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Role of Database Management Systems (DBMS) in Supporting Information Technology in Sector of Education

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Abstract: ***In the realm of Database Management Systems (DBMS), course curriculum covers several topics that range from data modeling to data implementation and examination. Such subject lay down a robust basis about IT students to conduct an analysis, design and employ a database system. Aside from the fundamental skills, IT students have to be capable of addressing database performance issues like when the system falls short of meeting the expectations of end-users. In this background, data base tuning is a topic that encapsulates different methods related with the enhancements of database performance and is crucial in the provision of effective database curriculum. However, such skills are often lacking in courses of database management systems. In this study, the researcher examined the assumption that database tuning is missing in the present IT curriculums. The study also conducted a survey among the academic and who have multiple skills to determine the significance of database tuning and to shed light on its function the curriculum of students studying database subject.***

Keywords: Database Management Systems, Information Technology, Data Tuning, Structured Query Language

1. Introduction

Owing to the complexity of the database tuning as a subject, a universal definition is still elusive and definitions abound throughout various resources on the concept. Rather than identifying a general definition, the researcher in this study defines database tuning as a continuous process of realizing optimum performance of the entire data base components. However, a database management system (DBMS or RDBMS) is not an isolated system in terms of functioning as other systems may influence its performance. Such systems are the operating system that runs the database, the interface applications coupled with the database, and the network used for communication in the database system and applications. Often times, the database developer is faced with the issue of discontentment coming from the end-user when it comes to the database application performance and use. More specifically, the applications may run correctly, but its untimely response time may cause frustration among end-users leading to dissatisfaction and ultimately, application abandonment (Agrawal, Chaudhuri & Narasayya, 2000; Nielsen, 1999).

Database tuning is a concept that is important for successful database related applications. In other words, an organization that implements a database application to minimize errors, enhance consistency and maximize the effective of employees should first enlighten the employees of its advantages. It is without a doubt that the system's sluggish/under par performance can adversely affect the perceptions of among employees about it and this could result in the employees' resistance to its use regardless of its accurate and improved functionality. Added to this, the customers' first application access will create their first impression of its ease and speed. For instance, if the organization offers the bill payment and claim service functions, it is crucial that the Web pages are easy to navigate and that the transactions occur in a timely manner as both can impact customer satisfaction with the organization. Hence, it is crucial for database applications to function accurately and in a timely manner in order to satisfy customers.

Prior studies (Agrawal, Chaudhuri, Kollar, Marathe, Narasayya & Syamala, 2005; Hoxmeier & Di Cesare, 2000) are of the consensus of how important it is for applications to meet the expectations of users, and on this basis, students of IT should be capable of solving performance issues that are linked with end-user's dissatisfaction of the application. Students of IT should be well-versed in database analysis and the effectively application of systems. With the occurrence of performance issues, IT students have to able to address the weaknesses in the performance and time of performance. This study aims to highlight the important and indication of database tuning among database who have multiple skills and academics, to provide an insight into the extent of database turning provided by the education offered to undergraduate and graduate students, as well as to examine the theoretical components of database tuning in the IT curriculum of the university. The students were majoring in various departments, with Information Systems department as one of them.

The rest of the paper is organized in the following manner; the second section provides fundamental concepts concerning database tuning, and the third section contains a review of the used methodology and approach to database tuning. This is followed by the fourth section that explains the topic of traditional university education, with the inclusion of college and have multiple skills surveys assessing the significance of the subject under study. The fifth section presents the results of the survey and the evaluation of the implication of integrating database turning into the curriculums of undergraduate and graduate IT courses. The sixth section contains the study limitations and their implications, and lastly, the seventh section presents the study conclusion, future studies.

2. Background of Database Tuning

Database tuning meaning entails several factors that surpass DBMS and the understanding of such factors allows the assessment of the concepts integration into the courses of database management. The first step entails the operational weakness and deterioration that arises from performance tightness. Such a performance arises when a database organization is appropriated more work that it could handle at one time, which it is incapable of achieving. The bottlenecks may also extend further than the DBMS and cover other external elements like the client implementation , system communication, working systems, among other combinations. As such, it is important for the database administrator to know the components and their interaction in order to be successful. This will assist in distinguishing performance tightness and highlighting the reason behind it and to provide alternative solutions. The components are mentioned here to provide an insight on the tasks that face IT graduates when it comes to database tuning as evidenced by prior studies (Vaidyanatha, 2001; Niemiec & Lane, 2002; McGehee, 2003a, b; SQL-Server-Performance.com, 2003; Mohamed, 2002; Quest Software, 2003; Agrawal, Narasayya & Yang, 2004).

The listed component is the disk input/output (I/O) bottlenecks that call for read/write disk drive heads to shift throughout drive platters physically and gather considerable time penalty while doing so. In particular, the time period for every I/O operation largely depends on the disk's Revolution Per Minute (RPM). In the latter drive reads operation, drive heads have to conduct a disk scan to search for the next sequential block and this contributes to the total operation time of I/O.

The next component is the central processing unit (CPU) bottlenecks. This component arises when there are considerable resources competing for computer processing time simultaneously. Database administrator able to opt for a joint resolution of making use of physical resources and restructuring the system of resolve the tightness.

The Random Access Memory (RAM) bottleneck is another component, where RAM akin to the CPU refers to a physical resource of the server to the extent that other processes running on it will use the available RAM in the database system. Moreover, if the DBMS system service is utilized as a network field controller, RAM may also be depleted for the process. This necessitates that the database service be a network member server and not a primary or backup domain controller system.
Another bottleneck component is the network bottleneck that is linked to the traffic issues in the network and the manner of behavior displayed by the database server in the network. This poor database performance precipitated by network traffic should be looked into by an expert network administrator for resolution.

Moreover, application decomposition is considered to be the highest network stress stemming from poorly structured client or server application. It is crucial for applications running over networks to use the client/server system architecture, wherein server-side processing mitigates traffic within the network. In this context, client applications are enabled to issue basic requests through views, stored procedures and triggers employing the least number of bits. On the database server side, it receives, operation and resends little of the information over the network to meet the demand of the client. This architecture is referred to as the thin client/fat-server architecture.

Meanwhile, SQL (Structured Query Language) refers to a declarative language that keeps the details regarding the performance of operations muted and hidden. For instance, for the retrieval of a set of records, a specific condition is provided in a statement and the database engine carries out an interpretation and execution of the operation to achieve a set of results. However, this may lead to issues of performance as SQL statement's execution plans vary according to the coding of the statement. The manner in which the SQL statement is provided has a great role in influencing the hidden implementation details performance. In this case, an SQL that is not effectively constructs may degrade the performance of the database system and is known as the first factors that are tackled in performance tuning. Numerous instances of poorly structured SQL exist as evidenced by Mohamed (2002), particularly when using various joins. An upside to it is the fact that majority of DBMS vendors offer paraphernalia to examine query and suggest exchanges on the basis of the DBMS knows concerning the reasonable structures of the databases. Such paraphernalia and the database objectives evaluation containing SQL such as views, stored procedures and triggers have a significant role in alleviating performance issues that stem from poor SQL construction.

Denormalization is a method to shift from greater database modeling forms to lower ones to expedite access to the database. This method is used during the derivation of a physical information model from reasonable form and more often than not, tables have to be weakness by combining them to decrease the number of joins needed for the extraction of the required outcomes. Evidently, this necessitates incurring costs for data duplication, which results in inconsistencies in data and in the enforcement of integrity constraints. The challenge comes from determining how far the table combinations have to be conducted and when the process should stop producing the required performance improvement.

Furthermore, indexes are considered to pose the top difficult challenges based on their indiscriminate use that are harmful to the database performance. The index is primarily used to improve the performance of used the table – indices should be adjusted to indicate table exchanges and their use may take a significant total of time. A great deal of examination is needed while using indices as tables are analyzed in their involvement in modifying and inserting activities. The indices definitions on tables for the aim of enhancing performance will generally slow the database system, with the insertion also update processes. In this context, the database administrator should oversee DBMS performance statistics continuously in order to re-evaluate the generation and the deletion of indices.

Owing to the permeation of the above factors in the computing field, they provide a significant aspect of the IT professionals' education. The issue often lies in the lack of extensive and universal methodology to conduct database tuning.

3. Database Methodology

The factors presented in discussed in the previous section can negative influence the performance of the database systems regardless about DBMS vendor. Therefore, the core implication is that the variables need examination also consideration in totality rather than individually, when working towards enhancing performance. This implication has been supported by the Oracle Corporation, in the concept called Total Performance Management (TPM) (Shallehamer, 1995).

In the present study, database tuning is examined holistically to transform it from a reactive, micro-level method that tackles arising issues, to a proactive macro-level one that pinpoints and offsets degrading performance. More specifically, TPM method provides a staying holistic experience that is distinct from either a top-down. Staying holistic method may be explanation through the approach of attacking problems from different sides and providing a organized way for the synthesis of paraphernalia and technicality in a dynamic computing surrounding. Its staying aspect is attributed to its programs evolution to satisfy the requirements and that are run selectively and with purpose rather than routinely (Shallahamer, 1995). The methodology views the database such entity whose size and complications, grows over time and hence, the important of performance management grows with it. The approach moves within three steps continuously.

With the reevaluation and changing of the established methodology, the system has to be adjusted accordingly. Several factors including the version of DBMS, upgrades and the overall users influence the database system performance, necessitating the continuous database tuning process.

In this line of advocacy, Microsoft Corporation supports the integration of performance monitoring with DBMS configuration in the SQL Server system of the company, albeit this handles only a part of the issue. Microsoft, time and again stressed the fact that the customized tools provided use DBMS versions conduct most for database tuning processes with higher effectiveness and this includes data warehouse (Miller & Lau, 2001). They stated that the SQL Server aims to let go of manual configuration and database tuning as it has become obsolete and archaic (Miller & Lau, 2001). However, because these manual practices are still used to options, suggested of database director do not do so but rather enable SQL Server to tune itself automatically.

Furthermore, SQL Server 7.0 has successfully made automatic adjustments for performance enhancements and the version after it, SQL Server 2000 has enhanced on the self-adjusting methods. Despite the fact that the level to which the self-tuning of the database is still ambiguous, the level and manner in which preceding versions of SQL Servers tuning is expected to exchange within upgrades to 7.0, also SQL 2000. Nevertheless, this will only handle a part of the problem in that although the process will be enhanced, a holistic approach is expected to generate long-term solutions and prevent indiscriminate patchwork. Prior authors (Shasha & Bonnett, 2002; Chaudhuri & Narasayya, 1997) advocates a more general perspective of database tuning that is not dependent on a specific DBMS vendor and that lays down a premise appropriate for teaching the fundamental database tuning concepts. This viewpoint on database tuning would enable students of IT to delve deeper into the main issues that are needed to resolve issues of performance.

4. Database in University Education

Graduating IT students are provided with coursework and internships enable them to develop and modify database applications for the company employing them in the future. However, the current IT curriculums and internships fail to provide graduate students with the skill to solve issues of poor database performance – a topic that is still ambiguous and debatable. Because students are unable to use their academic and internship experience to guide them through the resolution of issues, they are left to their own devices. It appears as if the topic has largely been ignored in IT curriculums in most universities. In this background, the researcher may reach to the conclusion that database tuning is conducted in an ad-hoc manner without a structured formal method or theoretical basis that could be appropriately integrated into the course curriculum. It can also be concluded is the existence of more general range of computer topics are required to be introduced into the curriculum to shed light on database tuning, giving room to study the topic extensively.

More importantly, aside from the above conclusion derived by the writer, it is notable that a thin line frequently distinguishes traditional high education curriculums from vocational technology learning . Therefore, subject, including database tuning that generally linked within particular software vendors instead of intellectual disciplines that can form a niche in university curriculums. In this context, the traditional university education aims to stand students intellectually within contributing to their learning ability instead of providing job training to them. In this regard, the American Council on Education (ACE), an umbrella organization for the American Colleges and Universities, described its core values as the values of inclusiveness and diversity that acknowledges the responsibility of higher education to the society, and it personifies the belief of extensive (American Council on Education, 2003a; Chaudhuri & Narasayya, 1999).

In this background, some institutions of higher learning aim to go on to offer a traditional, overall plan to undergraduate and graduate students, while others opt to hone their distinction and concentrate focus on what they offer, believing that mission specificity will drive them to meet the needs of learners from diverse backgrounds (American Council on Education, 2003b; Chaudhuri & Narasayya, 1998).

5. Database of Faculty and Professionals

Literature is clear on the innumerable factors entailed in database tuning and the existence of the underlying theoretical component that is distinct from any specific software vendor. Hence, an in-depth understanding of the database tuning topic is only possible if there are more extensively offered database courses. The researcher carried out a survey to measure the perceived importance of such courses among database professionals. The researcher also carried out a survey from each group of university college and database who have skills to determine their opinion of database tuning role in the realm of traditional university education.

6. Discussion of Results

E-mail survey was distributed via listservs to database academics, who have skills of database improvisers, leader and designers. The results generated 39 college members and 28 professional respondents indicating few enjoyable insights into database tuning in both academia and practice. The result showed that courses outnumbered graduate courses – with 63% taught at the undergraduate level, and 15% in graduate field. Also, 31% for cases were educated in the two levels and noting the two programs, it was evident that database tuning was not introduced in majority about subjects (60%), and database tuning was covered only one single topic out of sundry in half of the courses (50%). Among the respondents who related that tuning of database is only offered as part of a whole subjects, only a single respondent highlighted the amount of time dedicated to tuning of database (4%).

Moreover, majority of the respondents who did not learn of tuning of database (78%) indicated their conviction that it should be taught in some capacity and over 80% believed that it should mostly be taught to undergraduate students. This indicates that at present, no great stress has been given on learning tuning of database as a subject in traditional institutions of higher learning. Evidence was compounded by the fact that on pairing the faculty responses with 90% of the practitioners' responses, database tuning was not offered throughout the coursework, notwithstanding whether the students were studying under the disciplines of Computer Science, Computer/Management Information Systems or others. Regardless of the bleak conclusions, 80% of the college users who did not learn the subject related that like to cover the topic as a portion of current courses. Added to this, 90% of the professionals lacked database tuning background, while 78% related that the introduction of such topic in the curriculum would have been helpful.

However, 78% of the surveyed professionals indicated that database tuning knowledge was not importance at their jobs and just 22% to be importance. Among the respondents who did not learn it in college, 43% were accepted to be useful and 56% stated that it was not useful. An interesting differences can be noted in providers responses as they believe that tuning of database not a key role in their professional jobs but they like to be taught the subject in their prior educational experience.

The above highlighted inconsistency calls for future studies to provide insight although initial analysis may attribute it to two probable reasons; first, have weakness of learning and grasp of the subject, and second, the rigors of specific endeavors throughout the professional experience like the demands and performance expectations of the tasks related to employment.

7. Limitations of Study and Future Work

The aim of study to determine the viewpoint of database academics and who have skills concerning the topic of database tuning. The study used listservs to obtain data, which produced limited number of both group respondents. Added to this, the survey was dependent on the self-categorization of the respondents as database faculty and professionals, and this could have had a significant impact on the results. This was conducted to obtain the highest number of respondents possible.

This study shed light on the way database tuning is perceived by academics and professionals. Several of the study aspects may be explored in this section including the establishment of a focused group of respondents that the researcher referred to as database faculty and professionals and their answers to some pertinent questions. These include; 1) Why the database college not keep tuning of database in their subjects? 2) Why the database users think that tuning of database is importance and why the thinking it is not in their jobs? 3) What can be the better way to keep tuning of database in information technology? And lastly, 4) how database able to make significance affecting about tuning of database? These questions may be addressed in future work to determine the viewpoints and thoughts in teaching and using database tuning. The researcher also aims to conduct future works to examine the discrepancy of the practitioners' responses in their perception of the topic and to conduct software vendor independent studies that include a proposed method appropriate for advanced database course.

8. Conclusion

This study aimed to evaluate the value about including tuning of database such portion of the curriculum of the university's computer information systems. From the examination of institutions of higher learning, it appeared that only certain database tuning factors are covered in undergraduate subject, without extensive topic coverage. Despite the several factors involved in teaching the topic, it needs to be taught at the micro-level as well as the macro-level through a structured strategy. This is particularly pertinent as tuning of database had a theoretic institute that can occupy a considerable part of a subject, with not solely centering on any specific DBMS vendor package. That not however exclude requirement about shaking hands practical DBMS training.

Similar to ERM and SQL programming, As a consequence, the topic may be covered independent of any platform, while allowing the academic institution to steer clear of perceiving itself such training center of particular vendor bargain. Evidence indicates the tuning of database forms a core

portion of effectively running of database systems and the topic is suitable in traditional university education. To recapitulate the results; the initial study objective is answered by the finding that tuning of database is importance at the jobs for database implementation professionals albeit majority of them refused to accept this fact. They voiced their inclination to have been introduced the topic in their academic years but unfortunately, as the result showed, the topic is largely ignored and rarely offered in both programs of all levels for educations .

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