1. *Compare and contrast different approaches to database design (e.g., entity relationship modelling, normalisation, etc.) and briefly justify the approach you have used for answering Part 1 (A).*

The development of the database design can be approached in different ways, and this will depend on the environmental characteristics in which the database is to be built and utilized. Major distinction is based on the way database designer addresses requirements: creating top-down concept that proceeds to drilling into further details, or using the available details to create major components of the database so ensuing via bottom-up approach.

Setting a top-down design method will commence from general and move to the specific. The initial point is usually a high-level requirement set that determines the overall database scope. The concept focuses on entities as building blocks of the database and works on establishing their interaction / dependency and attributes for each one of them. On the other hand, the bottom-up approach uses the details and specific data points in the environment. The process groups them into meaningful sets. Its direction is opposite from top-down approach, thus using the distinct items as building blocks that are continuously clustered into larger and larger related entities.

Top-down approach emphasises an initial focus on higher-level concepts, such as collection of things, distinctive entities, relationships linking them, etc. Their characteristics are clearly defined and listed, leading to the adoption of attributes that are then displayed in the database tables. The overall process is clearly demarcated into the design phases, starting from the conceptual work that pinpoints the main components of the database without specifying entity details, logical model that expands on the database relationships and data domains, before design focus moves to the physical concept of the database structure. At each point, data concept requires further scrutiny and demands continuous support and feedback by end users. The approach is heavily dependent on users’ confirmation of the proposed concept thus often adding cost to the design work. However, this ensures that at later stages of the design, the possibility for major database changes are diminished. The usage of the visual tools and diagrams (e.g. ER diagrams) help users to comprehend the structure and interactions of the database components. The visualisation and conceptual model becomes virtual view of the database sets in the centralised, but even more importantly in distributed (non-centralised) environments.

With bottom-up methodology, designing process identifies basic data items and consequently groups them into data sets. The process firstly addresses attributes of the items that through grouping become entities. Starting a bottom-up plan often requires analysis of the available data, reports and printouts, receipts and invoices, etc. The usual methodology employed in the bottom-up approach is Normalisation. Normalisation process ensures removal of data repetition and redundancy, and also creates correct relationship links between tables. Through its levelled process (1NF to maximal 5NF), design gradually ensures streamlined tables that reject duplicate attributes, delivers the creation of child tables and associations through appropriate foreign keys and primary key relation to the rest of attributes in the table.

The design of the NorthChem database proceeded through top-down approach. The conceptual schema resulting from the information provided in the appendix and clarifying the business environment of the company was further backed by evaluation of the reporting structure available within the organisation. The decision to conceptualise the initial structure of the database via a) organisational description and b) ER diagram was influenced by advantages of the top-down approach. The strength of the methodology is in situations where database system is created from scratch. It allows designer to confirm the database scope at early stages and specify requirements without investing time into implementation needs. The relationships between entities ensure that there is a clear understanding of how amendments to any entity impact the rest of the design. Furthermore, due to project requirements not implementing incremental and modular delivery of the product, the concept could afford to remain centralised and tightly controlled. If business environment obliged that critical parts of the database are to be delivered as priorities, such situation would see global top-down methodology relying on heavy user involvement as cumbersome. Yet the project targets were to analyse the business realities and transform them into functional database, something suitably tackled via ER conceptual-logical-physical incremental design. Normalisation as representative of bottom-up approach is often seen suitable when objective of the design is to integrate existing database systems or execute changes within already-existing database system. It targets data and its dependency and with it, is more inclined to be initiated by existing system and not through business needs. Yet enforcement of normalisation process is a key for effective database design that ensures no data redundancy. In the NorthChem case, normalisation was implemented as additional, in-parallel check to conceptual / logical design stemming from ER diagram creation and its mapping to relations. This approach ensured that with top-down design, the database scope and its entities’ relations are clearly marked, while furthermore data efficiency was scrutinised through rigorous normalisation form process.

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