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Bridge Of Relations in the Information System, Case Study; Radiation Protection and Materials

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ABSTRACT

The management of information systems (MOIS) is the principal component, which acts as the heart that pumps and feeds the three others components in the databank. The databank is created as integrated network management system for nuclear/radiological authorities (NRA) and their technical support organizations (TSO). To satisfy the demand of NRA and TSO, two information systems are considered; task system and field system. The interaction of elements in tasks and fields system is within lines of connections and bridges of relation respectively. The text is discussed the evolution in building and managing both systems by call lines. Additionally, the text explains the transformation of data to information or the inverse process to fulfill the need of the scientific/regulatory employees to implement their duties in optimum time and effort. A case study of bridge of relation is undertaken between the radiation protection and materials. This relation is demonstrated through dose conversion software package.

Keywords: *Management of Information System, Materials, Radiation Protection, Database.*

1. INTRODUCTION

The Regulatory Authority Information System (RAIS) is a software application developed by the International Atomic Energy Agency (IAEA), to assist its Member States in managing their regulatory activities in accordance with IAEA Safety Standards and guidance, including the Code of Conduct on the Safety and Security of Radioactive Sources and supplementary Guidance [1].

The scope of the program covers by defaults; 1) National regulatory infrastructure information, 2) Facilities and Departments, 3) Radiation sources and associated equipment, 4) Authorization, 5) Inspection, 6) Enforcement, 7) Workers, 8) Radiation events and 9) Technical services.

Although that RAIS covers regulatory tasks, it is still reflecting an international frame for ideal regulatory infrastructure. It is expected that the regulatory infrastructure is not the same in all countries. Some regulatory organization in developing countries is independent agency operating within a legal system based on common law. The regulator is expected to act in the public interest [2]. RAIS can be far away from a national program in developing countries. Also, some other areas, which may important for some countries, are not covered. Therefore, the information systems in the Databank for NRA and its TSO is created to be a national database improve and facilitate the transaction of data/information between the different authorities in Egypt [3].

In general, the information system (IS) is a group of elements that interact to produce information [4], and it is build in various forms to represent data/information, and can be translated through graphs, images or other analysis tools [5]. Based on, the management of information systems is a principal component in the databank that transforms and retrieve all regulatory and scientific works performed by NRA and TSO [3]. Also, it feeds the other three components in the databank with the necessary information and data [6].

The scientific employees in TSO are concerning about research and development in different fields to solve the problems that faced the regulatory employees during performing their tasks. On the other hand, regulatory employees in NRA are considered, also, scientific employees because they are responsible to do various tasks considered in scientific facilities such as; inspection, reviewing and assessment, licensing, and establishing regulations for nuclear/radiological facilities. Therefore, IS is created as a scientific database packages of data and information. Consequently, the management of information systems (MOIS) is designed to satisfy all scientific demands from task and fields for NRA and TSO.

Owing to the dissimilarity of works performed in NRA and TSO, It is necessary to use some logical architecture structure for defining the elements and workflows in the system to reduce waste, and save time and effort. Additionally, IS is faced other challenges such as the software language selected, the transformation process of data/information or information/data, and the form of retrieve data/information.

2. ARCHITECTURE DESIGN OF IS

MOIS is used to plan, organize, and to control IS [7*]*. Meanwhile, MOIS is designed based on the statement; giving the right information to the right person at the right time, place and cost and in the right form [8]. Accordingly, the architecture design of the IS is defined as the methodology and systems undertaken for collection, rearrangement and transaction of data/information. In precise word, how the system will be implemented in its optimum form.

The evolution of the system design, in the present paper, is the resultant of three steps; understanding the system under consideration, analysis and design the real concept of this system, and finally who will be the applicable imaginary design of the system in MOIS.

2.1 Understanding the System

The interaction flow of data/information in and between NRA and TSO is resulted directly from the functional requirements, and in particular the need for implementation processes. Herein, the databank is used to connect NRA and TSO with continuous flow of data/information. Figure 1-a shows the virtual place considered of the databank between the two systems.

NRA has distinct and explicit duties to perform. In other words, NRA has specific tasks that describe their duties, such as; legal framework, licensing, review and assessment, etc…. On the other hand, TSO involves the analyses, research and development of these duties through scientific areas/fields for technical assistance. Therefore, MOIS shall design by two different information systems but within certain connections; task system and field system.

2.2 Analysis of the Real Concept

Apparently, in case of task system, each element is seemed to be independent from the others; licensing is different than review, and legal framework, etc… However, by analyzing the various tasks, it was found that all elements in the system share some common data/information. In other words, the licensing task required information from legal frame work, inspection, and from review of safety documents. The same situation is existed in the field system. Finally all elements in task/field IS are related, and/or intersect, and/or specified to other elements. The Ellipse shape, in Figure 1-b, can show the real visualization of task and field elements interactions.

2.3 Applicable Design of IS

For the sake of an applicable architecture design of the two IS in MOIS, a graphical projection of plan view is imagined. The element of each system is shown as a separate icon that linked to the others by lines of connections in case of task system and bridge of relation in case of field system.

These names are identified by the author; line of connection represents the link of data/information between elements in case of task system. However, in case of field system, the interaction of data/information between elements represents a real scientific relation.

It is very important to note that the systems, during performing a real work, more elements can be added in task and field systems.

The squares in the network background of the two systems that is consisted of call lines; the call lines are train of call orders in MOIS, which delivers data/information from/to element to other. The final design is translated on the window represented in Figure 2.

3. SOFTWARE LANGUAGE USED

Among various language, ORACLE language is used to perform MOIS. The code of PL/SQL is used in Oracle Database. L/SQL is way better than other languages as it contains modular code blocks and is robust in terms of error handling. Along with this, PL/SQL and SQL both run in same server processes, at run-time. It is well-known as a safe functionality tool that effectively helps in controlling, manipulating, restricting illegal access and validating the data from the database. Advantages of PL/SQL; 1) reduction in network traffic, 2) error handling, 3) application portability, 4) procedural language capability, 5) block structures [9].

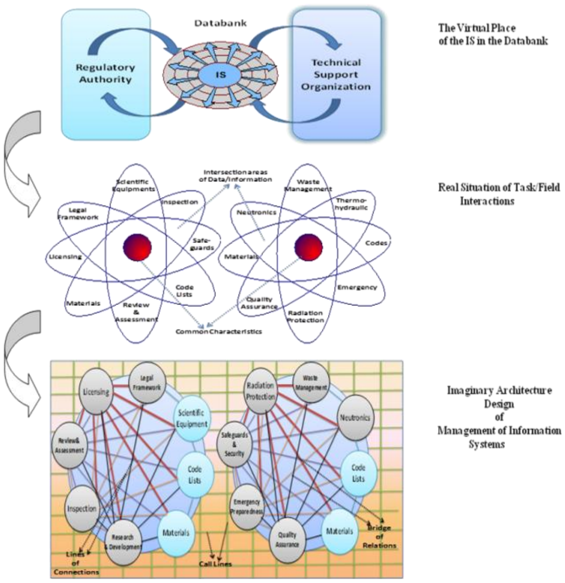


Fig. 1. The Evolution of the Architecture Design of MOIS.

4. IMPLEMENTATION OF A PROCESS IN MOIS

Modeling process in IS is an operation in which data and information is organized and translated on visual windows in a way that the scientific employee can accomplish the goals of the process in optimum time and efforts. This operation is implemented by the system analyst group (SAG) and the scientific managerial group (SAG) with the scientific employees (SE) [10]. This process is consisted of several successive steps;

1. The scientific employees shall describe their process (task or scientific area) in form of requirements, needs, input and out data used, and finally their goals. Many meeting shall occur between scientific employees SA and SMG to understand the process (task/field) and its requirements.
2. The three partners SAG, SMG and SE are in continuous meetings to enable and to recognize the resources required by each process, strengths and weakness, and identification of any risk factors [6]. The SMG collect samples of data and information of the process and its connection with other task or field for the analysis required by the SAG.
3. Analyze the process and select the optimum visions of database windows (input/output) that describe the system by SAG (design of the process). The modeling selected shall identify the stages of implementation (actual or current state), including describing the system of resources, use of process as well as the measures taken in different functional areas. The resulting process model should, also, selects suitable input/output data; 1) type (data and/or information, numerical, text, logic statement), 2) form (spread sheets, computer program). Finally, the programmer is accomplishing the system designed by the system analyst.
4. The execution of process design is achieved by the programmer.
5. The visual process is distributed on the local network to the specific scientific employees.
6. Finally, the validation of process (windows) shall be carry by the scientific employees under the tracking of SMG for further modifications.
7. Users frequently do not full acquaint of the system until it is almost done and tested. However, during performing work, the user may discover problems or required improvement in the process. Queries shall be sent to SMG who transfers all requests to SAG for improvement. Each task/field contents a wide range of data and information that will collected in the form of database spread sheets, computer programs and software packages. This process is an iterative operation.

There is no standard form for process modeling; however requirements, goals and task usually strongly influence the approach considering for process modeling by the SAG. Figure 2 shows the iterative operation. Any modification of the process is available by the continuous maintenance of the processes.

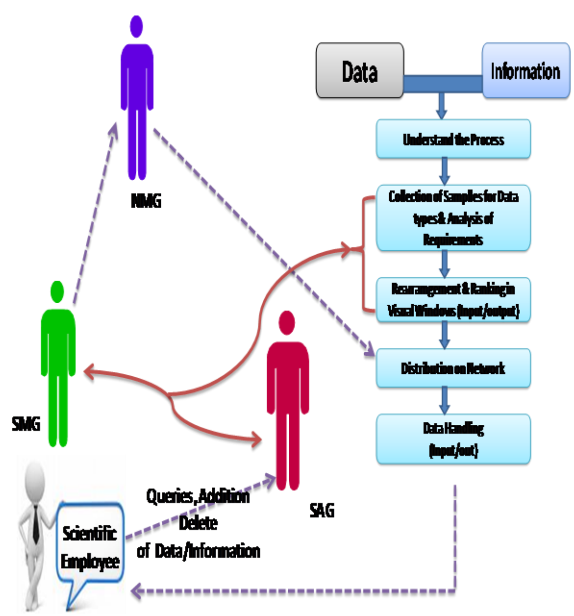


Fig. 2. Iterative Operation of Modeling Process

5. TRANSFORMATION OF DATA/INFORMATION

According to the requirement of scientific employee or/and depend on the level of data security, the data can be transformed to information and vice versa. The steps of this process are demonstrated in Figure 3. The process starts by understanding the requirement of scientific employees; what the employees need to perform their duties, what type of information (yes/no, statement, etc..). The second step is the collection of data/information samples, analysis, and filtration. The ranking of data are the hard step in the process to found the key data/information and design their code for translation operation. According to their arrangement and their value, data will be delivered to the employee in the required form.
For more explanation; by supposing two employees; the first employee is responsible of site permit (part of licensing) for site selection disposal site, and the second verify the safety assessment of the disposal site using software computer program. The first send the data necessary for the site to be used by the second employee. The second calculates a higher doses than the legal doses limit. The doses calculated shall be sent to the first employee. Through the software in MOIS, these data will be transformed to information “Rejection” and delivered to the first employee.

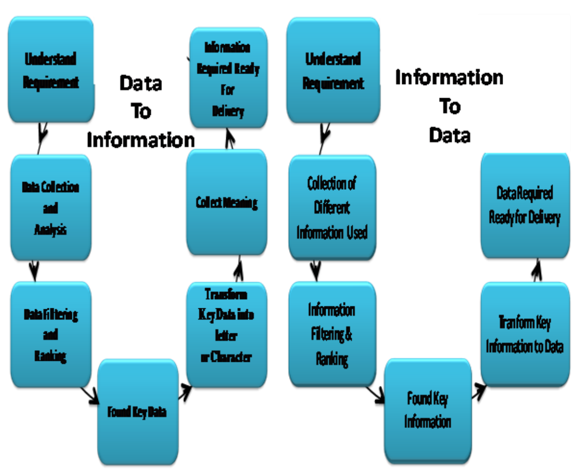


Fig. 3. Transformation Processes

In case of the inverse operation, using the same example, the first employee wants to send through MOIS the following statement; go to an iterative process in engineering barriers (x) the site has good characteristics. This statement shall be transformed into value and/or range of values for x barrier. Depend on the code transferred to the second employee shall make new iterations by changing barriers data conditions.

6. BRIDGE OF RELATION; CASE STUDY

The case study is considered on the bridge of relation between material and radiation protection in from the field system as shown in Figure 4. The squares are representing the data windows of element. The data required for the present case are collected from each the elements by call lines. This relation is proposed to design in the form of software computer code.

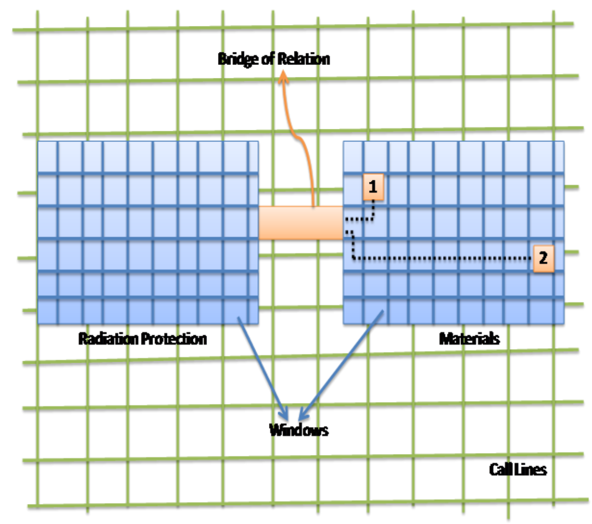


Fig. 4. Case Study; Bridge of Relation between Waste Management.

6.1 Radiation Protection and Materials

6.1.1 Code Structure

The structure is divided into four steps;

1- Data entry.
2- Calculations.
3- Collection of required data.
4- Output reports/data.

6.1.2 Data Entry

As known, the materials are classified in broad types; metal, polymers, wood, soil, glass, radionuclide, cement, and others. Also, different characteristics for each category shall be considered in this element; chemical characteristics, physical characteristics, mechanical, magnetic and others. Figure 5 and 6 demonstrates the windows required data entry in the database program.

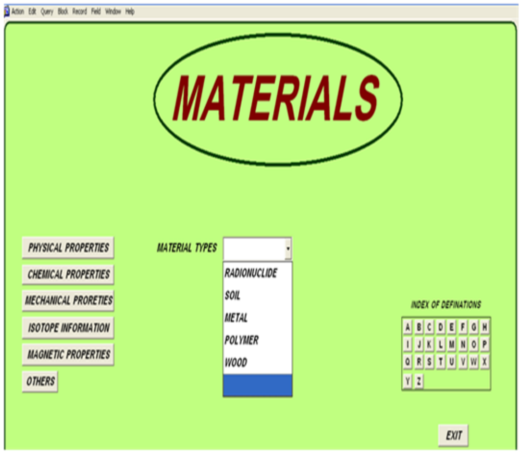


Fig. 5. Material Types and Properties

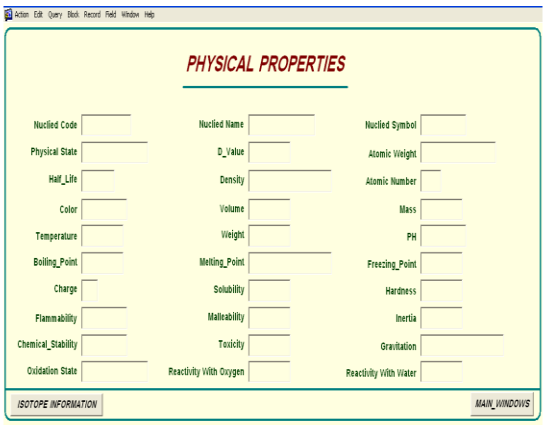
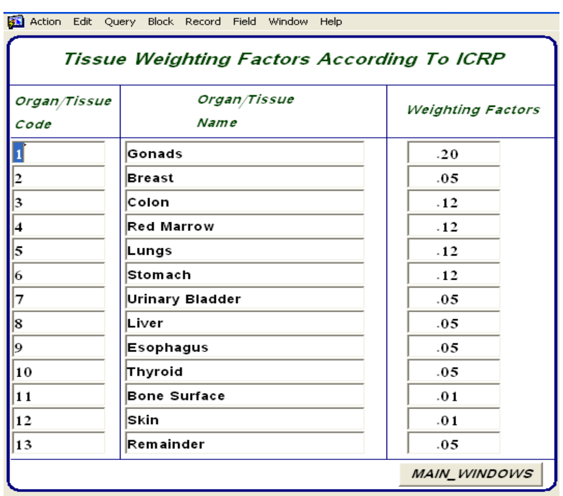


Fig. 6. Physical Properties of Material Selected

On the other hand, the windows required data entry in field of radiation protection are represented in Figure 7. These window is available only for data entry employees and hidden for scientific employees.



Tissue Weighting Factors According To ICRP

Organ/Tissue Code	Organ/Tissue Name	Weighting Factors
1	Gonads	.20
2	Breast	.05
3	Colon	.12
4	Red Marrow	.12
5	Lungs	.12
6	Stomach	.12
7	Urinary Bladder	.05
8	Liver	.05
9	Esophagus	.05
10	Thyroid	.05
11	Bone Surface	.01
12	Skin	.01
13	Remainder	.05

Fig. 7. Tissue Weighting Factor Windows

6.1.3 Calculations

Dose conversion calculations are defined in the present paper as the various radiological doses such as; exposure dose, absorbed dose, effective dose, etc...The dose conversion is started by the *Radiation exposure*, which is the measure of the ionization of air due to ionizing radiation from photons [11, 12].

$$\mathbf{F = \Gamma \times \alpha / r^2}$$

where F is the exposure rate, r is the distance, α is the source activity, and Γ is the exposure rate constant, which is dependent on the particular radionuclide used as the gamma ray source.

The absorbed dose is a physical dose quantity D representing the mean energy imparted to matter per unit mass by ionizing radiation. In the SI system of units, the unit of measure is joules per kilogram, and its special name is gray (Gy). The absorbed dose is defined in terms of the absorbed radiation energy per mass W_{1P}.

$$\mathbf{D = E.\ W_{IP}}$$

Equivalent dose is adose quantity H representing the stochastic health effects of low levels of ionizing radiation on the human body. It is derived from the physical quantity absorbed dose, but also takes into account the biological effectiveness of the radiation, which is dependent on the radiation type and energy.

$$\mathbf{H = Q.D}$$

The various body organs have different response to radiation. To determine the specific sensitivity to radiation exposure a tissue specific organ weighting factor w_T has been established to assign a particular organ or tissue T a certain exposure risk.

The sum of the products of the equivalent dose to the organ H_T and the weighting factor w_T for each organ irradiated is called the effective dose E. Effective dose is always used as a measure of risk [11].

$$E = \Sigma_T (w_T * H_T)$$

The previous equations are written in Oracle language in the form of computer code. The scientific user shall select the dose required to calculate from windows in Figure 8.

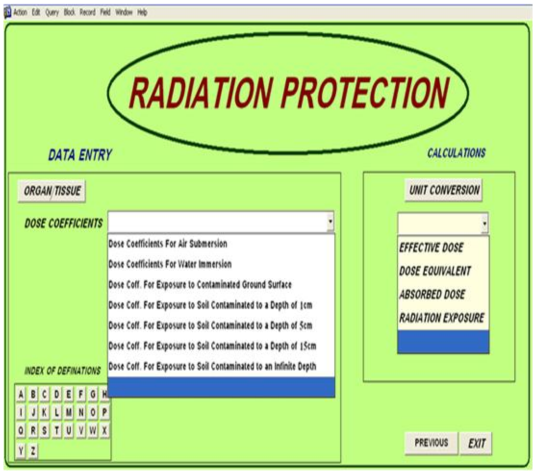


Fig. 8. Radiation Protection Window

6.1.4 Collection of Required Data

The data required for performed the calculations are collected from both elements by the call lines and configurated on the calculation window of the scientific users as shown in Figure 9.

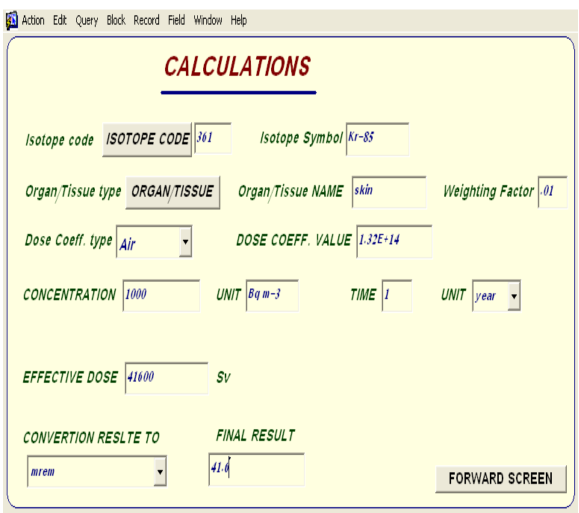


Fig. 9. Calculation Window

6.1.5 Output Reports /Data

The output resulted, according of the requirement of scientific employees, can be demonstrated through different reports or data.

7. CONCLUSIONS

The MOIS is controlled by two different IS based on the duties of the scientific employees; task system and field system. Each element in the task field is linked to the other elements by lines of connection. On the other hand, the element in the field system is linked to the other elements by bridge of relations. The two systems are fixed on the network by the call lines. The call lines are represented the train of call orders in the database program to transfer the data required from the intersected windows.

The case study shows a sample of the work that can be performed for the bridge of connection between the radiation protection and the material elements in the field system. The bridge is implemented by data base windows for the data in the material element. Additionally, the correlation of various doses is represented through software computer code. The computer code is performed through four steps; data entry, calculations, collection of required data, and output reports/data.

Finally, the IS in the databank is managed to be in a user friend form. Despite all difficulties faced the system analyst in design and processes, IS will be configurated in a logical simple way for the scientific employees (Seniors and Juniors) to proceed their works on/from the Databank within optimum time and efforts.

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