

Research Article

Relevance of Stored Procedures in Developing Smart Solutions

Omogbhemhe Mike Izah* , Onyijen Ojei Harrison, Odighi Mathew Onojiasun

Department of Computer Science, Faculty of Physical Sciences, Ambrose Alli University, Ekpoma, Nigeria

Abstract

With the evolution and adaptation of object-oriented mechanisms, the majority of software developers in this millennium have access to a multitude of contemporary software tools and services. When creating contemporary software, object-oriented mechanisms have helped certain processes, like stored procedures. An infinite number of programs can share a stored procedure, which is a previously run Structured Query Language (SQL) that is kept in the database for use in a specific application. Programming applications to run on remote servers and be downloaded onto a user's device via the Internet is known as software development. Creating software requires a lot of work and the blending of various styles and methods. A web browser like Google Chrome, Safari, or Mozilla Firefox can be used by an end user to access software. The syntax for writing stored procedures in software development is a collection of SQL statements that are kept in the system backend and have a specified name and purpose that can be shared by several programs. Since stored procedures only need to be written once, using them can help with data integrity preservation, productivity gains, and access control over what end users can enter or modify. It's never easy to achieve modularity, scalability, and tail tolerance in modern software. Therefore, the importance of stored procedures cannot be overstated. Achieving modularity, scalability and tail tolerance in modern software is always a difficult task. Hence the need for stored procedure cannot be under estimated. This paper unveils the relevance of stored procedure in building scalable and modular software.

Keywords

Smart Solutions, Stored Procedures, Server, Software Development, Database

1. Introduction

The range of digital technologies enabling new levels of operational capacity and business reach is a recurring theme across numerous market sectors. Fine-grained code reuse, low-coding tools, and software development tools like stored procedures in database management systems are all included in the definition of modern software development. A group of named Structured Query Language (SQL) commands that are saved in a relational database management system together

for future reuse and sharing by various programs is called a stored procedure. One of the many advantages of stored procedures is that they have the ability to access and modify data in a database without being restricted to a particular database or object. A subroutine that linked relational database system applications can access is called a stored procedure. Because stored procedures are collections of SQL and programming commands that carry out extremely specific tasks, they must

*Corresponding author: mikeizah@gmail.com (Omogbhemhe Mike Izah)

Received: 22 June 2025; **Accepted:** 3 July 2025; **Published:** 28 July 2025



Copyright: © The Author(s), 2025. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

be called or invoked. Most relational database system like SQL Server, Oracle, MySQL and others gives adequate support for stored procedure [1].

A section of declarative SQL statements kept inside the database catalog is called a stored procedure. Triggers, other stored procedures, and programs like Java, Python, and PHP can all call a stored procedure. Recursive stored procedures are those that call themselves from within the stored procedure. Recursive stored procedures are supported by the majority of database management systems. Nevertheless,

MySQL's support for it is lacking. It is advisable to verify the version of MySQL you are using prior to introducing recursive stored procedures in MySQL. An example of a stored procedure that receives a parameter, runs a query, and return the query results / outputs is shown in Figure 1 below. To be more precise, the stored procedure matches the Employee Record primary key with Business-ID that receives as a parameter. It will return the requested employee from the employee table.

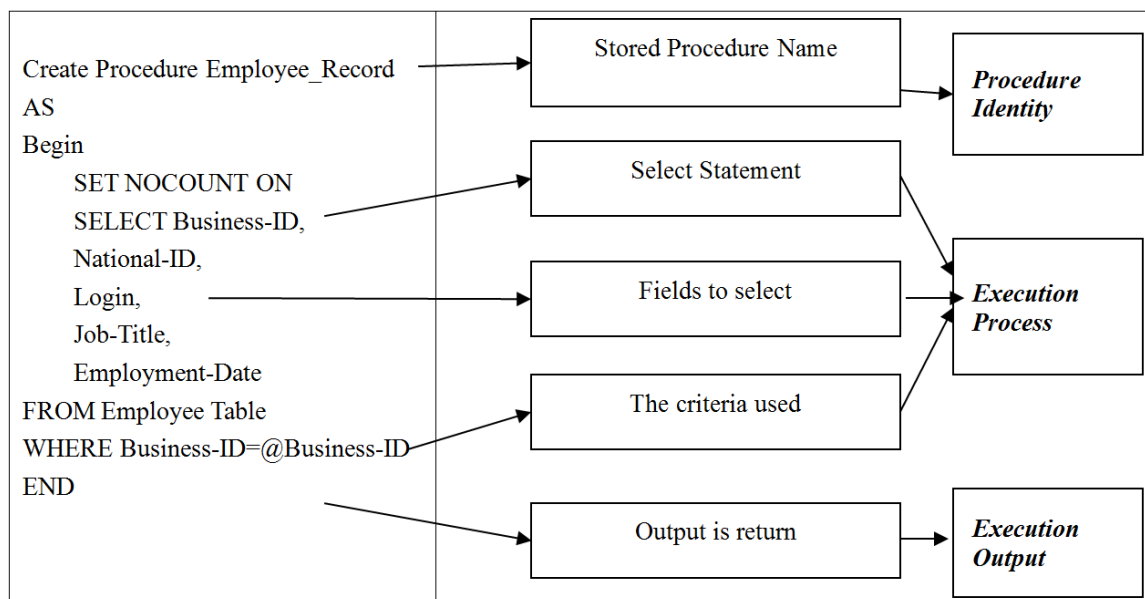


Figure 1. Stored procedure syntax for an employee.

Stored procedures are called for action when an application needs to use relational database information to accomplish a complex task [2]. A loan application to assess a customer's creditworthiness and ability to repay debt could serve as an example. The loan officer uses a 24-month period's average monthly income and his monthly account withdrawal total to determine the customer's ability to repay the loan [2]. The loan officer provides the customer's ID or social security number to a credit reporting website in order to confirm creditworthiness. The two aforementioned actions are intricate and challenging to complete with simple SQL commands. Furthermore, different customer information is linked to each action in the customer loan approval process, even though the same action may be carried out at different times for different customers (i.e., the same action is repeated multiple times).

2. Concepts of Software Development

Today's software development refers to creating programs and applications that utilize every advancement in technology. To optimize the advantages, it makes use of the various architectures, services, and capabilities that are available [3].

Stored procedure principles, which emphasize data storage and security for continuous delivery of new functionality, are widely used in modern software development. These guidelines are used for both small software products created by individual and large software products created by large team [4]. In order to be more innovative and to provide products and solutions more quickly, modern organizations are looking to leverage digital technologies. Along with increasing productivity and personalization, these technologies also make interactions and experiences more engaging [4]. An organization's boundaries are no longer limited to actual bricks but rather extend to an edge that bends in accordance with its end points. DevOps and other foundational processes are centered on establishing a new cooperative relationship that is advantageous to the software process as a whole. The swift, reliable, and release of software with increased frequency and control mechanism is implicit in that goal. A new set of regulations has forced software developers to adapt and evolve with a plethora of new tools and services at their disposal. Increased automation support, self-service provisioning, and a wider range of training services are all included in these tools.

2.1. Concepts of Stored Procedures in MySQL

The most well-known open source RDBMS, MySQL, is utilized extensively by businesses and the community alike. It did not, however, support stored procedures, stored functions, triggers, or events during the first ten years of its life. These features were added to the MySQL database engine in version 5.0 to increase its flexibility and power.

2.2. Benefits of Stored Procedures

- 1) Increase Software Performance: Stored procedures are built, compiled, and then kept in the database. But MySQL uses a slightly different implementation of stored procedures [5]. The stored procedures in MySQL are generated dynamically. MySQL creates and maintains a stored procedure cache for each and every connection after compiling the stored procedure. Software uses the compiled version of a stored procedure when it uses it more than once in a single connection; otherwise, the stored procedure functions similarly to a query.
- 2) Reduction of Traffic: Because stored procedures only require the software to send the name and parameters of the stored procedure, rather than multiple lengthy SQL statements, they help reduce traffic between the database server and software.
- 3) Reusability and transparent: Any application can utilize and see through stored procedures [6]. Stored procedures allow all software to access the database interface, saving developers the trouble of creating functions that are already supported by stored procedures.
- 4) Security: Without granting any permission on the underlying database tables, the database administrator can provide software that accesses stored procedures in the database with the necessary permissions.

3. Concept of Stored Procedure and Software Development

3.1. Stored Procedure

A stored procedure is a collection of named structured query language statement that are compiled and stored in the database which can be called to use by multiple programs. The use of stored procedures can help maintain data integrity (information is entered consistently), increase productivity (stored procedure statement are only written once), and control access to data (where end users can only enter or change data but cannot re-write the procedure. A collection of compiled SQL commands that are kept on the database server is known as a stored procedure [7]. Client applications are able to repeatedly run stored procedures without requiring compilation or sending them to the database server once they have been "stored." Performance is increased by stored procedures because they

lower CPU and network traffic. It is used to carry out operations on the database, including INSERT, UPDATE, DELETE, SELECT, as well as any combination of these operations. It can also be used to call command line arguments, send email, send return values, send output parameters, encapsulate business logic, and ensure data integrity.

3.2. Software Development

The process of creating web application for the internet or intranet is known as software development [8]. Web development involves a wide range of different tasks, from creating basic static page to creating intricate web application, electronic commerce platforms, and social media platforms. Web engineering, web design, web content development, client liaison, client-side/server-side scripting, web server and network security configuration, and e-commerce development are a more extensive list of tasks that are commonly associated with web development. "Web development" typically refers to the primary non-design elements of creating websites among web professionals: coding and creating markup [9]. Content management systems (CMS) can be used by software development to make content changes more accessible and easier for people with minimal technical knowledge. Web development teams for larger companies and organizations may include hundreds of web developers and use standard techniques like Agile methodologies to create websites. According to the U.S. Department of Labor and the Bureau of Labor Statistics [10], smaller organizations might only need one contracting or permanent developer, or they might need to assign a secondary developer to a related job position like information systems technician or graphic designer. Instead of falling under the purview of one department, software development can be a collaboration job by different departments. Front-end, back-end, and full-stack developers are the three categories of web developer specialization. While back-end developers work with servers, front-end developers are in charge of the functionality and design that appear in user browsers.

4. Modern Software Development Using MySQL Database

Based on a relational database management system (RDBMS), MySQL is a potent open-source database server that can manage numerous concurrent database connections [11]. Open Source refers to MySQL's status as free development tools with a large community of committed volunteer programmers who continuously add new features and make improvements. In contrast to open source development tools, which have a large and rapidly expanding global community of knowledgeable and committed users, development tools and database servers that require licensing fees have fewer programming resources. There has been debate over the superiority of each tool. Naturally, the developer with greater

familiarity with one tool than the other will support the tool with which they are most familiar. Based on our experience, MySQL is the best tool for developers. Applications that are properly developed can have complex functionality, speed, power, scalability, and clean, simple usability.

4.1. Relationship Within Stored Procedure and MySQL

A procedure, also known as a stored procedure, is a sub-routine that is stored in a database, subprogram in a normal programming language, according to [12]. A procedure consists of an SQL statement(s), a parameter list, and a name. Stored procedures are supported by almost all relational database systems; they were first introduced in MySQL 5. We used MySQL 5.6 under Windows 7 and went over the MySQL procedure in detail in the following sections. Two types of "routines" are supported by MySQL 5.6: stored procedures that you call and functions whose return values you use in other SQL statements in a manner similar to how you use pre-installed SQL server functions. The major difference is that UDFs can be used like any other expression within SQL statements, whereas stored procedures must be invoked using the CALL statement.

4.2. Why Stored Procedures Uses MySQL

Stored procedures are fast: Similar to prepared statements, the MySQL server also makes use of caching [13]. The primary increase in speed is due to a decrease in network traffic. Use a single call to a server-stored procedure to complete repetitive tasks that involve checking, multiple statements, and no interaction of the user.

Stored procedures are portable: When you write your stored procedure in SQL, you can be confident that it will execute on any platform that MySQL is compatible with. You won't need to install extra runtime environment packages, grant operating system permissions for program execution, or install different packages if your computer type varies. Writing in SQL has this benefit over external languages like Java and C#.

Stored procedures act as source code in the database: Furthermore, it makes sense to connect the data and the procedures that work with it. d) Procedures that are stored migrate! MySQL follows the SQL: 2003 standard quite closely. Other people (DB2, Mimer) also follow.

5. Creation of Procedure

A stored procedure is created by the statements that follow [14]. A procedure is linked by default to the default database, which is the database that is being used right now. When creating the procedure, give it the name database_name.stored_procedure_name in order to link it to a specific database. This is the entire syntax.

Syntax:

```
CREATE [Creating statement = {who are user or Pro-
spectus_user}]
PROCEDURE st_name ([proc_parameter[,...]])
[characteristic...] Features
proc_parameter: [ IN | OUT | INOUT ] param_name type
type:
Real/Valid SQLServer data type
Features:
COMMENTS 'string'
: LANGUAGE SQL
: [NOT] DETERMINISTIC
: {CONTAINS SQL | NO SQL | READS SQL DATA
: MODIFY DATA of the SQL}
: SQL SECURITY { DEFINITION}
Body of the Subroutine:
Valid SQL subroutine query
```

5.1. Main Parts of a Stored Procedure

According to [15], stored procedures can be thought of having three main parts:

- 1) Inputs: Stored procedure accept parameter values as inputs for its processes. This is highly depended on how the parameters are declared and how the modified values can be passed back to the sub program calling the procedure.
- 2) Execution: Executing SQL statement can easily be done by effective stored procedure through the utilization of conditional logic such as IF THEN or CASE statements and looping constructs to perform tasks. One stored procedure has the ability to call another one. Because stored procedures can use cursors to manipulate SQL query results, they can be very useful. The process can access results row by row with the use of cursors. Cursors essentially allow you to loop through the output of a SQL query. Because of this, database performance may suffer, so use cursors wisely.
- 3) Outputs: The major output of every stored procedure is a single value such as a number, text value or set of rows within a table.

5.2. Implementation of Store Procedures in Software Development

To implement stored procedures some basic concept must be understood which are:

MySQL Stored Procedure Variables

A named data object with a variable value is one that can alter while the stored procedure is being executed. Usually, to hold the instant results, we use the variables in stored procedures. The stored procedure is the only place these variables exist. Before utilizing a variable, it must be declared.

Declaring variables

The declaration of a stored procedure involves using a DECLARE statement as follows:

DECLARE variable_namedatatype (size) DEFAULT default_value;

Let's examine the statement above syntax in more detail:

- 1) First, you specify the variable name after the DECLARE keyword. The variable name must follow the naming rules of MySQL table column names.
- 2) Second, you specify the data type of the variable and its size. A variable can have any MySQL data types such as INT, VARCHAR, and DATETIME.
- 3) Third, when you declare a variable, its initial value is NULL. You can assign the variable a default value using the DEFAULT keyword.

For example, we can declare a variable named total_sale with the data type INT and default value 0 as follows:

```
DECLARE total_sale INT DEFAULT 0;
```

MySQL allows you to declare two or more variables that share the same data type using a single DECLARE statement as follows:

```
DECLARE x, y INT DEFAULT 0;
```

In this example, we declared two integer variables x and y, and set their default values to zero.

Assigning variables

Once you declared a variable, you can start using it. To assign a variable another value, you use the SET statement, for example:

```
DECLARE total_count INT DEFAULT 0;
```

```
SET total_count = 10;
```

The value of the total_count variable is 10 after the assignment.

Besides the SET statement, you can use the SELECT INTO statement to assign the result of a query, which returns a scalar value, to a variable. See the following example:

```
DECLARE total_products INT DEFAULT 0;
```

```
SELECT
```

```
COUNT(*) INTO total_products
```

```
FROM products;
```

In the example above:

- 1) First, we declared a variable named total_products and initialized its value to 0.
- 2) Then, we used the SELECT INTO statement to assign the total_products variable the number of products that we selected from the products table in the sample database.

5.3. Benefits of Stored Procedures in Software Development

- 1) Layer of Security: Between the database and the user interface, a stored procedure adds a crucial degree of security [16]. Because end users can enter or modify data but cannot write procedures, it supports security through data access controls. Data integrity is maintained by stored procedures because information is entered consistently. Because statements in a stored procedure only need to be written once, productivity is in-

creased.

- 2) Embedding queries in a graphical User Interface (GUI): Compared to query embedding in a graphical user interface (GUI), stored procedures have advantages. When an issue occurs in an application, stored procedures make troubleshooting simpler because of their modular design. Additionally, stored procedures can be adjusted, which removes the need to change the GUI source code in order to enhance performance. Coding stored procedures is simpler than creating a query using a graphical user interface.
- 3) Reduce Network Traffic: Because stored procedures execute commands as a single batch of code, they can help reduce network traffic between servers and clients. This means that rather than sending each and every line of code individually, just the call to execute the procedure is sent over a network.
- 4) Network Efficiency: To achieve the intended outcome, stored procedures can process vast amounts of data and include numerous commands. We can avoid pulling query results over the network for a client program to process by keeping all programming logic on the server.
- 5) Encapsulate Business Logic: Numerous clients and calling programs can be handled by databases. However, it is typical for a database to process requests from both built-in apps like Excel and custom apps like C#. Rather than depending on every program version to implement and correctly execute the rules, it makes sense to run the business logic on the server in stored procedures to guarantee that critical business logic stays consistent. Program consistency is aided by this, as they use the same logic. Additionally, this indicates that the data quality is higher.
- 6) Maintainable: Modifications are much simpler when complex programming logic and business rules are centralized into stored procedures. All you need to do is modify the stored procedure instead of searching through each application to find the appropriate places to make modifications. After the modification is saved and compiled, every calling program gains from it. Once more, this can aid in improving the caliber of your database.

5.4. Relevance of Stored Procedure in Modern Software Development Process

- 1) Performance: Procedure calls are rapid and effective because stored procedures are compiled only once and saved in executable form. Users automatically share and cache executable code. As a result, less memory and invocation overhead are needed. Furthermore, you can utilize the server's computing resources by utilizing stored procedures. Computation-bound processes, for instance, can be moved from the client to the server, where they will run more quickly. Similarly, callback

functions from SQL statements improve system performance by allowing the server to carry out application logic.

- 2) **Productivity and Ease of Use:** You can reduce duplication of code and boost productivity by building applications around a shared set of stored procedures. Additionally, stored procedures allow you to expand the RDBMS's functionality. For instance, stored functions that are called from SQL statements increase SQL's power.
- 3) **Scalability:** Scalability is increased by stored procedures because they separate server-side application processing. Furthermore, automatic tracking of dependencies for stored procedures facilitates the creation of applications that are scalable. With the Multi-Threaded Server (MTS) shared memory capabilities, Oracle8i can accommodate over 10,000 concurrent users on a single node. You can multiplex Net8 connections with the Net8 Connection Manager to increase scalability.
- 4) **Maintainability:** A stored procedure can be used confidently in a variety of applications once it has been validated. Only the procedure is impacted by changes to its definition; the applications that call it are unaffected. This makes enhancement and maintenance easier. Furthermore, it is simpler to maintain a procedure on the server than it is to maintain copies on different client computers.
- 5) **Interoperability:** Java is fully compliant with the Java Language Specification and provides all the benefits of an object-oriented, general-purpose programming language within the context of RDBMSs. Java offers complete access to Oracle data, just like PL/SQL, so any PL/SQL procedure can be written in Java..
- 6) **Security:** One way to limit user access to Oracle data is to restrict data manipulation to stored procedures that run with the user's privileges. One possible scenario is to grant authorization for a process to modify a database table, but to prevent access to the table itself.
- 7) **Replication:** Stored procedures can be copied or replicated from one Oracle8i database to another using Oracle Advanced Replication. They are perfect for putting in place a centralized set of business rules because of this feature. Once written, the stored procedures are copied and sent to all of the company's work groups and branch offices. This allows policies to be updated centrally rather than on separate servers.

6. Conclusion

Ultimately, we can conclude that a stored procedure improves the likelihood of code and execution plan reuse while simultaneously improving database performance by lowering network traffic and sending less data over the network. Automation during design ensures that all procedures generated have the same structure and naming conventions, which speeds up coding. The authors created a set of design-time

stored procedures that produce run-time stored procedures in an attempt to increase their coding efficiency in a big SQL project. They have since utilized these procedures in numerous projects. One of the key advantages of utilizing MySQL's stored procedures syntax is that it offers an interactive, user-friendly software that encourages open communication between visitors and generates content that is truly dynamic and adaptable. Compared to other database programming languages, stored procedures are much simpler to understand and can be readily tailored to meet the unique business requirements of clients. Consequently, it can be concluded that because of the great benefits of this technology, software engineers can use stored procedures when developing software.

Abbreviations

SQL	Structured Query Language
RDMS	Relational Database Management System
MTS	Multi-Threaded Server
PHP	Hypertext Preprocessor
CMS	Content management systems
DB2	Database 2
GUI	Graphical User Interface

Author Contributions

Omogbhemhe Mike Izah: Conceptualization, Investigation, Methodology Supervision, Writing – original draft
Onyijen Ojei Harrison: Writing – review & editing

Conflict of Interest

The authors declare no conflicts of interest.

References

- [1] Michael, B. and William, P. (2018). Object-Oriented Modeling and Design for Database Applications". Upper Saddle River, NJ: Prentice Hall, 2018.
- [2] Bob, B., Niels, B., and Dan, S. (2014). A First Look at SQL Server 2005 for Developers". Boston: Addison-Wesley, 2014.
- [3] Thomas, M. and Schmid, E. (2009). Interactive Whiteboards for Education: Theory, research, and practice". Hershey, PA: IGI Global. p. 1700.
- [4] Grove, R. (2009). Web Based Application Development. Boston: Jones & Bartlett Learning. p. 218. ISBN 0763759406.
- [5] Erikadoyle, O. (2018). Microsoft Edge Developer Tools-Microsoft Edge [Development.docs.microsoft.com](https://developer.microsoft.com/en-US/microsoft-edge/devtools)
- [6] Apple, (2018). Tools - Safari - Apple [Developer.developer.apple.com](https://developer.apple.com)

-
- [7] Bright Hub (2018). Growing Demand for Web Developers. Bright Hub.
- [8] Techopedia (2018). What is Web Development?-Definition from Techopedia. Techopedia.com
- [9] Campbell, J. (2017). Web Design: Introductory Cengage Learning. p. 27.
- [10] Bureau of Labor Statistics, U.S. Department of Labor.(2016). Information Security Analysts, Web Developers, and Computer Network Architects. Occupational Outlook Handbook, 2012-13 Edition.
- [11] McCormick, L. (2018). Introduction to Web Developer Tools (Windows). msdn.microsoft.com Retrieved 2018-09-06.
- [12] Devworks (2018). Latest Application Development and Mobile Web Development- Application Development, Application Trends.devworks.thinkdigit.com
- [13] Jos, W. and Anneke, K. (2015). The Object Constraint Language. Boston: Addison- Wesley, 2011.
- [14] Google Chrome (2018). Chrome Development Tools Overview-Google Chrome. developer.chrome.com
- [15] Date, C. J. (2015). Relational Database: Writings 1991-1994. Boston: Addison-Wesley, 2015.
- [16] Anley, C. (2016). Advanced SQL Injection. [http://www.nextgenss.com/papers/more advanced SQL injection.pdf](http://www.nextgenss.com/papers/more_advanced_SQL_injection.pdf) White Paper.