UNIT 04: DATABASE DESIGN & DEVELOPMENT

Assignment 2 Brief

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| **Programme Title** | Pearson BTEC Level 5 Higher National Diploma in Computing |
| Student Name/ID Number |  |
| Unit Number and Title | 04: Database Design & Development |
| Academic Year |  |
| Unit Tutor |  |
| Assignment Title | Implement, Test, and build project documents for businesses/organizations |
| Issue Date |  |
| Submission Date |  |
| Submission Format | |
| *Format:* This submission will have 3 components   1. Written report: The submission is in the form of an individual written report. This should be written in a concise, use font Calibri size 12, set number of the pages and use multiple line spacing at 1.3. Margins must be: left: 2.5 cm; right: 2 cm; top: 2 cm and bottom: 2 cm. You are required to make use of headings, paragraphs and subsections as appropriate, and all work must be supported with research and referenced using the Harvard referencing system. Please also provide a bibliography using the Harvard referencing system. 2. Implemented System (Software): The student should submit a system developed using an IDE, database. A finished functional relational database. Final working version in a format suitable to be run and assessed for functionality – this could be as project/solution files or final compiled executable. A full Testing document. Technical and User instructional videos/Document for successful use of the database. Use appropriate software and submit in a suitable format. A written report to evaluate the database and its implementation. 3. The recommended word limit is 1,500–2,000 words, although you will not be penalised for exceeding the total word limit.   *Submission:* Students are compulsory to submit the assignment in due date and in a way requested by the Tutors. The form of submission will be a soft copy in PDF posted on corresponding course of <http://cms.btec.edu.vn/> | |
| Unit Learning Outcomes | |
| **LO2**. Develop a fully-functional relational database system, based on an existing system design  **LO3**. Test the system against user and system requirements  **LO4**. Produce technical and user documentation. | |
| Transferable skills and competencies developed | |
| Computing-related cognitive skills:   * Demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to computing and computer applications * Use such knowledge and understanding in the modelling and design of computer-based systems for the purposes of comprehension, communication, prediction and the understanding of trade-offs * Recognise and analyse criteria and specifications appropriate to specific problems, and plan strategies for their solutions * Critical evaluation and testing: analyse the extent to which a computer-based system meets the criteria defined for its current use and future development * Methods and tools: deploy appropriate theory, practices and tools for the design, implementation and evaluation of computer-based systems.   Computing-related practical skills:   * The ability to specify, design and construct reliable, secure and usable computer-based systems * The ability to evaluate systems in terms of quality attributes and possible trade-offs presented within the given problem * The ability to deploy effectively the tools used for the construction and documentation of computer applications, with particular emphasis on understanding the whole process involved in the effective deployment of computers to solve practical problems * The ability to critically evaluate and analyse complex problems, including those with incomplete information, and devise appropriate solutions, within the constraints of a budget   Generic skills for employability   * Intellectual skills: critical thinking; making a case; numeracy and literacy * Self-management: self-awareness and reflection; goal setting and action planning * Independence and adaptability; acting on initiative; innovation and creativity * Contextual awareness, e.g. the ability to understand and meet the needs of individuals, business and the community, and to understand how workplaces and organisations are governed. | |
| **Vocational scenario** | |
| * As a Database Developer, you have been tasked with designing and building the new system for a business/organization. Your role includes designing, developing and implementing database systems based on customer requirements. You are also responsible for optimising the database system for performance efficiency, as well as testing and troubleshooting and performing bug fixes. * The primary goal of implementing a new system is to enable students to apply their acquired knowledge and skills to real-world scenarios while honing their analytical, design, programming, and problem-solving abilities. Additionally, the system must meet the specific requirements of the chosen business or organization, offering practical and feasible operational benefits. * Student system requirements, specifically:   **Software Requirements Analysis for Store X's Sales Management System**  **I. General Requirements**   * The software is developed for Store X to support effective sales management. * The software is developed on the .Net Framework 4.5 (C#) or higher platform, using SQL Server 2012 or higher as the database management system. * The software ensures high security with clear access rights for each user group.   **II. Functional Requirements**  **1. Product Management**   * Provide a full list of products with detailed information (product code, product name, selling price, inventory quantity, etc.) * Support functions: add new, edit, delete, search products. * Filter products by criteria (product code, product name, selling price, etc.) * Manage product images (add, edit, delete). * Update inventory quantity when importing or selling goods.   **2. Employee Management**   * Provide a full list of employees with detailed information (employee code, employee name, position, authority, etc.) * Support functions: add new, edit, delete, search employees. * Manage user accounts (username, password) * Employees must change their password upon first login * Clear access rights for each group of employees (admin, sales, warehouse)   **3. Customer Management**   * Provide a full list of customers with detailed information (customer code, customer name, phone number, address, etc.) * Support functions: add new, edit, delete, search customers. * Store customer purchase history   **4. Statistics**   * Statistic the number of products imported by product code * Statistic sales revenue by time (day, month, year) * Statistic profit by product, employee   **III. Security Requirements**   * All users must log in with a username and password to use the software. * Clear access rights for each user group:   + Admin group: has full access and usage rights to all functions of the software.   + Sales staff group: has access and usage rights to sales-related functions (such as product management, customer management, invoicing, etc.).   + Warehouse staff group: has access and usage rights to warehouse-related functions (such as inventory management, export, etc.).   + Employees are not allowed to add or delete other employees, or create and view statistics (except for the admin group). * Enhance system security by encrypting passwords, storing data securely, and regularly updating security patches. | |
| Assignment activity and guidance | |
| **Activities 1** - Develop the database system with evidence of user interface, output and data validations, and querying across multiple tables.   * Develop a user interface (UI) for users to interact with the database (e.g., forms, menus). * Design outputs (*reports, visualizations*) to present data to users in a meaningful way. * Implement data validation rules to ensure data accuracy and consistency during input. * Develop queries that can retrieve and manipulate data across multiple tables.   Activities 2 - Implement a query language into the relational database system   * Assess the suitability of the T-SQL query language for sales software applications. * Implement data connection and execute queries to fulfill software functionalities.   **Activities 3 -** Implement a fullyfunctional database system, which includes system security and database maintenance.   * System deployment requires each member to log in before using the system. * The system implements secure password encryption during login and maintains clear authorization levels based on user roles. * Develop a comprehensive backup and recovery plan to ensure data integrity during system failures. * Schedule regular maintenance tasks to optimize performance and proactively address potential issues.   Activities 4 - Assess whether meaningful data has been extracted through the use of query tools to produce appropriate management information.   * Through software functions to collect data. From there, create a comparison table between the current data and the data that needs to be collected from the requesting user. * Assess whether the level of compatibility between current data and the data that needs to be collected by the requesting user.   Activities 5 - Test the system against user and system requirements.   * Identify elements of the system that need to be tested. Consider data that should be used to fully test the system. * Match tests against user and system requirements. * Test procedures to be used: test plans, test models, e.g. structural testing, functional testing; testing documentation.   Activities 6 - Assess the effectiveness of the testing, including an explanation of the choice of test data used.   * Analyse test coverage to identify areas where user interactions are not adequately tested. Example: You have a function for calculating shipping costs based on weight and location. Test coverage shows that only basic weight values are tested, but not edge cases (e.g., very heavy items) or specific locations. * Assess the effectiveness of the chosen test data in uncovering potential issues within the system. Example: Login tests only use valid usernames and passwords. There should be additional tests for invalid inputs (e.g., empty username, incorrect password format) to simulate real-world user behavior. * Recommend improvements to the testing strategy for future iterations, focusing on areas with low coverage or insufficient data variation. Example: For the shipping cost calculation, create test cases with very high weight values and invalid location formats to ensure proper handling of edge cases.   Activities 7 - Create Evaluate the effectiveness of the database solution in relation to user and system requirements and suggest improvements.   * Compare the final system to initial user and system requirements (Acceptance Testing): * This is a formal evaluation stage where stakeholders (users, developers, and managers) come together to assess if the final system fulfills the original goals outlined in the user and system requirements documents. * Ex: Let's say a user requirement specified the ability to generate reports with various data filters. During acceptance testing, users would verify if the system offers report generation functionality with the promised filter options. * Assess the overall effectiveness of the database solution (User Satisfaction Survey): * This involves gathering user feedback on their experience with the completed system. This can be done through surveys, interviews, or focus groups. The goal is to understand how well the system addresses user needs and how satisfied users are with its functionalities. * Ex: A user satisfaction survey could ask questions about the ease of use, efficiency of data retrieval, and overall usefulness of the system for completing tasks. Analyzing the feedback helps identify areas where the system might need adjustments to better serve user needs. * Evaluate the system's performance, security, and maintainability (Performance Testing & Security Audit): * This stage involves a comprehensive evaluation of the system across multiple aspects.   + Similar to the process described earlier, you'd measure factors like data retrieval speed, response time, and system stability under various load conditions (e.g., many users accessing simultaneously).   + A security audit involves a systematic review of the system's security measures (e.g., user authentication, data encryption) to identify potential vulnerabilities and ensure adequate protection against unauthorized access or data breaches.   + Maintainability evaluation focuses on how easily the system can be modified, updated, and debugged in the future. Factors like code clarity, documentation quality, and modular design all contribute to good maintainability. * Ex: Performance testing might reveal a bottleneck in data processing during peak system usage. A security audit could identify a weak password policy that needs strengthening. Evaluating maintainability might highlight poorly documented code sections that could hinder future updates. * Identify areas for improvement based on the evaluation results: * After analyzing the results from acceptance testing, user satisfaction surveys, and performance/security/maintainability evaluations, you'd identify areas where the system falls short of expectations. These could be limitations in functionality, usability issues, performance bottlenecks, or security vulnerabilities. * Recommend specific enhancements for future development (System Improvement Roadmap): * Based on the identified areas for improvement, you'd create a roadmap for future system development. This roadmap would prioritize enhancement suggestions and outline a plan for implementing them in future versions of the database system. * Ex: Improvement recommendations could involve adding new reporting features, improving search functionalities based on user feedback, or implementing performance optimizations identified during testing.   Activities 8 - Produce technical and user documentation for a fully-functional system, including data flow diagrams and flowcharts, describing how the system works.   * Produce system architecture diagrams   + Database schema details   + Query documentation   + Programming code documentation (if applicable) * Produce user documentation for end-users:   + User manuals with clear instructions on how to use the system   + Tutorials and guides for specific functionalities   + FAQs (Frequently Asked Questions) to address common user issues   Activities 9 - Evaluate the database in terms of improvements needed to ensure the continued effectiveness of the system.   * Monitor system usage and user feedback to identify potential issues. * Analyze database performance metrics (e.g., query execution times, storage utilization). * Evaluate the effectiveness of data security measures. * Assess the overall maintainability of the system based on documentation and code clarity. * Identify areas for improvement based on the evaluation results. * Recommend changes to the database system or documentation to ensure its continued effectiveness. | |
| Recommended resources  *Please note that the resources listed are examples for you to use as a starting point in your research – the list is not definitive.* | |
| **Weblinks:**   1. https://support.microsoft.com/en-GB (2022) Database design basics [online] Available at: https://support.microsoft.com/en-us/office/database-design-basics-eb2159cf-1e30-401a8084-bd4f9c9ca1f5 [Accessed 1 August 2022] 2. https://www.guru99.com/ (2022) Database (Data) Testing Tutorial with Sample Test Cases [online] Available at: https://www.guru99.com/data-testing.html [Accessed 1 August 2022] 3. https://www.guru99.com/ (2022) Database Design in DBMS Tutorial: Learn Data Modeling [online] Available at: https://www.guru99.com/database-design.html [Accessed 1 August 2022] 4. https://www.integrate.io/ (2021) Complete Guide to Database Schema Design [online] Available at: https://www.integrate.io/blog/complete-guide-to-database-schema-design-guide/ [Accessed 1 August 2022] 5. https://www.lucidchart.com/pages/ (2022) Database Structure and Design Tutorial [online] Available at: https://www.lucidchart.com/pages/database-diagram/database-design [Accessed 1 August 2022] 6. https://www.softwaretestinghelp.com/ (2022) Database Testing Complete Guide (Why, What, And How To Test Data) [online] Available at: https://www.softwaretestinghelp.com/databasetesting-process/ [Accessed 1 August 2022]   **Journal articles:**   1. Batra, D. & Davis, J. (1992). Conceptual data modelling in database design: similarities and differences between expert and novice designers. International Journal of Man-Machine Studies, Volume 37, Issue 1, 1992, pp. 83-101. https://doi.org/10.1016/0020-7373(92)90092-Y. 2. Gunjal, B. (2003). Database System: Concepts and Design. Proceedings of 24th IASLIC–SIG2003. 3. Kaur, T. & Singh B. (2003). Testing of Databases. IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 6. ISSN 2348 – 7968 4. Kaur, Taranpreet & Sehra, Sumeet Kaur. (2015). Designing and Development of Database Testing Tool. International Journal of Computer Applications (0975 – 8887) Volume 120 – No.19. 14. doi:10.5120/21334-4330. 5. Kraleva, Radoslava & Kralev, Velin & Sinyagina, Nina & Koprinkova-Hristova, Petia & Bocheva, Nadejda. (2018). Design and Analysis of a Relational Database for Behavioral Experiments Data Processing. International Journal of Online Engineering (iJOE). 14. 117. doi:10.3991/ijoe.v14i02.7988. 6. Letkowski, J. (2015). Doing database design with MySQL. Journal of Technology Research. Volume 6.   **Reading:**   1. Captain, F. (2013) Six-Step Relational Database Design™: A step by step approach to relational database design and development, 2nd edn, CreateSpace Independent Publishing Platform 2. Hernandez, M. (2003) Database Design for Mere Mortals: A Hands-On Guide to Relational Database Design, 2nd edn, Addison Wesley 3. Stephens, R. (2008) Begin Database Design W / WS (Wrox Programmer to Programmer), 1st edn, Jossey-Bass   **HN Global:**   1. HN Global HN Global (2021) Reading Lists. Available at: https://hnglobal.highernationals.com/learning-zone/reading-lists 2. HN Global (2021) Student Resource Library. Available at: https://hnglobal.highernationals.com/subjects/resource-libraries 3. HN Global (2021) Textbooks. Available at: https://hnglobal.highernationals.com/textbooks | |

Learning Outcomes and Assessment Criteria

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| Pass | Merit | Distinction |
| **LO2**. Develop a fully-functional relational database system, based on an existing system design | | **LO2 & LO3**  **D2**. Evaluate the effectiveness of the database solution in relation to user and system requirements and suggest improvements. |
| **P2**. Develop the database system with evidence of user interface, output and data validations, and querying across multiple tables.  **P3**. Implement a query language into the relational database system. | **M2**. Implement a fullyfunctional database system, which includes system security and database maintenance.  **M3**. Assess whether meaningful data has been extracted through the use of query tools to produce appropriate management information. |
| **LO3**. Test the system against user and system requirements. | |
| **P4**. Test the system against user and system requirements. | **M4**. Assess the effectiveness of the testing, including an explanation of the choice of test data used. |
| **LO4** Produce technical and user documentation. | | **D3**. Evaluate the database in terms of improvements needed to ensure the continued effectiveness of the system. |
| **P5**. Produce technical and user documentation. | **M5**. Produce technical and user documentation for a fully-functional system, including data flow diagrams and flowcharts, describing how the system works. |

**1. Admin: Toàn quyền**

* **Mô tả quyền hạn:** Admin có toàn quyền quản lý và truy cập tất cả các bảng và chức năng trong hệ thống.
* **Quyền tương ứng:**
  + **Bảng staff:** Quản lý nhân viên (thêm, sửa, xóa, xem, phân quyền).
  + **Bảng product:** Quản lý sản phẩm (thêm, sửa, xóa, xem).
  + **Bảng customer:** Quản lý khách hàng (thêm, sửa, xóa, xem).
  + **Bảng orders:** Quản lý đơn hàng (xem chi tiết, sửa, xóa nếu cần).
  + **Bảng order\_details:** Xem và kiểm tra chi tiết đơn hàng.
  + **Quyền truy cập đặc biệt:**
    - Xem báo cáo thống kê (doanh thu, tồn kho, lãi lỗ).
    - Thay đổi thiết lập hệ thống hoặc cấp thêm quyền cho nhân viên khác.

**2. Nhân viên bán hàng: Quản lý bán hàng, khách hàng**

* **Mô tả quyền hạn:** Nhân viên bán hàng tập trung vào các tác vụ liên quan đến giao dịch và quản lý khách hàng.
* **Quyền tương ứng:**
  + **Bảng product:** Xem thông tin sản phẩm để tư vấn khách hàng (không được chỉnh sửa).
  + **Bảng customer:** Quản lý khách hàng (thêm, sửa, tìm kiếm, lưu thông tin).
  + **Bảng orders:** Quản lý đơn hàng (tạo mới, chỉnh sửa các đơn hàng do họ thực hiện).
  + **Bảng order\_details:** Xem chi tiết sản phẩm trong đơn hàng.

**3. Nhân viên kho: Quản lý kho**

* **Mô tả quyền hạn:** Nhân viên kho tập trung vào việc quản lý tồn kho, cập nhật số lượng sản phẩm khi có nhập hoặc xuất kho.
* **Quyền tương ứng:**
  + **Bảng product:** Quản lý sản phẩm (thêm, sửa, xóa số lượng tồn kho).
  + **Bảng order\_details:** Xem thông tin chi tiết đơn hàng để theo dõi sản phẩm đã được bán ra hoặc cần nhập thêm vào kho.
  + **Không có quyền trên bảng customer, orders, và staff** (để đảm bảo không can thiệp vào chức năng bán hàng hoặc quản lý nhân sự).