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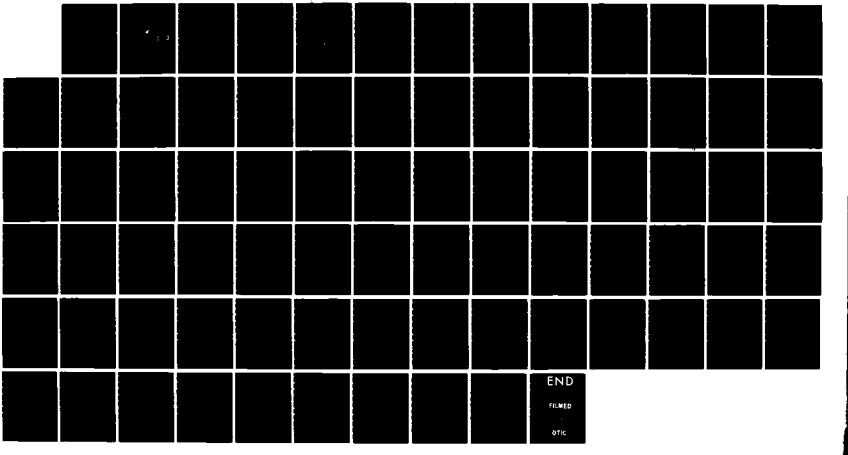

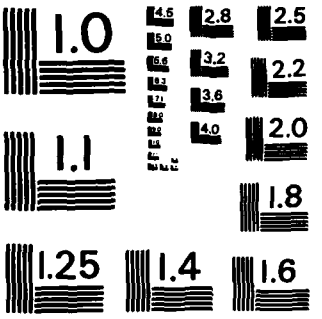

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NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

DATABASE DESIGN FOR PERSONNEL MANAGEMENT
IN REPUBLIC OF KOREA ARMY

by

Kwang Soo Baek

June 1984

Thesis Advisor: Neil C. Rowe

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Database Design for Personnel Management in Republic of Korea Army

by

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ABSTRACT

The decision to implement a database is motivated by the need to share data among a variety of diverse applications and to integrate data for supporting more sophisticated applications. Both of these requirements complicate the already difficult task of providing safe and efficient access to computerized data. The designer should select an appropriate database model among alternative database models. This thesis analyses various aspects of personnel management in the ROK Army and determines relationships between polices and data item relationships. Further, from the derived model, the data item relationships, database design theories, and database relationships with these 3 components a personnel management system is designed. In order to fully implement these recommendations, hardware must be chosen, and a significant volume of data must be loaded.

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I. INTRODUCTION

One of the factors which limits human performance is the limited capacity of human memory. Memory is commonly considered to be divided into two parts: short term and long term. Short term memory is compared to the primary storage of a computer. It is characterized by rapid access and volatility. Long term memory is compared to the secondary storage, in that it is more permanent in nature than short term memory and it needs more time and effort to record and to retrieve information from.

The basic idea of the database for doing personnel management is to provide means of extension, to both short term and long term memory. Long term memory should help users to easily store information which they would have difficultly to memorize. Short term memory should provide users with a method to reduce the burden upon its capacity. Instead of having to remember a piece of information, the user uses the key as input to retrieve the desired information from the personnel database system. Retrieved information need not to be memorized since it is easy to obtain.

A good personnel database system should provide its users with means for storing information and retrieving it, that are faster and more efficient, for a variety of diverse applications. Furthermore, a personnel database system reduces the manual labor and the expenses of National Defense.

To achieve these, a database, for doing personnel management in Republic of Korea's (ROK) Army will be designed. Chapter II addresses the background, that relates to the database design for ROK Army's personnel management, the end-user requirement and application system requirement,

and introduce the research direction and objectives of this thesis. Chapter III selects an appropriate database model, discusses the characteristics of the selected model, and introduces techniques for its designing. Chapter IV designs the personnel database by process of database design, and discusses special subjects. Finally, chapter V presents conclusions and recommendations for this thesis.

II. BACKGROUND

A. OVERVIEW

Often today, information needed in an important decision making process is somewhere in an organization but is not available to the personnel decision makers when they need it. Many personnel managers have not recognized that a better system is needed for information retrieval. With the use of a computerized personnel database, personnel decision makers can get far better information than was possible prior to computers, and the information will be much more timely.

Personnel managers need to adopt more accurate, complex and wide variety of information systems for the decision making process. It is impossible to obtain all information needed through manual or file systems when the information is needed within a relatively short periods of time.

Personnel decision making is a never ending process, and extends much further to include the possibilities for job redesign, counseling and guidance, the removal of organizational constraints, and the design of specialized training or development programs. Thus mapping the individuality of persons is necessary not only for personnel selection and placement, but for all other personnel programs as well. People differ greatly from one another; this fact does not carry implications about the static or dynamic nature of human abilities, needs, motives, and behavioral tendencies. Therefore, many personnel managers are becoming interested in PERSONNEL DATABASE SYSTEMS.

So as to understand end-user requirements and current applications of systems which provide limited kinds of

information, the description of end-user requirements is provided in section B. Section C summarizes the problem of current application of personnel systems and section D addresses the direction and objective of this thesis.

B. END-USER REQUIREMENTS

It should be obvious that the personnel function encompasses more than first imagined. Personnel Management is indeed concerned with individual personnel problems and also performs to support the achievement of military objectives. In other words, personnel management is basically concerned with the most effective application of military manpower as a means of reaching military objectives. [Ref. 1]

To achieve objectives set by the ROK Army, the Personnel Department at ROK Army HQ supports three groups: Personnel Planning, Personnel Administration, and Welfare [Ref. 2].

1. Personnel Planning

The Personnel Planning group should compare the present with future needs and goals, as well as make plans of action for the achievement of these objectives. Plans of action should include the long range, mid range and short range future. These plans must be carefully determined by using large, broad, and relevant factors of internal and external nature. The factors will help to set up a flexible and adjustable plan, and help assure that the direction of change in the ROK Army is straightforward and that it is attained. [Ref. 3]

By the variety of relevant elements, the personnel manager should have better information with which to decide the number of procurements from and retirements to civilian life, the number of personnel to be promoted to each rank, etc..

2. Personnel Administration

The fund of data on any person's background, career, interests, and other characteristics is potentially tremendous. The best basis available for predicting any person's future behavior is his current and past performance. The more the personnel manager knows about the individual officer, the better he can assign personnel, main functions, talents, and interests to his position needs, and the better his job/mission can be modified to fit his skill or needs. Obtaining a broad fund of relatively reliable objective data about any person, and using it as a means of knowing him better, is a derivation for reaching very important results. [Ref. 3]

Efficient procurement has to be made based on the information about the candidate's education, qualification, experience, skills, etc. Effective education and training is also important. It is not possible to plan education and training programs for each individual entrant into ROK Army. It is necessary to plan for groups of persons who are promoted at the same time to a higher rank, and for ROK Army candidates. Education and training data will be accumulated with other types of data and used to determine special abilities. Assignment can then be made to make optimum use of the person's abilities. It involves the recognition of unused abilities and development of latent skills to the degree required to meet the job needs. Promotion is also an important tool in the motivation of personnel. Since the number to be promoted at senior rank is known, the individual's abilities at his present rank is of high interest to both the promoting person and the member. [Ref. 4]

After candidates have been selected, their data can be synthesized and maintained so that it can be used at any time for transfer, new assignment, promotions, etc..

Personnel separation occurs when the person already has a new job, he has been attracted away from ROK Army, or he reaches the age limitation, rank limitation or maximum public service duration. The collected data about the person who is terminating must be complete in order for the personnel management system to give leads to other opportunities and fields.

3. Welfare

Managers in large or small unionized groups should achieve their goals more often than managers of nonunionized groups. The manager becomes more welfare conscious because of the threat of unionization. The welfare does appear adequate, but many intangible welfare benefits are given by attitude and approval. A more meaningful expression of welfare is that managers hope to carry out military objectives in full recognition of the importance of the worth of individuals taking part in the objectives.

Good salary and kind treatment are a means for welfare. Kind treatment includes such thing as mental and physical health, physical work and recreation, reward, personal services, leave, medical insurance, etc. These are also important for military morale. [Ref. 5]

C. APPLICATION SYSTEM REQUIREMENTS

Several computer centers were installed by the ROK Army. There are four types of computer centers. The type of computer center is determined by the purpose of use; education, personnel, logistics and intelligence. All the computer centers are directly controlled by the Staff of ROK Army HQ.. Computer centers for personnel management are located in same city as military forces. They each have different hardware systems. Applications with file systems

have been individually designed, developed and operated by the different operating systems.

They use several languages, COBOL, Assembly language, and PL/1. 83% of total applications' software is COBOL, 14% is Assembly, and 3% is PL/1. Assembly language tends not to be used by the programmer and the percentage of COBOL will be becoming higher and higher. Some application's systems are operated daily, weekly, monthly, and yearly. The files of the applications consist of indexed sequential access method (ISAM) or sequentially fixed_length records.

At present, many files of records without database techniques are used in ROK Army. These files contain limited data items that personnel managers require. Several file systems provide information to be used for doing personnel management by spooling, time sharing, and virtual techniques.

In order to provide personnel managers who want to use information with it as soon as possible, ROK Army personnel systems must have a capability to provide reliable information with efficient processing. This is complicated by the fact that the application systems use several different file system.

The problems of the file system are as follows [Ref. 6]. First, there is high level of redundancy. There are several of the same kind of data items among Personnel System, Pay Roll System, PX System, Military Medical System, etc.. These common data items are updated independently in each file system. It is very hard to maintain the accuracy of common data item on different file systems. Furthermore, the number of files for application will be more and more.

Second, the file systems are inflexible. Requests for information from a wide range of users are impossible to answer within given time. Even though the file systems contain data items for producing information to be provided,

it can not be provided relating to those data. The data can not be processed without reconstruction. Although millions have been paid for computer system, the information can not be obtained when it is needed.

Third, it can be expensive to make changes to a file system. According to request of users, a file system can be changed or modified. Sometimes the modifications are difficult because the applications were not adequately documented for other programers. As time goes on, this problem becomes worse because more programs are created or modified. And, whenever a file is changed, programs for that file system have to be changed or modified.

Additionally, individually developed file systems and non-standardized hardware systems do not help to achieve data-communications with each other.

Recently, the higher manager recognizes the need for the standardization of hardware and the unification of application softwares. One department, Software Developing Department, that directly manages to develop application systems and programs was found.

D. RESEARCH DIRECTION/OBJECT

It could be clearly seen that the personnel management system must have a great deal of relevant information so as to proceed efficiently and effectively through all of the aspects involved. This supporting information must be reliable and it must be accurate. This can be accomplished only if the relevant data is also accurate and contemporary. In order to reach the needs of all of the personnel functions, management must also gather historical data about rank, career, education, etc..

It can also be seen that one personnel function may need the same information as another function. For example, the

education and training function needs information about the educational history of a person so that it can be used to assign that person. This same information would again be used when personnel will be separated from ROK Army, to help him find a new job.

As time goes on, personnel managers need more accurate and increased information to do their decision making quickly. Information required by the personnel managers is sometimes too complex and considerable time is required to prepare it. Different personnel managers want to be supported with different information. From time to time, it is impossible to answer their requests with file systems. Several personnel file systems which are operated in ROK Army computer centers can be replaced by one personnel database system at one computer center. The new database system for doing ROK Army's personnel management has to be designed to operate with minimum man hours, and have the capability to provide decision makers with a broad variety of personnel information. Therefore, with a new personnel Database System, costs and man hours could be reduced.

The direction and objective of this thesis will show how the conception of database design is applied in the near future for doing personnel management in the ROK Army.

III. DATABASE MODEL SELECTION AND THEORIES FOR DESIGNING

A. OVERVIEW

A database model is a logical organization of data. And, it is important design tool to understand the local organization data. To design the database system, the designer must select an adequate database model to achieve their objectives among many kinds of database model. To select a useful database model among these, how many kinds of criteria should be considered and how to adopt those criteria for candidate model? After selection a adequate model, what principles are applied to build a effective and efficient database system? And, what are the techniques to reduce memory space? The eventual objectives of database systems organization are to develop applications easier, faster, more flexible, and more economical. These objectives must be achieved by the database system designers.

For these questions, the first part of this chapter describes how to select a database model and shows briefly the characteristics of the selected model. The remaining part presents the theories (techniques) for effective and efficient database system designing.

B. COMPARISONS OF DATABASE MODEL AND SELECTION

There are many types of data models. These include the relational model, the network model, the hierarchical model, the entity-relationship model, the binary model, and the semantic data model. Foremost among this list are the relational, network, and hierarchical models. [Ref. 7, 8, 9] Indeed, a preponderance of the commercial database systems in use today are based upon one of these three. However,

which of these data models is better for doing ROK Army personnel management? This is a question we shall attempt to answer as we evaluate them according to the criterion below.

To select one database model among these, the main standard of comparisons to achieve the objectives of a database system organization are as following [Ref. 10, 11] :

1. Ease of use. It requires less time for users to become familiar with database system. The principle cost may be time spent by the programmer writing applications' programs and by the user posing queries. A model that makes accurate programming and the phasing of queries easy.
2. Efficiency of implementation on data processing activity. The total cost of implementation a database comes from the computer time (execution time) spent.
3. Reality. The model represents as closely as possible to the real world situation.

In the standard of ease of use, the relational model is higher mark than others [Ref. 8, 10]. This model provides only one concept of the relation (section C) that the user or the programmer must understand. Furthermore, this model adopts very high level languages for expressing queries concerning data represented.

The network model requires understanding of both record types and links, and their interrelationships. The implementation of many-to-many relationships and relationships on three or more entity sets[1] is complex. Similarly, the hierarchical model needs an understanding of how to use pointers, and it has the same problems such that one-to-many relationships between two entity sets. [Ref. 12]

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[1]Entity set is a collection of entity that is represented directly by logical record type.

In the standard of implementation efficiency, the hierarchical model has more potential than the relational. But, the pointer-oriented implementation with variable length records needs a time to familiar with one-to-many mappings. [Ref. 13]

Through the above discussion, the relational model is considered better than others for ROK Army personnel management. The user has little knowledge on database systems and languages, and they are transferred frequently. within a short period of time. Therefore, they require to familiar readily with database system that does not need greatly programming skill. Then, the potential of efficiency in the relational model can be increased using the relational query languages (section C), and normal form (section E).

In addition, even though individual personnel data can be maintained individually, the most needs are for statistical information rather than individual personnel information to analyze and to plan for personnel management. In this case, most of the information output format are naturally used tabular forms. By these situations, the relational model is more helpful than others in ROK Army Personnel Management.

C. CHARACTERISTICS OF RELATIONAL MODEL

1. The concepts of Relational Model

The relational model represents data in the simple form of tables. A relation is simply a two-dimensional table having several properties. The entries in the table have a single value with flat files,[2] and the entries in any column are all of the same kind. Each column has a unique name and the order of the columns is not important. No two

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[2]A flat file has a fixed length neither repeating groups nor arrays.

rows in the table are identical and the order of the rows is insignificant. Each row of the relation is called a tuple. A relation that has n columns or n attributes is said to be of degree n. Each attribute has a domain, which is the set of values that the attribute can have. A relation of degree n has n domains, not all of which need be unique. To differentiate between attributes that have the same domain, each has a unique attribute name. [Ref. 14]

Within a given relation there are one or more attributes with values, these names will always be unique. If so, the attribute name is a primary key. If names are not unique, then the key must have more than one attribute or combinations of attributes. Some combinations of attributes have the unique identification property. This is called a secondary key.

Relational model represents one-to-one relationships, one-to-many relationships, and many-to-many relationships. This model is natural and convenient way to construct a relationship. These relationships are hidden from the users. The users can use only data values to represent and process relationships among tuples, and can access the data using terms and values that are familiar to them. [Ref. 10]

In addition, a relational schema is a listing of a relation name and its corresponding attributes, and definitions of constraints on data values. Relational database is specified by this relational schema. [Ref. 14]

2. Basic Operations on Relational Model

Relations can be manipulated using operators in the algebraic query languages to obtain a desired result by combining any of the columns and selecting any of the rows. There are several basic operations to manipulate relations as follows [Ref. 10] :

- Union. The union of two relations is formed by combining the tuples from one relation with those of a second relation to generate a third. Each relation must have the same number of attributes, and the attributes in corresponding columns must come from the same domain. Duplicated tuples are eliminated.

- Difference. The difference of two relations is a third relation containing tuples which occurs in the first relation but not in the second. Each relation must have the same number of attributes.

- Cartesian Product. The product of two relations is the concatenation of every tuple of one relation with every tuple of a second relation. The product of relation A (m tuples) and relation B (n tuples) has m times n tuples.

- Projection. The projection is an operation that selects specified attributes from a relation. The result of the projection is a new relation having the selected attributes(columns).

- Selection. The selection is an operation that selects specified tuples from a relation. The result of the selection is a new relation having the selected tuples (rows).

- Intersection. The intersection of two relations generates a third relation containing common tuples.

- Join. The join operation is a combination of the product, selection and projection operations. In two relation A and B, the join operator is as follows: First, generate the product of A times B. Next, do a selection to eliminate some tuples. Then, remove duplicated attributes with projections.

3. Data Manipulation Languages

The operations of algebraic query languages were previously discussed. The notation for expressing queries is usually the most significant part of the data manipulation languages. Data manipulation languages usually have operations beyond those of query languages. Of course, all data manipulation languages include insertion, deletion, and modification commands, which are not part of the query languages. Some additional operations are available such as arithmetic, assignment and print commands, aggregation of function (eg. average, sum, total, min, max, ...), and so on. [Ref. 10]

D. FUNCTIONAL DEPENDENCIES

The idea of a functional dependency, a constraint on the possible relations, is central to the design of database schemes. The major direction of most database designers effort is to obtain an accurate schema. The concept of what is meant by a "good"/"better" schema, and the associated conditions, must be formalized.

Given a relation R, if at every instant of time each value of A has no more than one value of B associated with it in the relation R, the attribute B is said to be functionally dependent on attribute A. Stating that B is functionally dependent on A is equivalent to stating that A functionally determines B, that may be written as f: A ---> B. This is in accord with mathematical logic in which A ---> B means that A determines B, that is, if A has a certain value "a" then B must have a value "b". [Ref. 15]

In figure 3.1 given the SERVICE NUMBER value there is only one corresponding value for each one of the other five domains. Functional dependencies between attributes are established directly by the meaning of the data. Saying

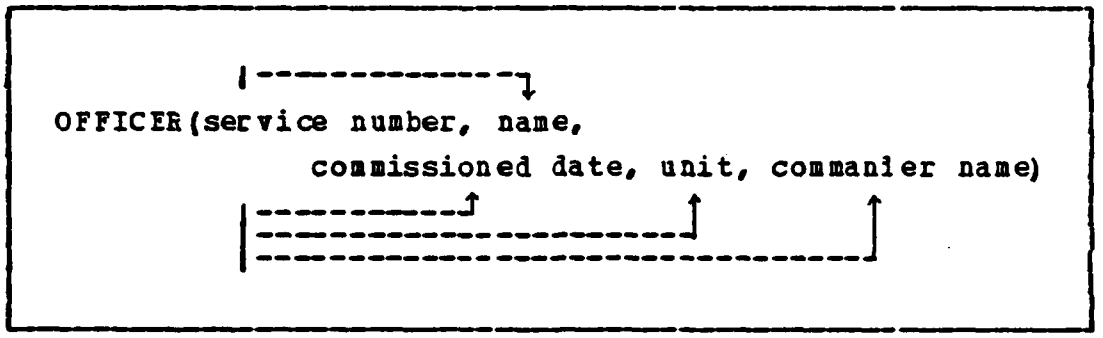

Figure 3.1 Functional Dependency within a Relation R.

that COMMISSIONED DATE is functionally dependent on SERVICE NUMBER means that each given officer is identified by SERVICE NUMBER, which must have only one COMMISSIONED DATE. But, NAME is not functionally dependent on COMMISSIONED DATE because two or more officers of different COMMISSIONED DATE can have the same NAME.

In a relation, every nonkey attribute is functionally dependent on at least the key attribute. When a relation has more than one key attribute, all its attributes are dependent on each key attribute since there can not be two or more attributes which have the same key value. [Ref. 16, 17]

E. NORMALIZATION OF RELATION SCHEMES

It is not good to have any redundancies in the specification of the schema. All designers would hope that the schema adequately separates the different information unit. Generally speaking, making of all functional dependencies is very time consuming, since usually many functional dependencies can be used to evaluate the schema and to normalize it into a better schema. Many reasons also have been suggested why normalizations are necessary. [Ref. 15, 16] In figure 3.1 undesirable side effects occur such as redundancy and anomalies:

- Redundancy. The UNIT and COMMANDER NAME are repeated once for each SERVICE NUMBER. This redundancy causes problems because it is wasteful storage, as well as redundant data which must be consistently maintained.

- Update Anomalies. The change of UNIT requires a series of changes of COMMANDER NAME. That is, a change should ripple through and cause a series of changes for the database to be consistent.

- Insertion Anomalies. When a commissioned officer is assigned his position in a new unit, UNIT and COMMANDER NAME must be contained.

- Deletion Anomalies. When an officer is separated from the military, any military information will cease to exist. This can be an anomaly if it is desired to retain important, long range information about the military.

These undesirable problems are removed from a relation by normalization. Good database designers have encouraged for a long time not to represent more than one "concept" or "entity" in a single relation. An important objective of normalization is to get rid of these types of anomalies by breaking a relation into simpler, but equivalent relations. [Ref. 10, 15] Figure 3.1 could avoid the anomalies' problem

OFFICER1(service number, name, commissioned date, unit)
COMMANDER(unit, commander name)

Figure 3.2 The Relations OFFICER1 and COMMANDER.

by using two relations that shows figure 3.2. In figure 3.2, OFFICER1 and COMMANDER are isolated and related by specifying the UNIT. These two relations are based on functional dependency, SERVICE NUMBER ---> UNIT, and UNIT ---> COMMANDER NAME. As a result, they do not interface with each other. In addition, the two relations are considered better than the original relation since the join of the two relations is equivalent to the original relation.

IV. DATABASE DESIGN USING RELATIONAL MODEL

A. OVERVIEW

Generally, the database design consists of two phases: the logical design and the physical design. It is hard to identify these exact two phases in the designing process. In this chapter, the relational theory is applied to the requirement (discussed in chapter II) for doing a ROK Army personnel management system. A relational database design is specified using three major components: relations, interrelation constraints, and domain and attribute/domain correspondences [Ref. 14]. To obtain these components concerning the database objectives, the designer should use the design methodology, the design techniques in each step, the validity of the information requirement, and a lot of endeavor. Of course, designing an integrated database is difficult, time consuming, and an unstructured process.

In order to design relational database in this chapter, section B shows data item analysis and data item groups. Section C presents data item groups and their applications. Section D contains database design. Section E introduces special discussions.

B. DATA ITEM ANALYSIS AND DATA ITEM GROUPS

The integrated file structure is made up of groups of all relevant data items to conveniently manage and operate a user organization. The main idea of a database is to place all relevant data in one database in a consistent and standardized method, to get rid of unnecessary redundancy and file handling, and to support selective inquiry capabilities designed to achieve a wide variety of informational requests.

So as to achieve these requirements, the author had to synthesize specific data items from several current file systems and other necessary data items from the user requirement (discussed in chapter II) with identifications and clarifications. The file system has included 87 separate data items that are collected. These data items are attached in Appendix A.

After collecting the data items, eliminating redundant or unnecessary duplication and adding the other data items that are required for the database model to consolidate the database. There are 169 data items that are composed of two basic groups according to frequency of updating or accessing. Data items are almost static in relation to others. These items are composed of the data that is not frequently updated. These data items are divided into two smaller groups:

1. Data items that are frequently used or retrieved by applications' programs could be grouped in Main Identification (MAIN) that contains eleven data items. This group will be occur only one time.
2. Data items that are infrequently used or retrieved by applications' programs are grouped in Personnel Characteristics (PSNLCH) that consists of five subgroups:
   - Commission subgroup (COMM) gives the information about native military education course and date of commission. This subgroup occurs only once and contains six data items.
   - Body Char subgroup (BODY) includes seven data items that give the information about blood type, height and uniform size. This subgroup will occur only one time.

- Marriage subgroup (MARR) contains two data items; martial status and status date. This subgroup may be repeated.
- Address subgroup (ADDR) contains three data items about present address and housing status. This subgroup will be repeated.
- Retirement subgroup (RETIRE) that gives the information about reason and date of retirement. This subgroup contains four data items and occurs only once.

Data items that are dynamic and frequently change, and are required to collect for historic purposes, are divided into several smaller groups depending on their corresponding historical applications. These groups are the following:

1. Promotion group (PRMT) has the information about rank. This group contains five data items that will be repeated.
2. Career group (CAREER) gives the information about military career. This group includes seven data items that will be repeated.
3. Education group (EDUCN) is composed of two subgroups:
   - Military Education subgroup (MEDUC) gives the information about military education courses and grades. This subgroup contains nine data items that will be repeated.
   - Civilian Education subgroup (CEDUC) has the civilian education background both before and after being in the military. This subgroup contains eight data items that will be repeated.
4. Capabilities group (CPBLTY) consists of three subgroups as follows:

- Physical Exam subgroup (PHYSIC) contains the physical capabilities. This subgroup has eight data items that will be repeated.
- Technical Capability subgroup (TECH) gives the information about some technical skill and the date obtained. This subgroup contains four data items that will be repeated.
- Foreign Language subgroup (FRLANG) includes six data items. This subgroup will be repeated.

5. Health Condition group (HEALTH) contains nineteen data items that will be repeated every year.
6. Award and Punishment group (AWARD) has the information about the awards received (medal, honor, or commendation) and any punishment given, and the date of occurrence. This group contains six data items and will be repeated.
7. Estimation group (ETMT) has the information about the estimates on a military person by the commander/seniors in a unit. This group is divided into two subgroups:
   - Service Estimation subgroup (SVEST) contains ten data items that will be repeated every year.
   - Recommended Order subgroup (RCMORD) includes three data items that will be repeated.
8. Secret Treatment group (SCRT) has the information on the permitted treatment of military secret documents. This group contains four data items and will be repeated.
9. War Experience group (WAREPR) is recorded with three data items. This group will be repeated.

10. Flying-time group (FLYTIM) has the amount of flying time with a certain kind of plane to carry out a given-mission. This group contains seven data items that will be repeated.
11. Welfare group (WELFARE) is composed of seven subgroups:
    - Family subgroup (FAM) gives the information about a family member. This subgroup contains four data items and will be repeated.
    - Education Expenses Reduction subgroup (EDUEXP) is the recorded amount of the reduced children's educational expenses. This subgroup contains four data items and will be repeated.
    - Mailing Address subgroup (MAIL) contains the mailing address to be used when there is a total war. This subgroup includes five data items and will be repeated. The data item 'Name' in this subgroup may be the same as the data item 'Name' of Family subgroup.
    - Leaves subgroup (LEAV) has the information about military vacations. This subgroup contains three data items and will be repeated.
    - PX Goods subgroup (PX) is a record about the various goods purchased from the PX. This subgroup contains five data items and will be repeated.
    - Payroll subgroup (PAY) has the information on salary. This subgroup contains eleven data items and will be repeated every month.
    - Transportation Reduction subgroup (TRANS) is the recorded amount of the reduced transportation

fee. This subgroup contains five data items and will be repeated.

C. DATA ITEM GROUPS AND THEIR APPLICATIONS

The main idea in building a database is to share data among a wide variety of applications and to consolidate data for maintaining more applications. Both of these requirements need the complex task of supporting safe and requirements using more interrelated data and support by sharing data among many applications. These database objectives can be attained by providing database management system (DBMS) software to physically link related data into complex file organizations.

The objectives are also attained by the development of database design methodologies that are non-redundant. Data updated by one application can be used by all other users of the data because of a major objective of database management is data sharing. The Main Identification (MAIN), Personnel Characteristics (PSNLCH), Promotion (PRMT) groups identified in the previous section are applied by all applications. The other groups in multiple applications are shown in the figure 4.1. The abbreviations used in the figure 4.1 come from group/subgroup names in the previous section. The numbers in the circles are used for applications: 1 is used for general informations of individual person, 2 is for limited informations of individual person, 3 is for application of procurement and promotion, 4 is for education, 5 is for assignment and transfer, 6 is for retirement, and 7 is for welfare.

D. DATABASE DESIGN

For producing an effective relational database design, David Kroenke [Ref. 14] presents several different criteria as follows:

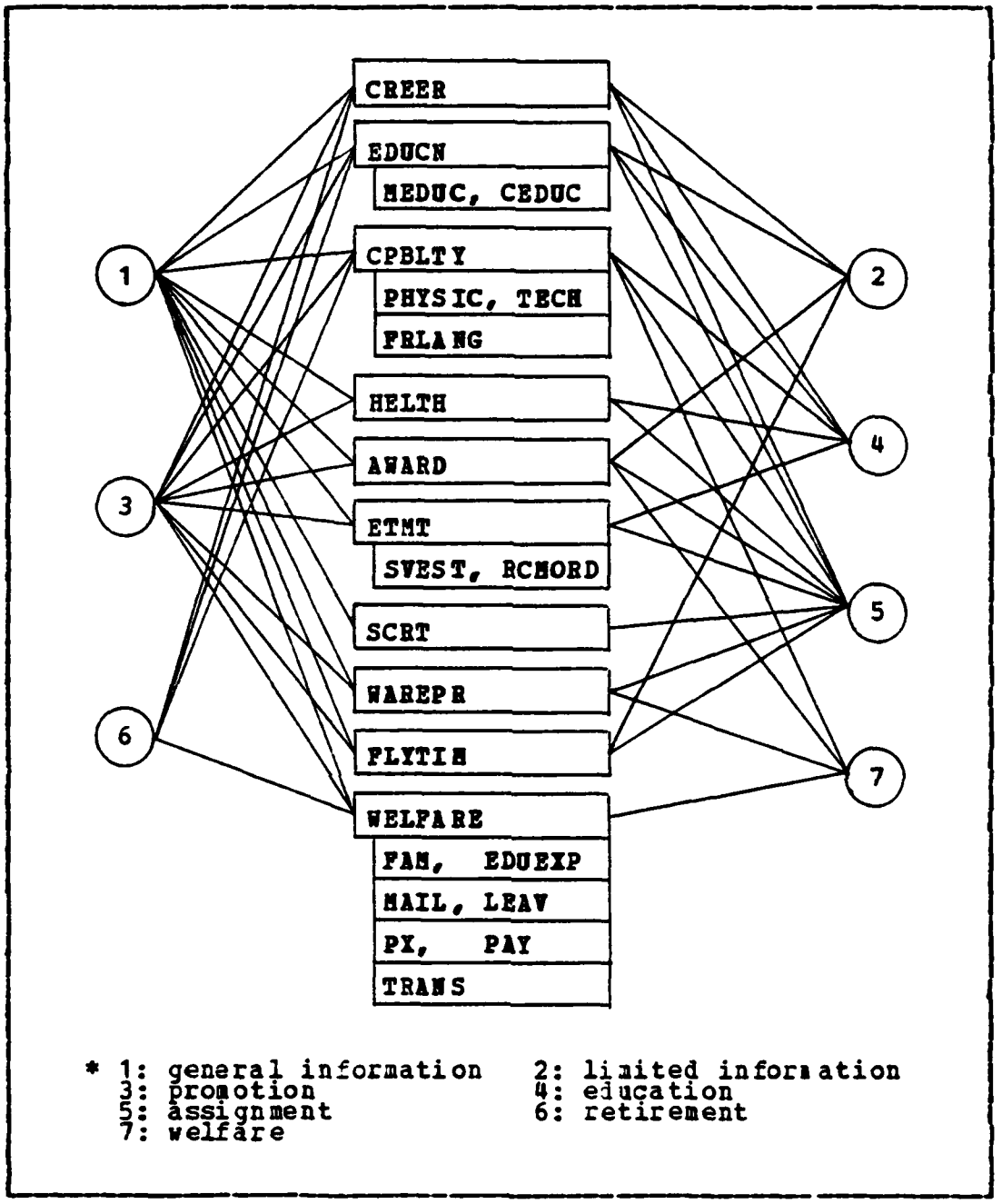

Figure 4.1 Data Item Groups and Applications.

• Elimination of modification anomalies

With some relations, changing data have undesirable consequences. These consequences are called modification anomalies (discussed in chapter III). If relations can be put into normal form, then modification anomalies do not happen. Thus, relations that are in normal form are prefered, and normal form that is become is a design objective.

• Relational independence

Two relations are independent if modifications can be made to one without regard for the other. To achieve relational independence, the relations can be joined together. However, the joined relation may occur modification anomalies. To get rid of modification anomalies, decomposition can be adopted in relations.

• Nonloss projections

The join of projection may create false records. In a database design, projection that generates false records. (loss projections) can not be permitted. Thus, one of the relational database design objectives is nonloss projections.

• Ease of use

One criterion for a relational design is user friendly. As far as possible, the designer should strive to build the relations in order that are familiar and seem natural to users.

Among the design criteria discussed above, the designer must decide priorities and make the best possible compromise in light of requirements. There is no standard rule for priority. Thus, the author gives a priority to ease of use since users have little knowledge on databases and users are frequently transferred.

The author examines data dictionary, determines that certain items in the record and certain records will need to exist, based upon the end-user requirement (discussed in chapter II). MAIN IDENTIFICATION record includes 3 items of private information, BIRTH PLACE, ORDER OF SON, and RELIGION. They are very commonly used and required as general information. BIRTH DATE and SEX are not included since the social security number indicates that information. Present rank is added in the PROMOTION record. SPECIAL BRANCH is needed for only a few persons, therefore can not be eliminated. RECRUITMENT DATE in the COMMISSION record is the information of annuity. In the near future RECRUITMENT DATE will be adopted to compute the length of service.

In the BODY CHARACTERISTICS record, weight is added in the HEALTH CONDITION record. Color of eyes and Color of hair are not important item since Korea is one unique nation, since all Koreans have brown eyes and black hair. HOUSING STATUS and STATUS DATE in the ADDRESS record are used for the information about housing allowance. MILITARY PERSONNEL RULES in the RETIREMENT record includes the reason why he retired, and is used for the annuity. Duration of service is from RETIRED DATE and RECRUITMENT DATE. This data is not stated directly in the requirement.

RANK STATUS in the PROMOTION record is one of the more important information within personnel treatment. If someone has two records with the same rank, two records are identified by RANK STATUS. RANK and PROMOTION DATE are enough to find the duration of service in the certain rank.

The duration of certain positions can be found from START DATE and COMPLETION DATE. Therefore, duration item in the CAREER record is not necessary. UNIT item gives the information about the next position to be assigned. The next position to be assigned is not usually with the same unit as before since it is important to familiarize all personnel with many other regions of military operations.

SCHOOL NAME item in the MILITARY EDUCATION record is the institution attended. One of the most important items is COURSE NAME. This item gives a lot of information, the number of the candidate, the number of the class, the size of the class, etc.. GRADE, AVERAGE GRADE IN CLASS, ORDER IN CLASS and CLASS SIZE are important data for selection of promotion. For instance, if a certain serviceman has an ORDER IN CLASS that reflects a standing in the top third of the CLASS SIZE, he is evaluated as an excellent serviceman.

EXAMED YEAR item in the PHYSICAL EXAM record is enough since every serviceman takes a physical exam yearly. FINAL RESULT item is not necessary since the final result is found from each item in the PHYSICAL EXAM. OBTAINED DATE in the TECHNICAL CAPABILITY record gives the information about the experience of techniques. Interpretation and translation in the FOREIGN LANGUAGE record is replaced with SPEAKING LEVEL and LISTENING LEVEL.

CHECKING YEAR item in the HEALTH CONDITION record is shorter and better than checking date since the health check is executed every year. AWARD/PUNISHMENT record is one of the more important data for morale and for promotion.

All items in SERVICE ESTIMATION record will be very frequently used to assign personnel to new positions, to select every applicant for education, and will be provided to the decision maker, namely the promotion selection committee. But, the total result is currently used. TOTAL RESULT item is not necessary since the total result can be derived from each item.

FLYING TIME record will be adopted for only aviation officers. This record is maintained after every sortie. The accumulation of flying time for each sortie is derived from TAKE OFF HOURS and LANDING HOURS.

There are several records in the WELFARE group. FAMILY record is very popular used as private information. Birth

date and sex is also not included (discussed in MAIN IDENTIFICATION group). In the EDUCATION EXPENSES REDUCTION record, social security number will be used as the primary key. ADDRESS item in MAILING ADDRESS record will be used when there is a total war, since all servicemen will be at war, the monthly payroll and other correspondences will be sent to another person. This address item for some servicemen will be the same as the PRESENT ADDRESS in the ADDRESS record. LEAVES record is very important for enlistedmen. This record may occur every year.

It is time to determine whether or not certain records are combined or separated. In all, the information about career events in the COMMISSION, RETIREMENT, PROMOTION, CAREER, and MILITARY EDUCATION records can be combined into a single record. The 36 initial items in the above records can be reduced to the following 17 items: Common items are SERVICE NUMBER, PERSONNEL ORDER, and DATE OF ORDER. COURSE NAME is used for COURSE of the COMMISSION record, and COURSE NAME of the MILITARY EDUCATION record. ORDER OF COURSE, ORDER IN CLASS, and CLASS SIZE are common to the COMMISSION, and the MILITARY EDUCATION records. START DATE is for COMMISSIONED DATE from the COMMISSION, PROMOTION DATE from the PROMOTION, RETIREMENT DATE from the RETIREMENT, and START DATE from the CAREER and the MILITARY EDUCATION records. COMPLETION DATE is for RECRUITMENT DATE from the COMMISSION, and COMPLETION DATE from the CAREER and the MILITARY EDUCATION records. UNIT is for SCHOOL NAME in the MILITARY EDUCATION, and UNIT in the CAREER records. COMPLETION REASON and POSITION are used only for the CAREER record. GRADE and AVERAGE GRADE are only for the MILITARY EDUCATION record. RANK and RANK STATUS are only for the PROMOTION record. MILITARY PERSONNEL RULE is only for the RETIREMENT record. By the combining of serveral records about career, total record length is reduced from 221 bytes

to 95 bytes. And this combined record name is CAREERS. If COURSE NAME is not blank and GRADE is blank, this record contains the information about the COMMISSION record. If COURSE NAME is not blank and GRADE is not blank, this record contains the information about the MILITARY EDUCATION record. If RANK is not blank, this has the PROMOTION record. If POSITION is not blank, this has the CAREER record. If MILITARY EDUCATION is not blank, this has the RETIREMENT record.

The ADDRESS and the MAILING ADDRESS records can be combined into a single record, PRESENT & MAILING ADDRESS. HOUSING STATUS and STATUS DATE are only for the ADDRESS record. NAME, SOCIAL SECURITY NUMBER, RELATION, and PRIORITY are for the MAILING ADDRESS record. This PRESENT & MAILING ADDRESS record has 8 items, and 106 bytes.

The WAR EXPERIENCE, AWARD/PUNISHMENT, and LEAVES records can be combined into a single record named WAR_AWARD_LEAVES. KIND OF AWARD/PUNISHMENT, WHO_GIVEN, and GENERAL ORDER are used for the AWARD/PUNISHMENT record. START DATE is for RECEIVED DATE of the AWARD/PUNISHMENT, START DATE of the LEAVES and the WAR EXPERIENCE. COMPLETION DATE is for DATE OF ORDER of the AWARD/PUNISHMENT, COMPLETION DATE of the LEAVES and the WAR EXPERIENCE records. WAR NAME is for the WAR EXPERIENCE, and REASON is for the LEAVES records. This record is reduced from 15 items to 9 items, and from 123 bytes to 93 bytes. The way to identify each information is as follows: If REASON (WRSN) is not blank, this is the information about the LEAVES record. If WAR NAME is not blank, this in the information about the WAR EXPERIENCE record. If WHO_GIVEN is not blank, this is the information about the AWARD/PUNISHMENT record.

PHYSICAL EXAM and HEALTH CONDITION can be combined into a single record, too. This record is called PHYSICAL EXAM & HEALTH CONDITION. CHECKING YEAR will be use with EXAM YEAR

of the PHYSICAL EXAM record. EYE (LEFT) uses with 100m, EYE (RIGHT) uses with 2000m, EAR (LEFT) uses with BROAD JUMP, EAR (RIGHT) uses with CHIN_UP, NOSE uses with GRENADE_THROW, and TOOTH (UP) uses with SANDBAG_CARRIAGE of the PHYSICAL EXAM record. If the last item, WEIGHT, is blank, this is the information about the PHYSICAL EXAM record.

However, combination into a single record can not be performed if the combined records have very different usage frequencies and/or circumstances. For instance, MARRIAGE and FAMILY records, SECRET TREATMENT and SERVICE ESTIMATION records, etc..

On the other hand, MAIN Identification record contains the private information, BIRTH PLACE, ORDER OF SON, and RELIGION. Therefore, the MAIN Identification record will be separated into two records, MAIN ID and PRIVATE. The MAIN ID record has 8 items and the PRIVATE record has 4 items. And, the PAY ROLL record should be kept separated for security reason.

By the above discussion, one record is separated into two records and 12 records are combined into four records. The number of total records is 20 and total items is 138 (attached appendix B).

Relationships can be derived from the defined records. SERVICE NUMBER in the MAIN ID record is to be matched just one time with SERVICE NUMBER in the PRIVATE and the BODY CHARACTERISTICS records. By the same ways, SERVICE NUMBER in the PRIVATE record is to be matched just one time with the MAIN ID record. These records have one-to-one relationships with each other. One-to-one relationships are illustrated in the figure 4.2.

SERVICE NUMBER in the MAIN ID record may have several CAREERS records with the same service number. But, there is only one MAIN ID record. There are one-to-many relationships from the MAIN ID record to the CAREERS records. Figure 4.3 represents one-to-many relationships.

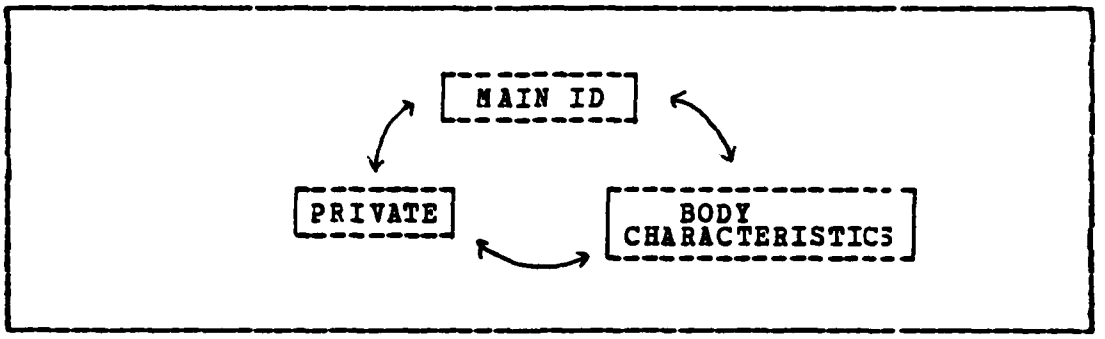

Figure 4.2 One-to-one Relationships.

one	to	many
MAIN ID	MARRIAGE,	FAMILY
	PAYROLL,	PX_GOODS
	FLYING TIME,	CAREERS
	PRESENT/MAILING ADDRESS	
PRIVATE	CIVILIAN EDUCATION	
	TECHNICAL CAPABILITY	
	FOREIGN LANGUAGE	
	SERVICE ESTIMATION	
BODY CHAR	WAR_AWARD_LEAVES	
	RECOMMEND ORDER	
	SECRET TREATMENT	
	TRANSPORTATION REDUCTION	
	PHYSICAL EXAM/HEALTH CONDITION	
FAMILY	EDUCATION EXPENSES REDUCTION	

Figure 4.3 One-to-many Relationships.

SERVICE NUMBER in one CAREERS record can be matched with several SERVICE ESTIMATION records with the same service number, vice versa. This case is an example of many-to-many relationships. Many-to-many relationships are represented in the figure 4.4. These records in the figure 4.4 are many-to-many relationships with each other.

MARRIAGE	PRESENT/MAILING ADDRESS
CAREERS	CIVILIAN EDUCATION
FLYING TIME	TECHNICAL CAPABILITY
RECOMMEND ORDER	SERVICE ESTIMATION
FAMILY	SECRET TREATMENT
PX_GOODS	FOREIGN LANGUAGE
PAYROLL	TRANSPORTATION REDUCTION
WAR_AWARD_LEAVES	
PHYSICAL EXAM/HEALTH CONDITION	

Figure 4.4 The List of Many-to-many Relationships.

Schema is developed by determining data items, records, and relationships among database records. This paragraph will review the entities presented in this chapter, the user requirements of chapter II and the relationships presented above. The designer must be particularly careful to determine whether these relations have attributes with values that are sets. Attributes with values that are sets are not permitted in a relation, each attribute has only one value per record, and records can not be contained in other records. After eliminating these problems, every relation's primary key can be decided and the logical schema are transformed into a relational schema as appendix C.

	subset	MAIN (SN)	PRIVA (SN)	BODY (SN)	ADDRS (SN)	CREERS (SN)	FAM (FAMSSN)
1	private(SN)	X					
2	body characteristics(SN)	X	X				
3	marriage(SN)	X	X	X	X		
4	present/mailing address(SN)	X	X	X			
5	creers(SN)	X	X	X	X		
6	civilian education(SN)	X	X	X	X	X	
7	technical capability(SN)	X	X	X	X		
8	foreign language(SN)	X	X	X	X		
9	physical exam/ health condition(SN)	X	X	X	X	X	
10	war/award/ leaves(SN)	X	X	X	X	X	
11	service estimation(SN)	X	X	X	X	X	
12	recommend order(SN)	X	X	X	X	X	
13	secret treatment(SN)	X	X	X	X	X	
14	flying time(SN)	X	X	X	X	X	
15	family(SN)	X	X	X	X		
16	education reduction(SN)						X
17	PX_goods(SN)	X	X	X	X		
18	payroll(SN)	X	X	X	X		
19	transportation reduction(SN)	X	X	X	X		

Figure 4.5 Interrelation Constraints.

Figure 4.5 presents interrelation constraints. For example, it specifies that the values of SERVICE NUMBER in PRESENT/MAILING ADDRESS must be a subset of the value of SERVICE NUMBER in MAIN ID. By the terms of projection,

PRESENT/MAILING ADDRESS (SN) subset of MAIN ID (SN).

And, domain and attribute/domain correspondences are replaced by Data Dictionary (appendix B) and code table

(appendix D). These will be used by application programmers and query/update users.

The relations in the schema (appendix C) must be not insertion or deletion anomalies. Also, all of the interrelation constraints must be inclusion constraints. No functional dependencies have been normalized across relations, and the relations are natural.

E. SPECIAL DISCUSSION

1. Service Number

The individual's service number is the primary key in the personnel database. Of course the social security number can also be used, however, for military purposes, the individual's service number is more useful.

Even within the military there are several different serial service number according to the serviceman's native military education courses. To make it easier to access the database the various service numbers must be changed into one unique form before loading into the database. When they are retrieved by the application software, they must be transformed back into their original form.

The recommended transformations by the author for individual service numbers are the following:

A. Officer

1) commissioned from Korean Military Academy: 000NNNNN
   Example: 20235 ====> 00020235
2) commissioned from 3rd Korean Military Academy: 005NNNNN
   Example: 512345 ====> 00512345
3) commissioned from ROTC: 0NNNNNNN
   Example: 84-01234 ====> 08401234
4) commissioned from OCS: 00NNNNNN
   Example: 253248 ====> 00253248

5) commissioned for the local defanse forces: 004NNNNN

Example: 412527 ====> 00412527

B. Warrant Officer: 003NNNNN

Example: 302132 ====> 00302132

C. Non Commissioned Officer and below: NNNNNNNN

Example: 80012356 ====> 80012356

12102732 ====> 12102732

D. Civilian: 50NNNNNN

Example: A112947 ====> 50112947

2. Transaction Processing

The index is used in order to immediately access a specific record, and consists of one or more attributes of a certain entity. It is usually considerably smaller than a certain entity and can refer to the attribute that is inverted, e.g., RANK is an index.

Insertion, update, deletion, and searching are important functions. When inserting one record, it is necessary to find the correct place to insert it. Searching is also necessary to locate a certain record that is to be updated or deleted. For instance, in order to find the UNIT name that a certain serviceman named Hong Kil Dong serves, if his service number is known, his CAREERS records can be easily found. Among several CAREERS records found, his unit name can be found from a certain record. That record has UNIT entity with value and the latest ORDER OF DATE. If his service number and birth place are known, several MAIN ID records with the same name and several PRIVATE records with different service number can be accessed. From several PRIVATE records, his service number can be found. This case has three indices, SERVICE NUMBER, BIRTH PLACE, and NAME. Another, when the list of officers who attended Naval Postgraduate School is asked, the indices must be

identified, such as, RANK of the CAREER record and SCHOOL NAME of the CIVILIAN EDUCATION record.

In order to obtain the desired information, analysis of the transaction processing concerning the database should be performed. This analysis specifies the inder and output required, transaction required (e.g., retrieval, update), entity names and relationships, its frequency, its purpose, report format, security, and the processing priority.

3. Journal

A DBMS must provide a way to restore the database to a consistent state that reflects the situation after some number of transactions were completed. The journal is a basic monitoring record in which all changes to the database of a certain type are recorded. A system journal records every transaction that happens within the system. Jeffery D. Ullman [Ref. 10] enumerates the most general case of journal entries that consists of

- A unique identifier for the transaction causing the change,
- The old value of the item, and
- The new value of the item.

In this Database the author suggests that journal entries consist of the following:

- Identification of the user who is accessing this data base.
- Date of transaction and beginning/ending times.
- Type of operation causing the change (insert, delete, update, list, etc).
- Key being affected by the change(service number, etc).
- The old value of the item.
- The new value of the item.
- All other contents typed by the user.

4. Data Dictionary/Directory

Each DBMS has its own method to predefine data descriptions. Each has a repository for the database description, a language facility to process that description, and a mechanism to input that description to the DBMS.

In DBMS the included data dictionary/directory (DD/D)[3] is primarily oriented toward the internal representation or the machine use of the data definition. The database definition does contain some dictionary information oriented toward the user. It should give nearly all the information that a good dictionary should provide for the variety of users who need access to data descriptions.

A DD/D has two primary users. On the directory side, it gives data definitions to the DBMS, to application programs, and to queries for access to the stored data. On the dictionary side, it supports the database administrator (DBA) and other users with information about the data definitions that compose the database. [Ref. 18]

5. Database Administration

The database administration is the authority that regulates the DBMS to provide maximizing benefits to users. It contains several specialties: information system analysis, database structure and physical organization design, security, recovery, user training, configuration tuning, and documentation. Each of these specialties may be designed for one individual for an uncomplicated database.

Once polices and procedures have been set, they should be documented and users should be trained in their applications. Furthermore, the DBA has responsibility to enforce procedures. User activity should be monitored,

---

[3]A dictionary that defines the internally necessary attributes of the data, their physical characteristics, and stored locations [Ref. 18].

additional training and other measures should be taken when users do not conform. In this case, additional measures are available to the DBA. One is that the DBA can warn the user and notify these user's senior manager. If this does not success, the DBA can punish the user by reducing job priorities. Generally speaking, such measures are not necessary. If polices and procedures are appropriate, are set for the good for all, and are carefully explained, users will be cooperative and follow them.

There are two types of documentation to be maintained by the DBA: One concerning database activity and the second concerning database structure. Documentation regarding data activity should contain database standards, data ownership, retrieval and access rights, recovery procedures, and policy enforcement. Good documentation is especially important in this area since it involves diverse user groups and these user's are frequently changed throughout the Korean Army. The DBA must publish, distribute, and maintain this documentation. The second type of documentation for the DBA office concerns the database structure. It should include information about standardized test procedures, test forms, record keeping methods, and test result. In addition it should include information about how the structure was changed, how it was tested, and the like. Without proper documentation of changes, the diagnosis of the problem is next to impossible. This documentation is neither published nor distributed but it must be maintained. [Ref. 14]

V. CONCLUSIONS AND RECOMMENDATIONS

As the ROK Army has been developed, the decision maker needs more accurate, and complex information. Furthermore, different decision makers require different information to perform personnel management. Manual labor and file systems can not achieve the objective of providing this information. Thus, the Army needs a computerized personnel management system. Particularly, one database system with diverse applications and an integrated database is required to support information for performing personnel management rather than having several file systems in several computer centers. Thus, reduced manual effort and time should decrease the size of staffs and should therefore increase combat capability.

To attain a database system, the database model must be decided before the system design phase. A relational database model is the most helpful in the ROK Army's personnel management, because this model is easy to use with simple relational concepts, and high level languages for queries.

This thesis covers the requirement analysis, data item analysis and their groups, analysis of their applications and their relationships, and three components for relational database design. Thus, the database design is completed using a relational model for performing personnel management in ROK Army. After being designed, the computer programs should be fully tested. The author's recommendations are:

1. The hardware with capabilities to support database system should be chosen. The number of computer resources should be sufficient to continuously service all end-users.

2. A tremendous amount of data must be loaded in the memory device. This labor intensive effort will unfortunately be constrained by personnel capabilities, and will necessarily take a long period of time to complete.

APPENDIX A

DATA ITEMS FROM CURRENT FILE SYSTEMS

personnel characteristics

001 service number
002 social security number
003 name
branch
004 original
005 special
function
006 main
007 secondary
commission
008 course
009 order of course
010 date
011 order in class
012 class size
013 main address
014 present address
015 order of son
016 blood-type
017 marital-status
018 religion
019 hobby
020 service type
021 height

promotion

022 administrative order
023 rank status
024 rank
025 promotion-date

military career

026 unit-name
027 position
028 period (yymmdd, yymmdd)

military education

029 school name
030 course
031 order of course
032 period (yymmdd, yymmdd)
033 grade
034 average grade
035 order in class
036 class size

civilian education

037 school name
038 major
039 degree
040 period (yymmdd, yymmdd)
041 location
042 graduation classification
043 scholarship from military

health condition

044 checking-year
045 checking result

foreign language capability

046 language
047 speaking level
048 listening level
049 reading level
050 interpretation level
051 translation level

technical capability

052 kind of licence
053 class
054 bureau

055 obtained-date

award/punishment

056 administrative order

057 kind of award/punishment

058 given-date

059 reason

war experience

060 war name

061 period (yymmdd, yymmdd)

secret treatment

062 permitted-date

063 classification

service estimation

064 estimate-year

065 kind of estimation

066 estimated-result

selected PX-goods

067 purchase-goods

068 manufactured-company

069 model

070 PX-location

071 purchase-date

flying-time

072 kind of plane

073 flying-mission

074 date (yymmdd)

075 period (hhmm, hhmm)

payroll

076 payroll month

077 basic salary

078 insurance

079 annuity

080 spouse's allowance

081 tax

082 tax advantage

083 salary

family

084 relation

085 name

086 social security number

087 dependent/independent

APPENDIX B
DATA DICTIONARY

This data dictionary contains data items and their records, consisting of six columns:

1. Item number. The item number contains four digits. First two digits stand for record number. The other two digits are a serial number of one record.
2. Data item. This column contains the data item name as it is known to the user.
3. Data name. This column contains the unique name for data item that will be used by programmer/user.
4. Type. This column contains the data item's type where "n" means numeric, "an" means alphanumeric, and "a" means alphabet.
5. Length. This column contains number of characters in each data item.
6. Description. This column contains the description of the data item. The abbreviation is used: YYMMDD for year (two digits), month (two digits), and day (two digits). YYMM for year and day, YY for year, HHMM for hours and minutes. See (n) stands for the number n in appendix D. A Won is the unit of Korean currency.

# item	data item	data name	type	length	description
	main id	**MAIN**		**(56)**	
0101	service number	SN	n	8	main key
0102	name	NAME	a	25	name (last,1st,2nd)
0103	original branch	ORGBR	n	2	19 types, see(1)

0104	special branch	SPEBR	n	1	2 types, see(2)
0105	main function	MAINFN	n	3	38 types, see(3)
0106	secondary function	SECNFN	n	3	129 types, see(4)
0107	social security number	SSN	n	13	-
0108	service type	SVCTYP	a	1	3 types, see(5)

	private	**PRIVA**		**(14)**	
0201	service number	SN	n	8	key
0202	birth place	BRTHPL	n	4	city, see (6)
0203	order of son	ORDSON	n	1	1 - 9
0204	religion	RELIGN	n	1	4 types, see(7)

	body characteristics	**BODY**		**(24)**	
0301	service number	SN	n	8	key
0302	blood-type	BLOOD	n	1	6 types, see(9)
0303	height	HEIHT	n	4	centimeters
0304	size of shoes	SHOE	n	3	millimeters
0305	size of pants	PANT	n	2	1 - 18, see(10)
0306	size of shirt	SHRT	n	2	1 - 18, see(10)
0307	size of hat	HATS	n	3	(inches X 10)
0308	size of gloves	GLOV	a	1	3 types, see(11)

	marriage	**MARR**		**(15)**	
0401	service number	SN	n	8	key
0402	marital-status	MARTAL	n	1	2 types, see(12)
0403	status-date	MARDAT	n	6	YYMMDD

	present/mailing address	**ADDRS**		**(114)**	
0501	service number	SN	n	8	key
0502	address	ADPRST	an	42	-
	* blank for mailing address				
0503	housing status	HUSTAT	n	1	4 types, see(13)
	* blank for mailing address				

0504 status date	STDATE	n	6	YYMMDD	
* blank for mailing address					
0505 name	ADNAM	an	42	name(last,first,second)	
* blank for present address					
0506 social security number	ADSSN	n	13	-	
* blank for present address					
0507 relation	ADREN	n	1	8 types, see(33)	
* blank for present address					
0508 priority	ADPRY	n	1	1 - 9	
* blank for present address					

---

careers	CREERS		(95)	
0601 service number	SN	n	8	key
0602 personnel order	CRPORD	an	15	-
0603 date of order	CRDAT	n	6	YYMMDD
0604 course name	CRCUR	n	4	see(18)
* for commission, military education				
0605 order of course	ORDCUR	n	3	001 - 999
* for commission, military education				
0606 order in class	CRORD	n	3	001 - 999
* for commission, military education				
0607 class size	CRSZE	n	3	001 - 999
* for commission, military education				
0608 start date	CRSTAT	n	6	YYMMDD
* for commission date, promotion date, retire date, and start date of career and military education				
0609 completion date	CRCPL	n	6	YYMMDD
* for recruitment date, completion date of career and military education				
0610 unit	CRUNT	an	10	unitcode, see(17)
* for career, school name of military education				
0611 completion reason	CREAS	n	1	
* for career				
0612 grade	CRGRD	n	3	percentage(%)

	* for military education				
0613	average grade	CRAVG	n	3	percentage(%)
	* for military education				
0614	rank status	CRRSTA	n	1	4 types, see(15)
	* for promotion				
0615	rank	CRRNK	n	2	24 types, see(16)
	* for promotion				
0616	military personnel rule	CRRUL	n	6	article, clause, paragraph, see(14)
	* for retirement				
0617	position	CRPOS	an	15	-
	* for career				

	civilian education	CEDUC		(71)	
0701	service number	SN	n	8	key
0702	school name	CSCHL	an	25	-
0703	major	CMAJR	n	4	see(19)
0704	degree	CDEGR	n	1	4 types, see(20)
0705	start date	CSTRT	n	6	YYMMDD
0706	completion date	CCMPL	n	6	YYMMDD
0707	location	CNTRY	n	3	country, see(21)
0708	location	CLOCA	a	16	city
0709	graduation classification	CGRCL	n	1	3 types, see(22)
0710	scholarship	CSCHS	n	1	2 types, see(23)

	technical capability	TECH		(26)	
0801	service number	SN	n	8	key
0802	kind of licence	TECLCN	n	4	see(25)
0803	licence number	TECNMB	n	7	serial number
0804	class	TECCLS	n	1	7 types, see(26)
0805	obtained-date	TECDAT	n	6	YYMMDD

	foreign language	FRLANG		(14)	
0901	service number	SN	n	8	key

0902	language	FLANGU	n	3	20 types, see(27)
0903	speaking level	FSPEAK	a	1	3 types, see(24)
0904	listening level	FLISTN	a	1	3 types, see(24)
0905	reading level	FREAD	a	1	3 types, see(24)

---

physical exam/ health condition PHEALTH (40)

1001	service number	SN	n	8	key
1002	checking-year	CHYR	n	2	YY
	* for examed year of physical exam				
1003	eye (left)	LEYE	a	1	3 types, see(28)
	* for 100m of physical exam				3 types, see(24)
1004	eye (right)	REYE	a	1	3 types, see(28)
	* for 2000m of physical exam				3 types, see(24)
1005	ear (left)	LEAR	a	1	3 types, see(28)
	* for broad jump of physical exam				3 types, see(24)
1006	ear (right)	REAR	a	1	3 types, see(28)
	* for chip-up				3 types, see(24)
1007	nose	NOSE	a	1	3 types, see(28)
	* for grenade-throw				3 types, see(24)
1008	tooth (up)	UTOOT	a	1	3 types, see(28)
	* for sandbag-carriage				3 types, see(24)
1009	tooth (down)	DTOOT	a	1	3 types, see(28)
1010	hand (left)	LHAND	a	1	3 types, see(28)
1011	hand (right)	RHAND	a	1	3 types, see(28)
1012	foot (left)	LFOOT	a	1	3 types, see(28)
1013	foot (right)	RFOOT	a	1	3 types, see(28)
1014	lung	LUNG	a	1	3 types, see(28)
1015	neck	NECK	a	1	3 types, see(28)
1016	skin	SKIN	a	1	3 types, see(28)
1017	round of chest	CHEST	n	4	centimeters
1018	highest blood pressure	HBLD	n	4	mmHg
1019	lowest blood pressure	LBLD	n	4	mmHg

1020	weight	WEIHT	n	4	kilograms

	war award leaves	AWARD		(93)	
1101	service number	SN	n	8	key
1102	kind of award/punishment * for award/punishment	WKND	n	3	19 types, see(29)
1103	start date * for war experience, leaves	WSTAT	n	6	YYMMDD
1104	who_given * for award/punishment	WGVN	an	15	-
1105	general order * for award/punishment	WGEN	an	15	-
1106	completion date * for war experience, leaves	WCMPL	n	6	YYMMDD
1107	war name * for war experience	WNME	an	16	-
1108	reason (for leaves)	WRSN	n	1	5 types, see(34)
1109	reason * for award/punishment	WDRSN	a	23	-

	service estimation	SVEST		(19)	
1201	service number	SN	n	8	key
1202	estimate-year	SVYR	n	2	YY
1203	integrity	SVIGT	a	1	3 types, see(24)
1204	honesty	SVHNS	a	1	3 types, see(24)
1205	responsibility	SVRSP	a	1	3 types, see(24)
1206	personality	SVPSN	a	1	3 types, see(24)
1207	capability	SVCPB	a	1	3 types, see(24)
1208	estimated-order	SVORD	n	2	-
1209	total estimatees	SVTTL	n	2	# of total

	recommend order	RCMORD		(14)	
1301	service number	SN	n	8	key
1302	recommended-year	RCYR	n	2	YY

1303	recommended-order	RCORD	n	2	-
1304	total recommendees	RCTTL	n	2	# of total

	secret treatment	**SCRT**		**(36)**	
1401	service number	SN	n	8	key
1402	classification	SCRCLS	n	1	6 types, see(30)
1403	permitted-date	SCRDAT	n	6	YYMMDD
1404	personnel order	SCRORD	an	15	-
1405	data of order	SPEDAT	n	6	YYMMDD

	flying-time	**FLYTIM**		**(30)**	
1501	service number	SN	n	8	key
1502	type of plane	FLPL	n	2	-
1503	flying-mission	FLMSSN	n	2	4 types, see(31)
1504	date	FLDAT	n	6	YYMMDD
1505	take-off hours	FLOFF	n	4	HHMM
1506	landing hours	FLLAND	n	4	HHMM
1507	weather-time	FLHOOD	n	2	HHMM (period)
1508	night-time	FLNITE	n	2	HHMM (period)

	family	**FAM**		**(48)**	
1601	service number	SN	n	8	key
1602	social security number	FAMSSN	n	13	-
1603	family member	FAMEM	a	25	name (last, 1st, 2nd)
1604	dependent	FAMDEP	n	1	2 types, see(32)
1605	relation	FAMREL	n	1	8 types, see(33)

	education expenses reduction	**EDUEXP**		**(51)**	
1701	social security number	EDUSSN	n	13	-
1702	school name	EDUSCH	an	28	-
1703	amount of reduction	EDUAMT	n	6	won
1704	reduction month	EDUMON	n	4	YYMM

	PX-goods	PX		(41)	
1801	service number	SN	n	8	key
1802	purchase-goods	PXGDS	n	2	13 types, see(35)
1803	manufactured-company	PXCO	an	11	-
1804	model	PXMDL	an	10	-
1805	PX-location	PXLCT	n	4	city, see (7)
1806	purchase-date	PXDAT	n	6	YYMMDD

	payroll	PAY		(75)	
1901	service number	SN	n	8	key
1902	payroll month	PAMON	n	4	YYMM
1903	basic salary	PASARA	n	7	won
1904	military insurance	PAINSU	n	7	won
1905	annuity	PAANU	n	7	won
1906	spouse's allowance	PAWIF	n	7	won
1907	family allowance	PAMEM	n	7	won
1908	encourage allowance	PAENC	n	7	won
1909	tax	PATAX	n	7	won
1910	tax advantages	PAADV	n	7	won
1911	salary	PASALY	n	7	won

	transportation reduction	TRANS		(33)	
2001	service number	SN	n	8	key
2002	reduction-date	TRDAT	n	6	YYMMDD
2003	departure-hours	TRHOU	n	4	HHMM
2004	origin	TRORG	n	4	city
2005	destination	TRDST	n	4	city
2006	how	TRHOW	n	1	4 types, see(36)
2007	amount of reduction	TRRDC	n	6	won

APPENDIX C
RELATIONAL SCHEMA

1. main id

   MAIN (SN, NAME, ORGBR, SPEBR, MAINFN, SECNFN, SSN, SVCTYP)

2. private

   PRIVA (SN, BRTHPL, CRDSON, RELIGN)

3. body char

   BODY (SN, BLOOD, HEIHT, SHOE, PANT, SHRT, HATS, GLOV)

4. marriage

   MARR (SN, MARTAL, MARDAT)

5. present/mailing address

   ADDRS (SN, ADPRST, HUSTAT, STDATE, ADNAM, ADSTN, ADREN, ADPRY)

6. commission, retirement, promotion, career, and military education

   CREERS (SN, CRPORD, CRDAT, CRCUR, ORDCUR, CRORD, CRSZE, CRSTAT, CRCPL, CRUNT, CREAS, CRGRD, CRAVG, CRRSTA, CRRNK, CRRUI, CRPOS)

7. civilian education

   CEDUC (SN, CSCHL, CMAJR, CDEGR, CSTRT, CCMPL, CNTRY, CLOCA, CGRCL,CSCHS)

8. technical capability

   TECH (SN, TECLCN, TECNMB, TECCLS, TECDAT)

9. foreign language

   FRLANG (SN, FLANGU, FSPEAK, FLISTN, FREAD)

10. physical exam/ health condition

PHELTH (SN, CHYR, LEYE, REYE, LEAR, REAR, NOSE, UTOOT, DTOOT, LHAND, RHAND, LFOOT, RFOOT, LUNG, NECK, SKIN, CHEST, HBLD, LBLD, WEIHT)

11. war experience, award/punishment, and leaves

AWARD (SN, WKND, WSTAT, WGVN, WGEN, WCMPL, WNME, WRSN, WDRSN)

12. service estimation

SVEST (SN, SVYR, SVKND, SVIGT, SVHNS, SVRSP, SVPSN, SVCPB, SVORD, SVTTL)

13. recommendation crder

RCMORD (SN, RCYR, RCORD, RCTTL)

14. secret treatment

SCRT (SN, SCRCLS, SCRDAT, SCRORD, SPEDAT)

15. flying time

FLYTIM (SN, FLPL, FLMSSN, FLDAT, FLOFF, FLLAND, FLHOOD, FLNITE)

16. family

FAM (SN, FAMSSN, FAMEM, FAMDCEP, FAMREL)

17. education expenses reduction

EDUEXP (EDUSSN, EDUSCH, EDUAMT, EDUMON)

18. PX_goods

PX (SN, PXGDS, PXCO, PXMDL, PXLCT, PXDAT)

19. payroll

PAY (SN, PAMON, PASARA, PAINSU, PAANU, PAWIF, PAMEM, PAENC, PATAX, PAADV, PASALY)

20. transportation reduction

TRANS (SN, TRDAT, TRHOU, TRORG, TRDST, TRHOW, TRRDC)

* The under lines stand for the primary key.

APPENDIX D
SAMPLE CODE TABLE

1. Original Branch

infantry	21
artillery	22
armed corps	23
aviation	24
engineer	25
signal corps	26
ordnance	31
quarter master finance	32
transportation	33
chemistry	34
adjutant general	41
M.P.	42
finance	43
information and education	44
medical	51
judicial	52
nurse	53
military religion	54
women	55

2. Special Branch

inspection	1	military music	5

3. Main Function (samples, officer only)

infantry officer	110
armed officer	120
field artillery officer	131
defence artillery officer	132
intelligent officer	141
combat engineer	151

construction engineer	152
engineering equipment management	153
communication & electronic	161
signal equipment management	162
aviation officer	171
chemical officer	211
mobile equipment management	221
ammunition officer	223
material management	231
transportation management	241
adjutant officer	311
M.P. officer	321
financial officer	331
information & education officer	341
medical officer	411
medical administration	412
medical equipment management	413
women officer	421

4. Secondary Function (samples)

general function

personnel	510	personnel planning	511
personnel management	512	manpower	513
NIKE repair	654	HWAK repair	655
VALCAN repair	656	Elicon repair	657
TOW repair	658	rocket repair	659

special function

surgeon	771	orthopedist	772
neurologist	773	plastic surgeon	774
obstetrician	775	oculist	776
otorhinolaryngology	777		

5. Service Type

short	1	long	2
extension	3		

6. City (samples)

Seoul	0100	Busan	0200
Inchon	0300	Daejun	0400
Chungju	0500	Junju	0600
Gwangju	0700	Jeju	0800
Changweon	0900	Daegu	1000
Chunchung	1100	Pyonyang	1200
Sineoju	1300	Chunjin	1400
Heongnam	1500		

7. Religion

catholic	1	protestant	2
buddhist	3	none	9

8. Commission Course

KMA	1	3rd KMA	2
ROTC	3	OCS	4
Special OCS	5		

9. Blood Types

A	1	B	2
AB	3	O	4
RH-	5	RH+	6

10. Size of Pants/Shirt
codes is equal the numbers of size

11. Size of Gloves

small	1	middle	2
large	3		

12. Marital Status

marriage	5	divorce	9

13. Housing Status

military quarters	1	military apartment-house	2
rent	3	owner	4

14. Military Personnel Rules(samples)

article	clause	paragraph	
41	2	1	410201
41	2	2	410202
41	2	3	410203
42	1	1	420101
42	1	2	420102
42	2	3	420203
43	2	2	430202
44	2	3	440203
44	2	5	440205

15. Rank Status

regular	1	temporary	2
appointed	3	demotion	4

16. Rank

general			
general	11	lieutenant general	12
major general	13	brigader general	14
officer			
colonel	21	lieutenant colonel	22
major	23		
captain	31	first lieutenant	32
second lieutenant	33		
warrant officer	41		
NCO			
master sergeant	51	sergeant	52
staff sergeant(I)	53		
private			
staff sergeant(II)	61	lance corporal	62
corporal	63	first private class	64
second private class	65		
civilian			
group I	71	group II	72
group III	73	group IV	74

group V	75	group VI	76
group VII	77	group VIII	78
group IX	79		

17. Unit Code

not included for secret reasons

18. Military Education Courses(samples, only maniatory courses)

officer

National Defense College	1001
Army Defense College (regular course)	1002
Army Defense College (nonregular course)	1003
Officer Advanced Course	1004
Officer Basic Course	1005

warrant officer

advanced course	2001

non commissioned officer(NCO)

NCO Advanced Course	3001
NCO Basic course	3002

enlisted men

basic MOS course	4001

19. Major (sample)

administration	0101	agriculture	0102
architectural engineering			0103
bacteriology	0201	biology	0202
business	0203		
chemistry	0301	civil engineering	0302
communication	0303		
computer science/information system			0304
construction engineering			0305

20. Degree

Ph. D	1	Master	2
bachelor	3	Diploma	4

21. Country (samples)

Burma	101	Indonesia	102
Japan	103	Malaysia	104
Philippines	105	Singapore	106
Taiwan	102		
Denmark	201	England	202
France	203	Germany	204
Italy	205	Norway	206
Portugal	207	Spain	208
Sweden	209		
South Africa	301		
Australia	401		
Brazil	501	Canada	502
Chile	503	Columbia	504
Mexico	505	Peru	506
united States	507		

22. Graduation Classification

graduation	1	not graduation	2
completion	3		

23. Scholarship

military	1	others	2

24. Physical Examination Class

excellent	A	good	B
capacity of development	C		

25. Licences (samples)

electric repair	2201
electrical equipment repair	2202
electronic testing-equipment repair	2203
radio / TV repair	2204
compressor operation	3301
crane operation	3302
excavator operation	3303

grader operation	3304
mixer (concrete) operation	3305
paving machine (concrete, asphalt) operation	3306
power-shovel operation	3307
tractor operation	3308

26. Licence Class

engineer top	1	engineer I	2
engineer II	3	skill top	4
skill I	5	skill II	6
skill III	7		

27. Foreign Languages

Arabic	801	Bulgarian	802
Burmese	803	Chinese	804
Dutch	805	English	806
French	807	Grecian	808
German	809	Indonesian	810
Iranian	811	Italian	812
Japanese	813	Polish	814
Russian	815	Spanish	816
Swedish	817	Thai	818
Turkish	819	Vietnamese	820

28. Health Condition

normal	A	non-normal	B

29. Award

medal

Dongbaek	11	Kwangbok	12
Chunsu	13	Sam-il	14

honour

Chung-mu	21	Wha-rang	22
Uel-ji	23	In-hun	24

commendation

president	31
prime minister	32

ministry of national defense	33		
chief of general staff	34		
field army commander	35		
corps commander	36		
division commander	37		
regiment commander	38		
battalion commander	39		
punishment			
heavy reprimand	51	reprimand	52

30. Secret Treatment Classification

top	1	secret	2
confidential	3	restricted	4
cipher	5		

31. Fly Mission

fight	10	reconnaissance	20
operation	21	training	30

32. Dependant

dependant	1	independant	2

33. Relation

grand father	1	grand mather	2
father	3	mother	4
brother	5	sister	6
spouse	7	children	8

34. Leaves

annual	1	sick	2
reward	3	asking	4
others	5		

35. PX-Goods

auto	11	autocycle	12
color TV	21	audio-system	22
video-record player	23	personnel computer	24
camera	31	telescope	32

mixer	41	refrigerator	42
wash machine	43	gas-range	44
golf	51		

36. Transportation

plane	1	bus	2
train	3	ship	4

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