there is a similar type of requirements where all the possible combination of cuboids are stored for dynamic business analysis. Lattice of cuboids are implemented for this purpose. In this service oriented framework a lattice model will be proposed to meet the dynamic requirement of the recruiter and this will be further useful to do the analytical processing as exercised in data warehouse.

This service-oriented model will assume evaluation of every skill set such as Analytical Thinking (A), Communication Skills (C) etc. as a different service. These different services will be composed level-wise by taking two or more services at a time. The initial level will be NULL set at level-0. In level-1 every skill is introduced one after one. In level-2 all the possible combinations of 2 services will be composed. This will be continued till N^{th} level to compose N^{th} services at a time. This will form the lattice structure having 2^N number of nodes where N is the number of skill set.

Suppose there are 5 services in the service lattice model. Say these are A, B, C, D and E. With these 5 services the service lattice will look like as shown in Figure 1

Every service node is going to contain the score of every student of associated skill set. The score is calculated based on their performance in the tests. Finally in the service node the records are stored in descending order of score.

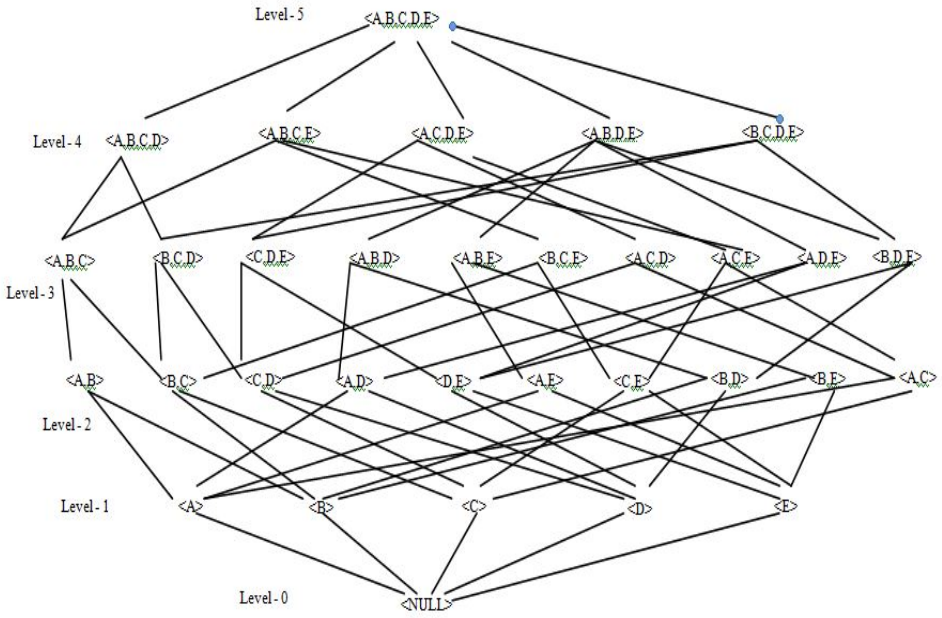

Figure 1: Lattice Service Model with 5 dimensions

5.1 Algorithm of Lattice Service Model

Step 1: Initialize a Service node with NULL value at level-0

Step 2: Every skill set (depicted as a service) is added in level-1

Step 3: Service node in Level-2 is created by combining every pair of services at level-1

Step 4: Every service node contains the score of every student in corresponding skill and is sorted in descending order

Step 5: Initialize I =2

Step 6: Repeat Step 6 Till N^{th} level

6.a: Service Nodes at $(I+1)^{th}$ level is created is created by combining two Service nodes at I^{th} level which has exactly (I-1) services in common

6.b: Every service node contains the score of every student in the associated skill set and is sorted in descending order

Step 7: End

As the values in every service node is stored in descending order of scores based on the requirement of the recruiters the third-party company can immediately recommend top students based on their skill.

5.2 Example

As discussed in section 3, Four skill sets are identified for recruitment those do not require human interaction. These are Analytical Thinking (A), Communication Skills (C), Knowledge of Contemporary Issues (K) and Organizational ability (O). Henceforth proposed lattice service model will be based on 4 services. It is depicted in Figure 2.

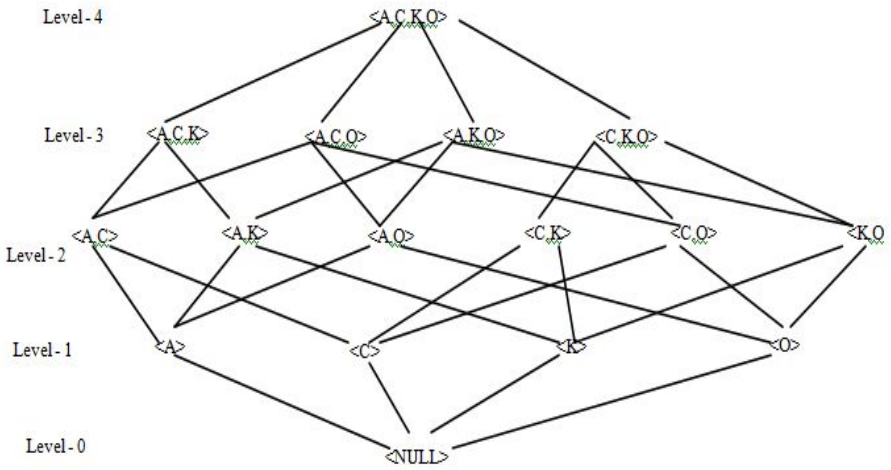

Figure 2: Lattice Service Model with 4 Services

Every service node contains the score of every student and the values are sorted in descending order of score. For example the service node <ACO> will store the value as given in Table 1. The marks obtained in Analytical Thinking (A) is given under column A, Communication Skills (C) is given under column C and Organizational ability (O) is given under column O. Score gives the average of all these marks. The data are stored in descending order of Score. Hence the top k rows represent the performance of top k candidates from the skill set Analytical Thinking (A), Communication Skills (C) and Organizational ability (O). Table 1 contains few student's data records:

A	C	O	Score
96	93	95	94.66
95	94	91	93.33
92	89	90	90.33
91	90	86	89.00
92	87	87	88.66
89	88	85	87.33
86	84	85	85.00

Table 1: ACO Service Node Data Representation

6 Case Study and Comparative Analysis

In this section a real life analysis is demonstrated for various modes of recruitments of an IT company in India. Off-campus drive recruitment, On-campus drive recruitment and proposed lattice service model are compared. Different cost parameters are given in Indian National Rupees (INR).

6.1 Off-Campus drive Cost calculation

Different cost components of Off-campus driving are Advertising cost, Reviewing Cost, Interview process, joining cost and other miscellaneous cost.

1. Advertising Cost:
   Newspaper = 45,000
   Job portals = 30,800
   Other media = 15,000
   No of useful CV received = 60
   Total advertising cost per useful CV = (15000+10800+3000) / 60 = 1500
2. Reviewing Process
   Number of employees engaged in this reviewing process = 6
   Number of days for the reviewing process = 7
   Cost/Day per Reviewing Staff = 2000
   Number of candidates selected for interview = 50
   Total Reviewing cost per candidate selected for the interview = (2000*7*6) / 50 = 1680
3. Interview Process
   Number of employees engaged in the interview process = 6
   Number of days in the interview process = 5
   Cost/Day per interviewer = 2000
   Total Number of candidates selected = 45
   Total interview cost per candidate = (2000*5*6) / 45 = 1333
4. Joining Cost
   Medical Examination Expenses = 18,000
   Training Expenses = 21,500
   Other joining costs = 7400
   Number of candidates Recruited = 40
   Total joining cost per candidate = (18000+21500+7400) / 40 = 1173
5. Other Miscellaneous cost
   Background check expenses = 50,000
   Others = 0
   Number of candidate recruited = 40
   Total miscellaneous cost per candidate = 1250

Adding the above five components total cost per candidate is calculated for off-campus drive of recruitment as

1500+1680+1333+1173+1250 = 6936

6.2 On-campus Drive Cost Calculation

Different cost components of On-campus driving are Accommodation cost, Reviewing Cost, Interview process, joining cost and other miscellaneous cost.

1. Accommodation Cost
   Number of HR required to conduct the drive = 3
   Total days to conduct the exam = 2
   Travel cost per HR = 14000 (To and From)
   Staying Cost/Day per HR = 6000
   Food Cost/Day per HR = 2000
   Others miscellaneous amount = 15000
   Total amount spent for 3 HRs in a day = (6000+2000+2000) *3 = 30,000

Total amount spent on HR = 30000*3 = 90,000
Total Cost for the accommodation = 90000+15000 = 1, 05,000
2. Joining Cost
Medical Examination Expenses = 18,000
Training Expenses = 21,500
Other joining costs = 7400
Total cost for the joining = 18000+21500+7400 = 46900
3. Other Miscellaneous cost
Background check expenses = 50,000
Others = 0
Total miscellaneous cost per candidate = 50,000
Number of candidates Recruited = 40
Considering the above three factors total cost to recruit per candidate is calculated as
(105000+46900+50000) / 40 = 5047

6.3 Proposed Lattice Service Model

Different cost components of proposed lattice service model are Interview cost, joining cost, miscellaneous cost and the fees for the usage of third party service using lattice service model.

1. Interview Cost
   Number of employees engaged in the interview process = 4
   Number of days in the interview process = 2
   Cost/Day per interviewer = 2000
   Total no candidates selected = 60
   Total interview cost per candidate = (2000*2*4) / 60 =266
2. Joining Cost
   Medical Examination Expenses = 18,000
   Training Expenses = 21,500
   Other joining costs = 7400
   No of candidates Recruited = 40
   Total joining cost per candidate = (18000+21500+7400) / 40 = 1173
3. Other Miscellaneous cost
   Background check expenses = 50,000
   Others = 0
   Number of candidate recruited = 40
   Total miscellaneous cost per candidate = 1250
4. Fees for usage of third party service using lattice service model
   Total cost for using Model=40,000/-
   Number of candidate recruited = 40
   Total Model cost per candidate=1000/-

Considering the above 4 factors total cost to recruit per candidate is calculated as
266+1173+1250+1000 = 3689

A graphical representation is presented in Figure 3 to show the cost-effectiveness of the proposed lattice service model. Moreover as the human resources requirements are reduced in the proposed model it will be easy for the HR managers to plan and execute the recruitment process.

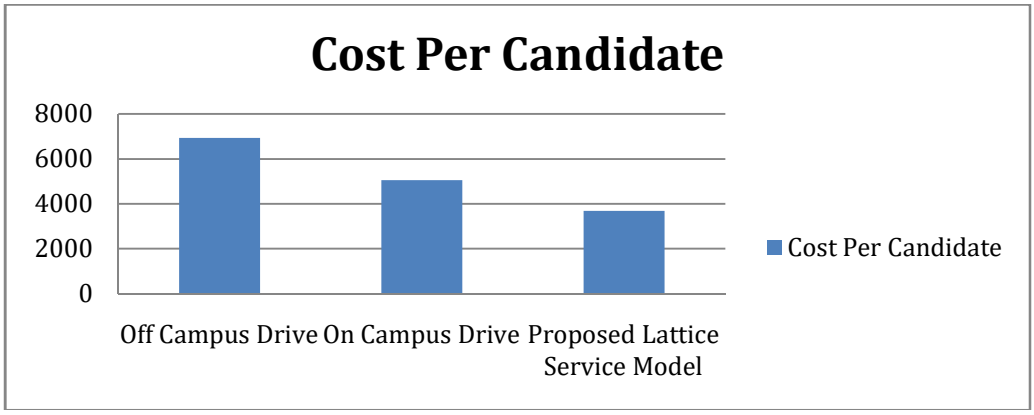

Figure 3: Comparative cost calculation of different types of recruitment

7 Conclusion

This research work identifies a business problem in the domain of Human Resource (HR) management. Recruitment is a major challenge for the HR managers. The process involves many complexities due to multi-stage evaluation, allotment of resources to conduct these rounds, travelling to different Institutes, getting dates as well as the slots from the Institutes etc. No standard model is there to manage these stages. It depends on the efficiency of the HR managers how well these could be managed. Authors of this research work identified these problems and provided an alternative solution. In the proposed model many rounds (not require human interactions) are eliminated for the recruiters as these are conducted by a trusted third party and they provide the suitable resource persons immediately. It is deployed as a service framework as the third party provides the resources with the necessary skill set as per the requirements of the recruiters. In order to make sure that the system can provide the resource persons with necessary skills dynamically a lattice based model is deployed which is capable to represent different skill parameter as services and generate all possible combination of services. Case studies reveal the effectiveness of the model in terms of cost and time.

This model could be extended of the recruitment of the senior resource persons who have experience and specialization in specific skills. Even some of the companies look for specialized skills in fresher's candidates. This model can be redefined to cater these business requirements.

References

[1] G.M.Lundberg,A.Gaustad and B. R. Krogstie, "The employer perspective on employability," *2018 IEEE Global Engineering Education Conference (EDUCON)*, 2018, pp. 909-917, doi: 10.1109/EDUCON.2018.8363327.

[2] S. Hameed and G. S. Nileena, "IEEE student quality improvement program: To improve the employability rate of students," *2014 IEEE International Conference on MOOC, Innovation and Technology in Education (MITE)*, 2014, pp. 219-222, doi: 10.1109/MITE.2014.7020275.

[3] A. Karnad, S. Yadappanavar and P. G. S. Hiremath, "Evaluation and validation of problem solving and thinking skills based on student academic performance," *2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication*

Technology (RTEICT), 2017, pp. 642-646, doi: 10.1109/RTEICT.2017.82566769.

[4] A. Khanna, A. Agarwal and P. Maheshwari, "University-industry collaboration: A new way of educating future generations of engineers in India," *2018 Advances in Science and Engineering Technology International Conferences (ASET)*, 2018, pp. 1-6, doi: 10.1109/ICASET.2018.837692 9.

[5] A.Bandi "Instruction Delivery Modes and Learning Experiences in COVID-19 Pandemic" Journal of Computer Sciences in Colleges Vol. 37 No. 2 pp. 70-79

[6] S.Laumer, N. Blinn and A. Eckhardt, "Opening the Black Box of Outsourcing Knowledge Intensive Business Processes--A Longitudinal Case Study of Outsourcing Recruiting Activities," *2012 45th Hawaii International Conference on System Sciences*, 2012, pp. 3827-3836, doi: 10.1109/HICSS.2012.459.

[7] Davison H.K., Bing M.N., Kluemper D.H., Roth P.L. (2016) Social Media as a Personnel Selection and Hiring Resource: Reservations and Recommendations. In: Landers R., Schmidt G. (eds) Social Media in Employee Selection and Recruitment. Springer, Cham. https://doi.org/10.1007/978-3-319-29989-1_2 .

[8] Saju Mohanan, Sunitha Cheriyan, Rajesh R.K “Deploying smartAcademy:A cloud integrated methodology to develop smart IT graduates to meet the ICT enabled industrial needs in Middle East , 7th International Conference on Innovative Computing Technology (INTECH 2017) .

[9] Subhadeep Ghosh, Santanu Roy, Soumya Sen "An Efficient Recommendation System on E-Learning Platform by Query Lattice Optimization" 4th Int. Conference on Data Management, Analytics & Innovation (ICDMAI 2020) https://doi.org/10.1007/978-981-15-5616-6_6

[10] A. A. Khan and V. A. Chakkarwar, "A Privacy Preserving Improvised Approach for QOS Aware Web Service Recommendation," *2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, 2018, pp. 1-7, doi: 10.1109/ICCCNT.2018.8493866 .

[11] Z.Gao and J.An, "Multi-Agent-based Service Recommendation Model in IoT," *2020 International Conference on Robots & Intelligent System (ICRIS)*, 2020, pp. 187-190, doi: 10.1109/ICRIS52159.2020.00054.

[12] B.Alghofaily and C. Ding, "MLP4ML: Machine Learning Service Recommendation System using MLP," *2020 IEEE International Conference on Services Computing (SCC)*, 2020, pp. 84-91, doi: 10.1109/SCC49832.2020.00020.

[13] Partha Ghosh, Takaaki Goto, Jyotsna Kumar Mandal, Soumya Sen "Materialized View Driven Architecture over Lattice of Cuboids in Data Warehouse" 8th ACM/ACIS International Conference on Applied Computing & Information Technology (ACIT 2021) https://doi.org/10.1145/3468081.3471064.

[14] Santanu Roy, Soumya Sen , Narayan C Debnath "Optimal Query Path Selection in Lattice of Cuboids using Novel Heuristic Search Algorithm" 33rd International Conference on Computers and Their Applications (CATA 2018) pp. 134-139 ISBN: 978-1-5108-5867- 1.